Videoconferencing of Movement-based and Psychologically Informed Interventions for Chronic Pain: A Systematic Review and Horizon Scan

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PREFACE

The VA Evidence Synthesis Program (ESP) was established in 2007 to provide timely and accurate syntheses of targeted health care topics of importance to clinicians, managers, and policymakers as they work to improve the health and health care of Veterans. These reports help:

- Develop clinical policies informed by evidence;
- Implement effective services to improve patient outcomes and to support VA clinical practice guidelines and performance measures; and
- Set the direction for future research to address gaps in clinical knowledge.

The program comprises four ESP Centers across the US and a Coordinating Center located in Portland, Oregon. Center Directors are VA clinicians and recognized leaders in the field of evidence synthesis with close ties to the AHRQ Evidence-based Practice Center Program. The Coordinating Center was created to manage program operations, ensure methodological consistency and quality of products, interface with stakeholders, and address urgent evidence needs. To ensure responsiveness to the needs of decision-makers, the program is governed by a Steering Committee composed of health system leadership and researchers. The program solicits nominations for review topics several times a year via the program website.

The present report was developed in response to a request from the Office of Rehabilitation and Prosthetic Services. The scope was further developed with input from Operational Partners (below), the ESP Coordinating Center, the review team, and the technical expert panel (TEP). The ESP consulted several technical and content experts in designing the research questions and review methodology. In seeking broad expertise and perspectives, divergent and conflicting opinions are common and perceived as healthy scientific discourse that results in a thoughtful, relevant systematic review. Ultimately, however, research questions, design, methodologic approaches, and/or conclusions of the review may not necessarily represent the views of individual technical and content experts.

ACKNOWLEDGMENTS

The authors are grateful to Liz Wing, MA, and Stacy Lavin, PhD, for editorial and citation management support, and the following individuals for their contributions to this project:

Operational Partners

Operational partners are system-level stakeholders who help ensure relevance of the review topic to the VA, contribute to the development of and approve final project scope and timeframe for completion, provide feedback on the draft report, and provide consultation on strategies for dissemination of the report to the field and relevant groups.

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Technical Expert Panel

To ensure robust, scientifically relevant work, the TEP guides topic refinement; provides input on key questions and eligibility criteria, advising on substantive issues or possibly overlooked areas of research; assures VA relevance; and provides feedback on work in progress. TEP members are listed below:

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The Coordinating Center sought input from external peer reviewers to review the draft report and provide feedback on the objectives, scope, methods used, perception of bias, and omitted evidence (see Appendix D for disposition of comments). Peer reviewers must disclose any relevant financial or non-financial conflicts of interest. Because of their unique clinical or content expertise, individuals with potential conflicts may be retained. The Coordinating Center works to balance, manage, or mitigate any potential nonfinancial conflicts of interest identified.

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EXECUTIVE SUMMARY

Key Findings

- One VA-based randomized non-inferiority-controlled trial was included that studied the delivery of acceptance and commitment therapy in person compared with videoconferencing. Pain interference improved within both treatment arms at 8 weeks and 6-month follow-up. No statistically significant difference in outcomes was found between treatment delivery modalities.
- A scan of future research yielded 6 registered protocols, 3 protocol papers, and 1 published pilot study, indicating that future research on this topic is forthcoming.
- Future research should focus on comparative, adequately powered study designs with well-described interventions of both psychologically informed and movement-based approaches to pain management delivered via videoconferencing and assessing patient-important and health care systems-important outcomes.

INTRODUCTION

With the onset of the COVID-19 pandemic, one of the biggest changes in practice has been to the delivery of care. Telehealth technology has been an important mode to maintain the availability and continuity of care during these times for providers across the health care continuum—from physicians to nurses to therapists—in settings ranging from primary care to specialty care. The Veterans Health Administration (VHA) was uniquely adept at applying this change in delivery, as it has long utilized telehealth services to deliver care to Veterans across the country. This enabled the VHA to implement programs that were already in place to quickly provide Veterans with the necessary technology and to deliver care through telehealth. Currently, the VHA offers telehealth services and communication with providers via instant messaging on MyHealtheVet, telephone calls, and videoconferencing on VA Video Connect (VVC). Early in the pandemic, telephone appointments made up a significantly greater share of virtual care, likely due to their being less complex in nature and having fewer barriers to implementation. Implementation barriers for VVC include that both the patient and the provider need camera-enabled devices, access to adequate connectivity for streaming video, and a certain level of comfort navigating a telehealth platform.

Like other types of care, treatment for chronic pain quickly adopted remote practice. While face-to-face visits were discouraged, public health recommendations continue to encourage nonpharmacological pain management approaches such as behavioral therapy, exercise-based therapies, and self-management approaches to stem the use of prescription opioids. This meant a shift to virtual pain management to meet the continued demand for these services during the pandemic.

Nonpharmacological approaches to pain management may be well suited for the virtual care environment. Yet it is not widely understood if the effectiveness of this treatment modality translates to the virtual environment when delivered via videoconferencing. Thus, the purpose of this review is to examine the effectiveness of chronic pain management interventions delivered via videoconferencing compared to in-person care.

Key Questions

At the request of the Office of Rehabilitation and Prosthetic Services, the Office of Patient Centered Care and Cultural Transformation, and the Office for Pain Management and Opioid Safety, we conducted a systematic review to address the following key questions (KQ):

KQ1: Among patients with chronic pain, what is the effect of videoconference-delivered psychologically informed interventions for nonpharmacological chronic pain on pain, functionality, quality of life, and patient engagement?

KQ2: Among patients with chronic pain, what is the effect of videoconference-delivered therapeutic exercise and movement interventions for nonpharmacological chronic pain on pain, functionality, quality of life, and patient engagement?

METHODS

We developed and followed a standard protocol for this review in collaboration with operational partners and a technical expert panel (PROSPERO registration number CRD42021279069).

Data Sources and Searches

We searched MEDLINE (via Ovid), Embase (via Elsevier), CINAHL Complete (via EBSCO), and Cochrane Central Register of Controlled Trials (via Ovid) from inception to June 10, 2021. We hand-searched previous systematic reviews conducted on this topic for potential inclusion.

Study Selection

In brief, study eligibility included randomized designs that evaluated the effect of synchronously delivered videoconferencing interventions explicitly focused on pain management. We excluded studies that evaluated videoconferencing pain management compared to other video-based controls (*ie,* not in person), as the operational partners who commissioned this report were keenly interested in the comparison of videoconferencing care with in-person care.

Studies identified through our primary search were classified independently by 2 investigators for relevance to the KQs based on title and abstract. All citations classified for inclusion by at least 1 investigator were reviewed at the full-text review level. If both investigators agreed on exclusion, the study was excluded at the full-text level. All articles meeting eligibility criteria were included for data abstraction.

Data Abstraction and Quality Assessment

Data elements include descriptors to assess applicability, quality elements, intervention details, and outcomes. Study risk of bias was assessed using the Cochrane EPOC risk of bias 2 (ROB 2) tool, which is applicable to randomized studies. The strength of evidence as assessed using the approach described by Grading of Recommendations Assessment, Development and Evaluation (GRADE). We limited GRADE ratings to those outcomes identified by the stakeholders and technical expert panel as critical to decision-making.

Data Synthesis and Analysis

We summarized the literature using relevant data abstracted from the eligible studies. Summary tables describe the key study characteristics of the primary studies: study design, patient demographics, and details of the intervention and comparator. We were unable to conduct quantitative synthesis (*ie*, meta-analysis) to estimate summary effects, given the paucity of literature that met eligibility criteria. We analyzed the data narratively, as quantitative synthesis was not feasible. The narrative synthesis focused on documenting the intervention components and outcome categories.

Given that little information was available in the published literature on this topic that met eligibility criteria, we conducted a horizon scan of published pilot studies and protocol papers. We also conducted a search of protocol registrations in Cochrane Central Register of Controlled Trials to forecast when future studies on this topic may become available in the published literature and the types of interventions likely to be forthcoming.

RESULTS

Results of Literature Search

We identified 8,252 citations, of which 142 were reviewed at the full-text stage. Of these, 1 study met eligibility criteria. The randomized trial was conducted within the VA. Due to the nascent literature, we conducted a horizon scan that included 6 protocols in trial databases, 1 pilot, and 3 published protocols.

Summary of Results for Key Questions and Horizon Scan

KQ 1

Only 1 noninferiority randomized trial met eligibility criteria for KQ1. This study compared the delivery of acceptance and commitment therapy in person compared with video teleconferencing. No statistically significant difference in outcomes was detected between the in-person and videoconferencing delivery modalities. Additionally, pain interference improved within both treatment arms at 8 weeks and 6 months follow-up. While no significant differences in patient satisfaction were found, a statistically significant number of patients withdrew from the videoconferencing group compared to the in-person group from baseline to posttreatment at 8 weeks (46% vs 23%; $p = 0.01$).

KQ 2

No studies met eligibility criteria for KQ2.

Horizon Scan

The horizon scan of the literature yielded 1 pilot study, 3 published protocols, and 6 protocols registered in trial databases of studies that are potentially relevant to this topic. Most of the studies on the horizon plan to use movement-based approaches to nonpharmacological pain management. Two describe a psychologically informed approach, and 2 identified protocols describe an intervention that uses a combination of behavioral and movement therapies. Most planned studies will be conducted outside the United States, but 2 identified registered protocols are for forthcoming studies within the VA.

DISCUSSION

Key Findings and Strength of Evidence

Only 1 study met inclusion criteria and evaluated acceptance and commitment therapy delivered via videoconferencing and in person. Findings from this single study indicate that the impact of virtually delivered pain management is a possible substitute for in-person care. The outcomes reported included 5 pain measures, 2 quality-of-life measures, and 1 function measure. The evidence was rated as low certainty. These categories were rated down for possible risk of bias and imprecision. Continued research in this area is likely to change the GRADE ratings.

To augment the dearth of identified literature, we conducted a horizon scan of planned studies. We identified 1 pilot study that assessed videoconferencing delivered prehabilitation. While underpowered to detect differences between arms for pain, function, disability, physical performance, or satisfaction outcomes, this study found the in-person and videoconferencing delivery to be equivalent. The 3 protocol papers identified on this topic indicate that future research will focus on real-time physiotherapy (physical therapy), group exercise, guided exercise, reflection, and relaxation techniques. Of the 6 protocols identified via trial registration databases, 2 are psychologically informed intervention studies, 3 are movement-based intervention studies, and 1 combines these approaches. These protocols similarly suggest that this is a burgeoning field of research likely to yield results in coming years.

Applicability

The findings of this review are directly applicable to the VA population. The 1 included study was conducted with Veterans and in the VHA. Of the 10 planned studies identified in the horizon scan, 2 will be conducted within the VHA. Additionally, 7 future studies will be conducted in countries with nationalized health care, which may make findings of these planned studies more applicable to the VHA health care environment.

Future Research

Given the paucity of evidence on this topic, several areas are in need of further exploration. In brief, further comparative and adequately powered studies that assess the impact of nonpharmacological pain management approaches delivered via videoconferencing are needed. Continued research is needed on interventions that utilize behavioral therapy, exercise-based therapy, and a combination of both approaches. Detailed descriptions of interventions are also necessary for future implementation and systematic reviews. Future research should focus on system-level (*eg*, no-show rates, unscheduled change of modality from videoconferencing to telephone) and patient-important outcomes (*eg*, pain interference, patient satisfaction, engagement). A key area of opportunity for future research includes describing differences in access across patient-level subgroups (*eg*, rural populations, underrepresented racial and ethnic groups, those with severe or treatment-resistant pain).

Conclusions

Further research is needed to investigate the effectiveness of behavioral and movement-based videoconference interventions for chronic pain. Additionally, research is needed to understand patient preferences as well as the facilitators and barriers for successful implementation and scalability of such interventions within a variety of settings. The VHA is well positioned to

conduct needed evaluations of chronic pain management care delivered via videoconferencing given its mission-driven focus, diverse patient populations, robust virtual care infrastructure, and wealth of administrative data. Such evaluations will be needed to guide clinical and operations practice to optimize equitable deployment and access to high-quality health care delivered via videoconferencing.

EVIDENCE REPORT

INTRODUCTION

PURPOSE

The Evidence Synthesis Program (ESP) responded to a request from the Office of Rehabilitation and Prosthetic Services, the Office of Patient Centered Care and Cultural Transformation, and the Office for Pain Management and Opioid Safety for a review of effectiveness of videoconferencing to delivered nonpharmacological treatments for chronic pain. Findings from this review will be used to optimize the delivery of virtual care among Veterans with chronic pain.

BACKGROUND

With the onset of the COVID-19 pandemic, many health care professions needed to change their practice for the safety of the public at large in an attempt to decrease community exposures to the SARS-CoV-2 virus. Elective procedures were put on hold early in the pandemic due to overcrowding of hospitals; meanwhile, conservative care treatments were encouraged to adopt remote practice to maintain social distancing in adherence with local and national guidelines.[1] As a result, telehealth technology grew in prominence and has played a central role in maintaining the availability and continuity of care during pandemic times for providers across the health care continuum—from physicians to nurses to therapists—in settings ranging from primary care to specialty care. The Veterans Health Administration (VHA) was uniquely adept at applying this change in delivery, as it has long utilized telehealth services to deliver care to Veterans across the country.

Telehealth services are available on a variety of platforms, providing patients and practitioners with a range of resources to be connected to one another. Currently, the VHA offers telehealth services and communication with providers via instant messaging on MyHealtheVet, telephone calls, and videoconferencing on VA Video Connect (VVC). During the first 10 weeks of the pandemic, in-person ambulatory visits within the VHA decreased by nearly 56%.[2] Meanwhile, telephone visits increased by approximately 139% and VVC visits rose by about 72%.[2] Early in the pandemic, telephone appointments made up a significantly greater share of virtual care due to the lower complexity and ease of implementation of this virtual modality.[3] For VVC, implementation barriers include the need for hardware such as camera-enabled devices for both providers and patients, access to adequate connectivity for streaming video, and skills and confidence navigating a telehealth platform.[3]

Both within the VA Health Care System and in the civilian population, chronic pain is highly prevalent in the United States. Approximately 100 million adults in the United States live with some form of chronic pain, with the expectation that this number will continue to grow over the next decade.[4] Estimates of the prevalence of chronic pain in adults in the United States range from 15% to 64%,[5] with a higher prevalence of both chronic pain and high-impact chronic pain reported among women, older adults, those living in poverty or with public health insurance, and people residing in rural areas.[6] While pharmacological approaches to pain management can be effective, interest in nonpharmacological approaches is growing as an effective strategy to cope with chronic pain and to combat excessive opioid prescribing for pain-related conditions.[7,8] In

the case of chronic low back pain, the Clinical Practice Guideline on noninvasive treatments for low back pain recommends that clinicians and patients should initially select nonpharmacologic treatment with exercise, multidisciplinary rehabilitation, and other moderate-quality evidence treatment forms. Providers are only recommended to consider opioids when patients have failed nonpharmacologic treatment and nonsteroidal anti-inflammatory drugs.[9] Thus, early in the pandemic, treatment for chronic pain was a specific practice that was quickly pushed to adopt remote practice. Although face-to-face visits were discouraged, public health recommendations continue to encourage nonpharmacological pain management approaches such as behavioral therapy, exercise-based therapies, and self-management approaches to stem the use of prescription opioids. Yet this meant that the supply of nonpharmacological pain services needed to quickly pivot to meet the sustained high demand for this type of care. Telehealth has been used as a safe option for self-management of diabetes, heart failure, asthma, cancer, and other chronic disease management. The proposed benefits of telehealth include addressing concerns in the environment where they occur by treating patients in their homes or usual environment, improving adherence, and increasing cost effectiveness.[10] While the impact of using telehealth delivery has been examined for other chronic conditions, the benefits of virtual care for the nonpharmacological treatment of chronic pain remain less certain.[11]

Nonpharmacological approaches to pain management may be well suited for the virtual care environment. As a part of the Whole Health approach, the VHA is a leader in this area with the implementation of telehealth in complementary and integrative health services (Tele-CIH) to foster nonpharmacologic approaches to care. The application of videoconferencing for the delivery of nonpharmacological pain care is a promising area. Yet it is not widely understood if the effectiveness of this treatment modality translates to the virtual environment when delivered via videoconferencing. Thus, the purpose of this review is to examine the effectiveness of videoconferencing compared with in-person care for patients with chronic pain.

METHODS

TOPIC DEVELOPMENT

This topic was developed at the request of the Office of Rehabilitation and Prosthetic Services, the Office of Patient Centered Care and Cultural Transformation, and the Office for Pain Management and Opioid Safety. Key questions as outlined below were driven in particular by shifts in virtual care during the COVID-19 pandemic. Findings from this review will be used to optimize the delivery of virtual care among Veterans with chronic pain.

KEY QUESTIONS

The following key questions (KQs) were the focus of this review:

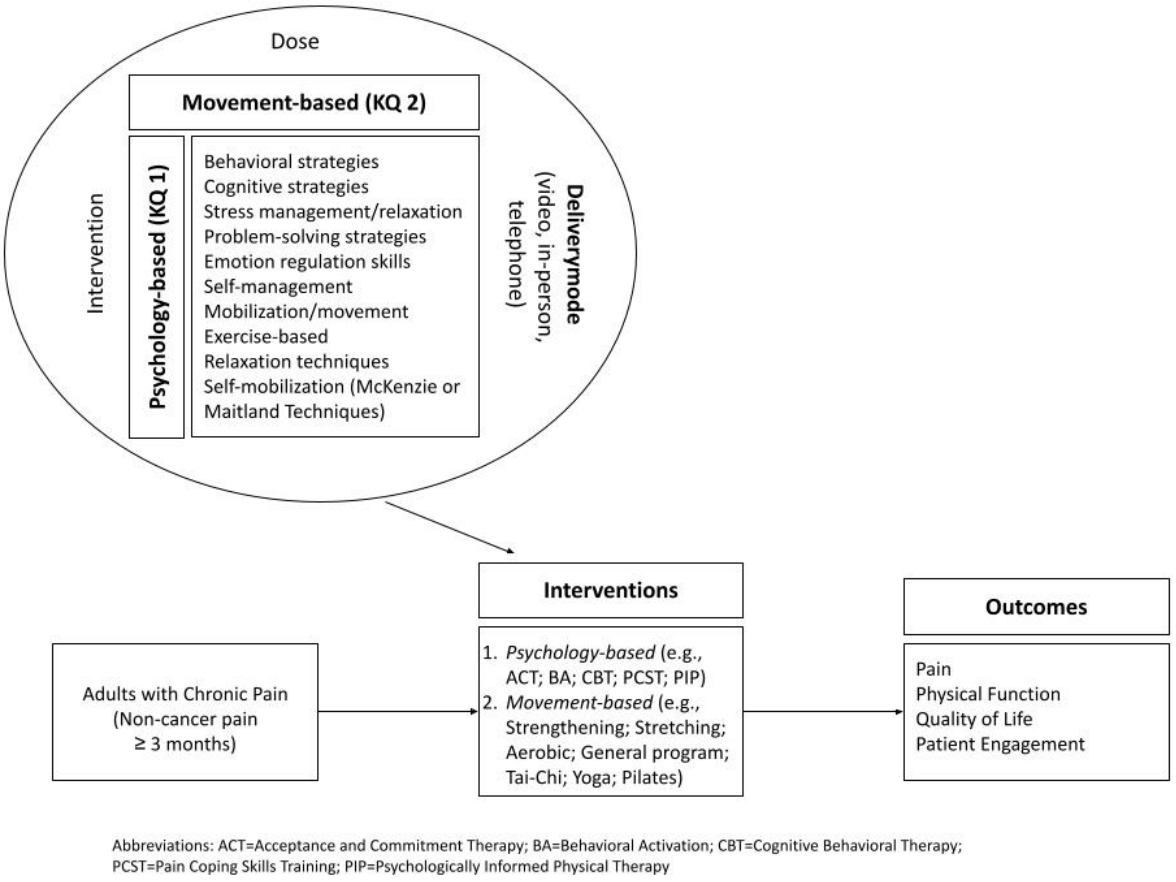
KQ1: Among patients with chronic pain, what is the effect of videoconference-delivered psychologically informed interventions for nonpharmacological chronic pain on pain, functionality, quality of life, and patient engagement?

KQ2: Among patients with chronic pain, what is the effect of videoconference-delivered therapeutic exercise and movement interventions for nonpharmacological chronic pain on pain, functionality, quality of life, and patient engagement?

ANALYTIC FRAMEWORK

The analytic framework shown in Figure 1 provides a conceptual overview of this review. The population of interest was adults with chronic pain. The interventions evaluated included nonpharmacological modalities for pain management that may be effective in the virtual care environment, including psychologically informed behavioral approaches like cognitive behavioral therapy (KQ1) and movement-based therapies like physical therapy (KQ2). The outcomes of interest were pain (*eg*, interference), physical function (*eg*, performance-based physical function and self-report), quality of life, and patient engagement (*eg*, home practice, session completion rates, self-reported engagement or satisfaction).

Figure 1. Analytic Framework



Abbreviations: ACT=Acceptance and Commitment Therapy; BA=Behavioral Activation; CBT=Cognitive Behavioral Therapy; PCST=Pain Coping Skills Training; PIP=Psychologically Informed Physical Therapy

PROTOCOL

A preregistered protocol for this review can be found on the PROSPERO international prospective register of systematic reviews (http://www.crd.york.ac.uk/PROSPERO/; registration number CRD42021279069).

DATA SOURCES AND SEARCHES

We conducted a primary literature search from inception to June 10, 2021, of MEDLINE (via Ovid), Embase (via Elsevier), CINAHL Complete (via EBSCO), and Cochrane Central Register of Controlled Trials (via Ovid) using a combination of database-specific controlled vocabulary and selected terms (*eg, chronic pain, videoconferencing)* to search titles and abstracts (see Appendix A for complete search strategies). To ensure completeness, search strategies were developed and executed by an expert medical librarian, with input from the other authors. We hand-searched previous systematic reviews conducted on this topic for potential inclusion.

STUDY SELECTION

Eligibility Criteria

Studies identified through our primary search were classified independently by 2 investigators for relevance to the KQs based on title and abstract from our *a priori* established eligibility criteria. All citations classified for inclusion by at least 1 investigator were reviewed at the full-text review level. The citations designated for exclusion by 1 investigator at the title and abstract level underwent screening by a second investigator. If both investigators agreed on exclusion, the study was excluded. All articles meeting eligibility criteria were included for data abstraction. All results were tracked in an electronic database (for referencing, EndNote, Clarivate Analytics, Philadelphia, PA; for data abstraction, DistillerSR; Evidence Partners Inc., Manotick, ON, Canada).

Table 1 describes the study eligibility criteria organized by PICOTS elements (population, intervention, comparator, outcome, timing, setting) and other criteria such as study design, language, and publication type. Specifically, for the intervention we sought to identify studies that evaluated the effect of synchronously delivered videoconferencing interventions explicitly focused on nonpharmacological pain management. We focused our review on psychologically informed and movement-based nonpharmacological approaches. Psychologically informed interventions encompassing psychological and behavioral therapies (*eg*, cognitive behavioral therapy [CBT]/acceptance and commitment therapy [ACT], meditation, mindfulness) and/or self-management education and support approaches[12] (*eg*, back school, pain education) are defined as tasks undertaken by patients to manage the symptoms, treatments, lifestyle changes, and physical and psychosocial consequences associated with chronic pain. Movement-based interventions included supervised exercise and movement therapies (*ie*, active, structured physical activity or activities designed to reduce impairments and improve movement-related function). We excluded studies that evaluated videoconferencing pain management compared with other video-based controls (*ie*, not in person), as the operations partners who commissioned this report were keenly interested in the comparison of videoconferencing care with in-person care.

Table 1. Study Eligibility Criteria

Study Characteristic	Inclusion Criteria	Exclusion Criteria
Population	Community-dwelling adults (≥18 years of age) with chronic (3+ months) non-cancer pain	• Inpatient populations (*eg*, tele-ICU, inpatient rehab) • Patients receiving care in an emergency room or tele-urgent care setting • Populations with less than 75% patients with chronic (3+ months) non-cancer pain • Postoperative patients
Intervention	All KQs: Synchronous videoconference care delivered over at least 2 encounters in which: 1. All (or the majority; *ie*, greater than 50%) of in-person	• Remote monitoring, wearables if not associated with virtual synchronous care • Telehealth interventions that do not involve synchronous

Study Characteristic	Inclusion Criteria	Exclusion Criteria
	nonpharmacological pain care is supplanted by virtual care. 2. Care is delivered remotely by a provider of a patient who is not physically present in the same location. 3. Care is administered within the context of longitudinal care provision (even if individual visits are for acute concerns). 4. Care is focused on pain management. * Interventions are not required to be exclusively virtual care by a provider as described above; rather, they may include the above with other asynchronous telehealth tools (*eg*, remote monitoring systems). KQ1: Behavioral interventions encompassing psychological and behavioral therapies and/or self-management education and support approaches KQ2: Therapeutic exercise and movement interventions*:* Supervised exercise and movement therapies	care delivered by provider to a patient (*eg*, one-way automated texts, reminder systems, self-management apps, or internet-based interventions that patients access outside their health care system) • Interventions delivered only by telephone • Majority not delivered by videoconferencing KQ1: Non-specific counseling even if focused on pain (*ie*, not manualized) KQ2: Non-evidence-based approaches as defined by current clinical guidance (*eg*, Up-to-Date)
Comparators	• In-person care without any videoconference delivery • Telephone delivered • Combination of in-person and telephone delivered	No comparator
Outcome	• Pain (*eg*, interference) • Physical function performance-based physical function and self-report • Quality of life • Patient engagement (*eg*, home practice, session completion rates, patient-reported engagement, satisfaction)	Any outcomes not listed
Timing	No limit	NA
Setting	Any outpatient setting (*ie*, general medical or specialty care clinic)	• Intervention delivered primarily in hospital inpatient setting (including emergency room) • Subacute rehabilitation
Study design	Randomized trials	• Not a clinical study (*eg*, editorial, letter to an editor) • Uncontrolled clinical study • Qualitative studies • Prospective or retrospective observational studies • Clinical guidelines • Measurement or validation studies

Study Characteristic	Inclusion Criteria	Exclusion Criteria
		• Studies self-identified as pilot or feasibility studies or studies of N <20
Countries	OECD[a]	Non-OECD
Publication types	Full publication in a peer-reviewed journal	Letters, editorials, reviews, dissertations, meeting abstracts, protocols without results

[a] OECD (2021) = Organization for Economic Co-operation and Development includes Australia, Austria, Belgium, Canada, Chile, Colombia, Costa Rica, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States

DATA ABSTRACTION AND ASSESSMENT

Data from published reports were abstracted into a customized DistillerSR database by 1 reviewer and over-read by a second reviewer. Disagreements were resolved by consensus or by obtaining a third reviewer's opinion when consensus was not reached between the first and second reviewers. Data elements include descriptors to assess applicability, quality elements, intervention details, and outcomes.

Key characteristics abstracted were participant descriptors (*eg*, age, sex, race), intervention characteristics (*eg*, provider type, movement-based or behavioral-based approach), comparator, and outcomes (See Appendix C for full list of outcomes reported in the identified literature). Multiple reports from a single study were treated as a single data point, prioritizing results based on the most complete and appropriately analyzed data. Key features relevant to applicability include the match between the sample and target populations (*eg*, age, Veteran status).

We used the Cochrane EPOC risk of bias 2 (ROB 2) tool, which is applicable to randomized studies.[13] These criteria are adequacy of randomization, deviation from indented interventions, missing outcome data, measurement of outcome, and selective outcomes reporting. We assigned a summary ROB score (low, some concerns, or high) to individual studies.

The strength of evidence was assessed using the approach described by Grading of Recommendations Assessment, Development and Evaluation (GRADE).[14] We limited GRADE ratings to those outcomes identified by the stakeholders and technical expert panel as critical to decision-making. In brief, this approach requires assessment of four domains: risk of bias, consistency, directness, and precision. Additional domains to be used when appropriate are coherence, dose-response association, impact of plausible residual confounders, strength of association (magnitude of effect), and publication bias. These domains were considered qualitatively, and a summary rating was assigned after discussion by 2 investigators as high, moderate, low, or very low strength of evidence. In some cases, high, moderate, low, or very low ratings are impossible or imprudent to make. In these situations, a grade of insufficient is assigned.

SYNTHESIS

We summarized the literature using relevant data abstracted from the eligible studies. Summary tables describe the key study characteristics of the primary studies: study design, patient demographics, and details of the intervention and comparator. We were unable to conduct quantitative synthesis (*ie*, meta-analysis) to estimate summary effects, given the paucity of literature that met edibility criteria.

We analyzed the data narratively, as quantitative synthesis was not feasible. The narrative synthesis focused on documenting the intervention components and outcome categories.

HORIZON SCAN

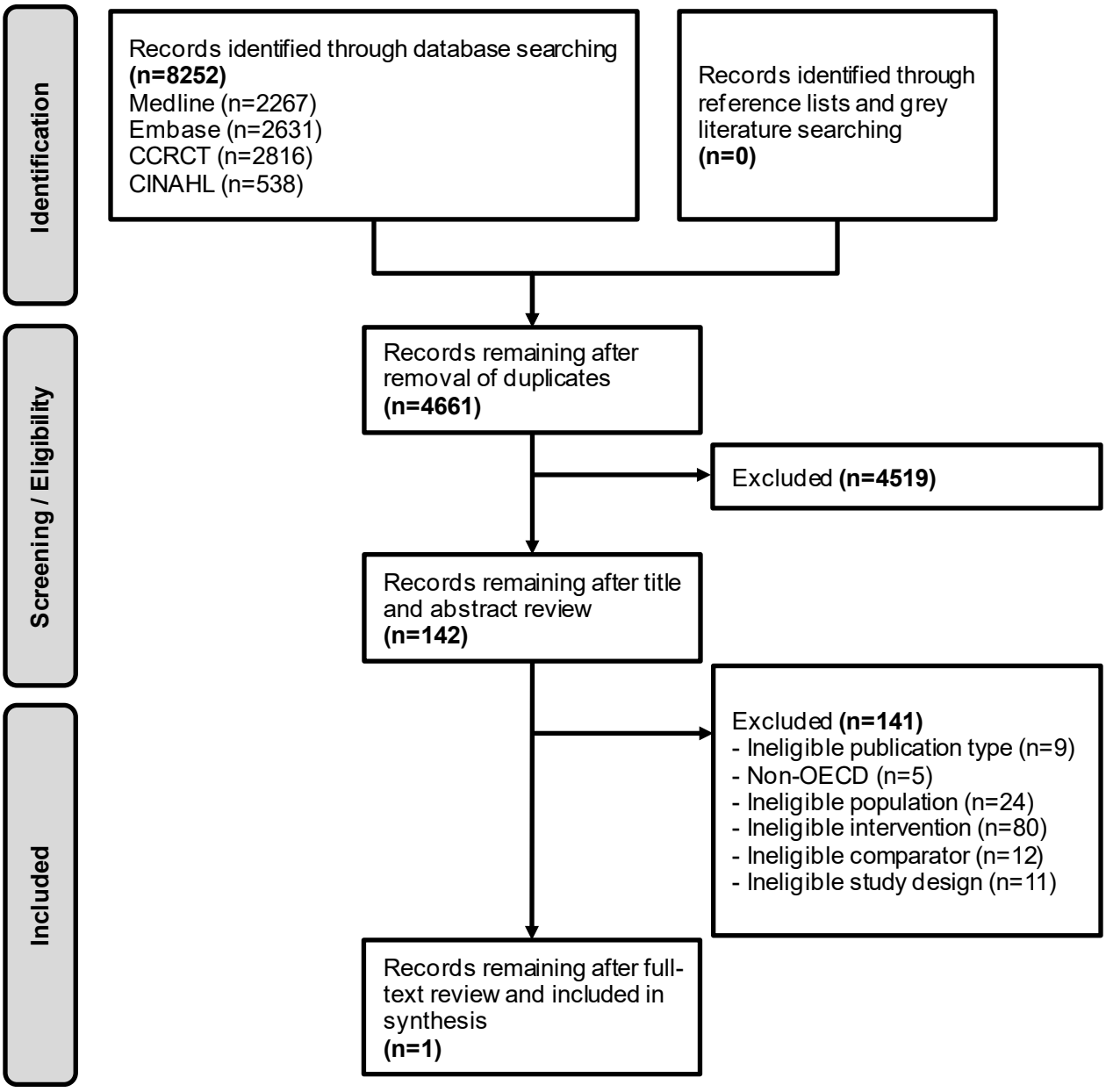
Given that little information meeting eligibility criteria was available in the published literature , we conducted a horizon scan to forecast when studies on this topic may become available in the published literature and the types of interventions likely to be forthcoming. We conducted a systematic search for potently relevant published pilot studies and protocol papers. We also conducted a search of protocol registrations in Cochrane Central Register of Controlled Trials for potential studies that may address the key questions of this review.

RESULTS

LITERATURE FLOW

The literature flow diagram (Figure 2) summarizes the results of the study selection process. (See Appendix B for a list of excluded studies.)

Figure 2. Literature Flowchart



Abbreviations. CCRCT=Cochrane Central Register of Controlled Trials; CINAHL=Cumulative Index to Nursing and Allied Health Literature; OECD=Organisation for Economic Co-operation and Development

LITERATURE OVERVIEW

Our search identified 8,252 potentially relevant articles. We conducted our search in MEDLINE (via Ovid), Embase (via Elsevier), CINAHL Complete (via EBSCO), and Cochrane Central Register of Controlled Trials (via Ovid) (Figure 2). After removing duplicates, there was a total of 4,661 articles. After applying inclusion and exclusion criteria to titles and abstracts, 142 articles remained for full-text review. Of these, 1 study was retained for data abstraction. The randomized controlled trial was a VA study conducted in the United States (Table 2). We also identified 6 protocols in trial databases, 1 pilot, and 3 published protocols.

Table 2. Characteristics of the Included Study

Study Design	Sample Size *Follow-up*	Population	Intervention Characteristics	Comparator	Outcomes Assessed
Psychologically Informed Interventions					
Herbert, 2017[15] Noninferiority RCT	N=129 Veterans *Post-treatment or 6-month follow-up*	Male: 82.2% Mean age: 52 years (SD13.3) White: 47% Black: 28% Hispanic: 14% Asian: 5% Other: 5%	8-week individual acceptance and commitment therapy (ACT) intervention (60-min sessions) delivered by Master's level study therapist (delivered via video vs in person)	In-person ACT	BPI Interference; BPI Severity; PHQ-9; PASS-20; PSQI; SF12-MCS; SF12-PCS; MPI-Activity
Movement-Based Interventions					
None	–	–	–	–	–

Abbreviations. ACT=acceptance and commitment therapy; BPI=Brief Pain Inventory Short Form Interference Scale; MCS=Mental Component Summary; MPI=West Haven-Yale Multidimensional Pain Inventory; PASS=Pain Anxiety Symptoms Scale-Short Form; PCS=Physical Component Summary; PSQI=Pittsburgh Sleep Quality Index; RCT=randomized controlled trial; SD=standard deviation; SF=Medical Outcomes Study 12-Item Short Form Health Survey

KQ1: Among patients with chronic pain, what is the effect of videoconference-delivered psychologically informed interventions for nonpharmacological chronic pain on pain, functionality, quality of life, and patient engagement?

KEY POINTS

- One randomized noninferiority trial conducted within the VA was included which compared the delivery of acceptance and commitment therapy in-person compared with video teleconferencing.
- Pain interference improved within both treatment arms at 8 weeks and 6 months follow-up.
- No statistically significant difference in outcomes was found between treatment delivery modalities.

DETAILED FINDINGS

One unique study met eligibility criteria and was retained for data abstraction. This study was a noninferiority randomized trial conducted in the VA San Diego Healthcare System (VASDHS) facilities in the San Diego area.

CHARACTERISTICS OF INCLUDED STUDY

The included study by Herbert and colleagues compared videoconferencing with in-person delivery of acceptance and commitment therapy (ACT) in the VA San Diego Healthcare System.[15] The trial consisted of 8 60-minute weekly sessions of manualized ACT treatment delivered by a study therapist (at least master's level trained in psychology) either in-person or via videoconferencing. The intervention utilizes "experiential exercises to encourage psychological and behavioral flexibility," and ACT highlights the importance of at-home assignments to reinforce skills developed during treatment sessions.

The study recruited 129 Veterans 25-89 years of age with a diagnosis of chronic pain. Patients with severe psychiatric illness and suicidal ideation were excluded. Six (9%) patients in the in-person group and 18 (28%) in the videoconferencing group discontinued participation. Respectively, 3 and 5 patients were lost to 6-month follow-up. The patient population in this study closely resembled the system-wide VA patient population, with the majority of participants being male (82.2%) at an average age of 52 years old (standard deviation [SD]=13.3). Most patients were married (55%) and the largest proportion of participants (36%) reported an annual income under $20,000. Most patients were from underrepresented racial and ethnic groups with 28% Black, 14% Hispanic/Latino, 5% Asian, 2% Native Hawaiian/Other, 1% American Indian/Alaskan Native, and 3% multiracial. Most patients reported their baseline pain location as being in their low back (78%), with the top 3 specific pain conditions reported as degenerative disc disease (43%), osteoarthritis (20%), and musculoskeletal pain (12%).

Summary of Findings

For the purposes of this systematic review, the outcomes of interest were pain (*ie,* pain interference), physical function (*ie,* performance-based and self-reported), quality of life, and patient engagement. Herbert et al found that among primary outcomes (*ie*, pain interference) and secondary outcomes the videoconferencing group was noninferior to the in-person group at both ends of treatment assessments and 6-month follow-up within groups (Table 3). Secondary outcomes included mental and physical quality of life; pain acceptance; and a multidimensional measure of disability, functioning, and pain outcomes. All outcomes, with the exception of sleep quality and activity level, showed significant improvements over time regardless of treatment arm allocation, but there were no statistically significant between-group differences. While no significant differences in patient satisfaction were found, a statistically significant number of patients withdrew from the videoconferencing group compared to the in-person group from baseline to posttreatment at 8 weeks (46% vs 23%; p = 0.01).

Table 3. KQ1 Results Table

Study	Intervention	Outcomes
Psychologically Informed Interventions		
Herbert, 2017[15]	8-week individual acceptance and commitment therapy (ACT) intervention (60-min sessions) delivered by Master's level study therapist (delivered via video vs in person).	***Pain 6-month follow-up*** BPI interference: 0.70 (-0.07 to 1.48) BPI severity: -0.06 (-0.72 to 0.60) PHQ-9: 1.22 (0.88 to 3.32) PASS-20: -4.01 (-11.01 to 3.00) PSQI: -0.14 (1.69 to 1.42)
		Quality of life 6-month follow-up SF12-MCS: .46 (3.59 to 4.50) SF12-PCS: -1.56 (-4.54 to 1.42)
		Functionality 6-month follow-up MPI-Activity: 0.31 (0.02 to 0.60)
		Patient engagement 6-month follow-up NR

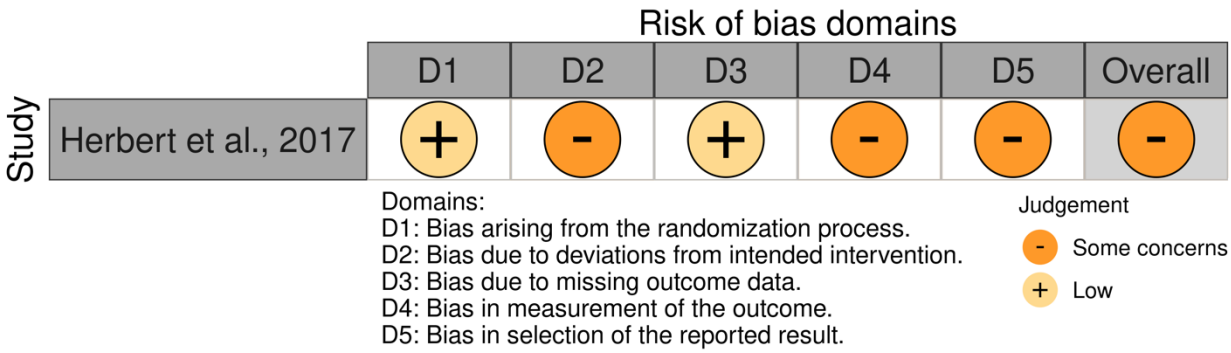
Abbreviations. BPI=Brief Pain Inventory Short Form Interference Scale; MCS=Mental Component Summary; MPI=West Haven-Yale Multidimensional Pain Inventory; PASS=Pain Anxiety Symptoms Scale-Short Form; PCS=Physical Component Summary; PHQ=Patient Health Questionnaire; PSQI=Pittsburgh Sleep Quality Index; SF=Medical Outcomes Study 12-Item Short Form Health Survey

QUALITY OF EVIDENCE FOR KEY QUESTION 1

The overall risk of bias (ROB) assessment as well as the rating by domain are outlined below (Figure 3). Our included study was rated as "some concerns" for the overall ROB. The sources of bias in this study were centered around concerns over participant retention. The study reported a substantial number of participants who discontinued participation in the study or were lost to follow-up (28% videoconferencing group vs 9% in person). The research staff did reach out to participants to gather reasons for participant drop-out, including time demands of the study, time and transportation, and lost interest and illness. There was also concern over the administration of outcomes, as patient-reported outcomes were likely administered differently in the in-person arm compared to the video teleconferencing arm. The study did not outline how the patient-

reported outcomes were administered for the video teleconferencing arm or the timeline with which these outcomes were returned to the study staff.

Figure 3. Risk of Bias Summary



KQ2: Among patients with chronic pain, what is the effect of videoconference-delivered therapeutic exercise and movement interventions for nonpharmacological chronic pain on pain, functionality, quality of life, and patient engagement?

No studies were identified that met eligibility criteria for KQ2.

HORIZON SCAN OF EMERGING STUDIES

KEY POINTS

- We identified 1 pilot study, 3 published protocols, and 6 protocols registered in trial databases of studies that could be potentially relevant to this topic.
- Most of the identified studies in the horizon scan planned to use movement-based approaches for nonpharmacological pain management. Only 1 identified protocol described an intervention that used a combination of behavioral and movement therapies.
- Most planned studies will be conducted outside the United States, but 2 identified registered protocols are for forthcoming studies within the VA.

DETAILED FINDINGS

Given that only 1 study was identified that met eligibility criteria, we evaluated pilot studies, protocol papers, and protocol registrations to provide some forecast for emerging research in this field. We identified 1 pilot study, 3 published protocols, and 6 protocols registered in trial databases. Of the 10 forthcoming studies, most (n=7) are focused on assessing movement-based approaches to nonpharmacological pain management delivered via videoconferencing. Of the 3 that have some behavioral components, all use approaches informed by CBT. All but 4 of these planned studies will be conducted outside the United States, and 2 of the US-based studies will be conducted within the VA.

Next we detail key aspects of the 3 approaches of the planned studies (*ie*, published pilot studies, published protocol papers, registered protocols). See Table 4 for the characteristics of these studies.

Pilot Studies

We identified 1 pilot study, which was a Canadian-based randomized trial comparing the feasibility and efficacy of a 12-week tele-prehabilitation and in-person program as compared to treatment as usual on pain and disability for 34 individuals waiting for a total knee or hip arthroplasty.[16] Prehabilitation is a phase of rehabilitation that takes place prior to a surgery. The goal of prehabilitation is to improve a patient's functional capacity so they are able to withstand inactivity following surgery and avoid associated functional decline. In both the in-person and tele-prehabilitation groups, participants met with a physiotherapist twice per week and followed an established and tailored protocol of exercises, including hip, knee, and proprioceptive muscle

range of motion and strengthening exercises, with a cardiovascular warm-up, as well as education about medication use and ice application. Participants were asked to repeat the exercises daily outside of sessions. Participants in the treatment as usual group met with a community-based physiotherapist for one home visit and received a booklet with information about the surgery, medication, and post-surgery rehabilitation.

This study was underpowered to detect differences between groups. Yet, 100% of participants in the tele-prehabilitation group reported that they felt their treatment goals were met, and 91% reported that they perceived their care to be just as good as in-person care. Compliance with the rehabilitation programs was high, ranging from 73% to 77% (unsupervised and supervised sessions, respectively) in the tele-prehabilitation group and 80 to 86% in the in-person group. Authors reported issues with the primary technology platform used for the study (Reacts Lite app), so alternative software (*eg*, Facetime, Skype) was used for 28 of the 191 tele-prehabilitation sessions, and 9 sessions were conducted by telephone. Authors also noted that four participants in the tele-prehabilitation group requested to be seen in person due to exacerbated pain, so guidance was given to these participants so that they could complete the exercise protocol through tele-prehabilitation as intended.

Published Protocol Papers

We identified 3 relevant published protocol papers describing studies that met our eligibility criteria.[17-19] Two of these were movement-focused only,[18,19] and 1 included both behavioral and movement components.[17] One study will recruit participants with persistent pain in any location,[17] while the other studies specified osteoarthritis pain of the knee[19] or knee and/or lower back.[18] All planned studies will be conducted outside the United States, with two set in New Zealand[17,19] and one in rural Australia.[18] Two studies were designed as noninferiority trials.[17,19]

In the only protocol to combine both movement and behavioral approaches, adults with persistent chronic pain (n=180) will be randomized to receive either an in-person or a virtual group-based pain management program.[17] The virtual program, called iSelf-help, will be conducted via videoconferencing platform (*ie*, Zoom) and will consist of 2 60-minute sessions weekly for 12 weeks. The first weekly session will be conducted by 2 pain management clinicians and will focus on CBT-informed educational content and guidance on exercises. The second weekly session is to be held by a peer-support facilitator and focus on self-reflection, goal setting, and fostering social support.

The other 2 published protocol papers described interventions focused on movement-based approaches to nonpharmacological pain management. In the first protocol, 394 participants with pain from knee osteoarthritis will be randomized to received 5 individual consultations with a physical therapist over 3 months delivered in-person or via videoconferencing.[19] The other movement-based protocol will randomize 156 rural Australians with chronic lower back or knee pain to a maximum of 8 videoconference consultations over 3 months with a physical therapist compared with usual care, which could vary based on what was available in the local community and was not restricted by the protocol.[18]

Registered Study Protocols

We identified 6 registered protocols in trial databases that met our search criteria.[20-25] Of the included registered protocols, 2 are psychologically informed intervention studies (KQ1)[21,23] and

3 are movement-based intervention studies (KQ2),[20,22,24,25] with 1 study combining psychologically informed physical therapy through the use of motivational interviewing.[20] The studies identified as registered protocols investigate multiple chronic pain diagnoses including knee pain/knee osteoarthritis,[20,22,25] chronic musculoskeletal pain,[21,24] and chronic pain associated with HIV.[23]

These studies are set in the United Kingdom,[22] Australia,[20,25] and the United States.[21,23,24] Of particular note, 2 protocols from the United States are studies taking place in the VA Health Care System—1 study utilizing cognitive behavioral therapy (KQ1)[21] and 1 utilizing telehealth for at-home yoga (KQ2).[24] Most of the studies are currently actively recruiting at their sites.[21,23,24] One study is listed as ongoing[22] and the remaining study is not yet recruiting.[20]

It important to note that, although no studies were identified at the full-text level for KQ2, our search through registered protocols in trial databases identified 4 studies that potentially meet our inclusion criteria for exercise and movement-based interventions. The registered protocols for movement-based interventions vary widely in their treatment approach from targeted physical therapy exercises to group exercise and activity tracking. The included studies with interventions related to KQ1 use cognitive behavioral management techniques.

Table 4. Horizon Scan Study Characteristics[a]

Study Design Country Registration #	Target Sample Size Recruitment Target Population Planned Duration	Intervention	Comparator	Primary Outcome Other Outcomes
Pilot Study				
Doiron-Cadrin, 2018[16] Pilot RCT Canada NCT02636751	N=34 Patients on a wait list for a hip or knee joint arthroplasty 2 sessions per week for 12 weeks	Group exercise delivered by a physical therapist. Participants were asked to repeat the same exercise program between visits at home and to write down the exercises in a logbook.	In-person prehab	Primary outcome: Lower Extremity Functional Scale (LEFS) Other outcomes: Patient-reported functional; physical performance
Protocol Papers				
Hinman, 2020[19] Noninferiority RCT Australia ACTRN12619001240134	N=394 Knee OA 5 sessions for 3 months	Physiotherapists will prescribe an individualized exercise program consisting of 5–6 strengthening exercises to be performed at home 3 times/week. Strengthening: quads, hip abductor/gluteal, hamstring/gluteal, calf, and balancing (if appropriate). Physiotherapists will also work with participants to come up with individual physical activity to increase/maintain physical activity at recommended articles. Patients are provided an “Exercise Booklet” in both arms as well as the "Knee Plan and Logbook." Patients receive education at all visits. The video consultations will take place using Zoom.	Face-to-face, clinic-based delivery of the same intervention	Primary outcome: Knee pain on walking; physical function Other outcomes: Pain; self-reported physical function; patient engagement; quality of life

Study Design Country Registration #	Target Sample Size Recruitment Target Population Planned Duration	Intervention	Comparator	Primary Outcome Other Outcomes
Hale, 2021[17] Noninferiority RCT New Zealand ACTRN12619000771156	N=180 Persistent non-cancer pain 2 group sessions weekly for 12 weeks	Each video session is composed of education, advice on guided exercises, and reflection and relaxation techniques. Education sessions will focus on knowledge and CBT-based self-management skills (eg, pain education, activity pacing, relaxation, and distraction techniques). Later in the same week, a 60-minute video session held by a peer-support facilitator will focus on self-reflection, goal setting, and the sharing of experiences with peers about what went well and what did not over the week and developing a peer support network. It will also provide an opportunity for practicing guided relaxation techniques and exercises.	In-person, group-based pain management program	Primary outcome: Roland Morris Disability Questionnaire Other outcomes: Pain; patient engagement; quality of life
Mesa-Castrillon, 2021[18] RCT Australia ACTRN12618001494224	N=156 Non-specific LBP; knee OA 8 sessions for 3 months	eHealth-delivered physical activity plan and a progressive resistance exercise program designed during remote video consultations with a physiotherapist.	Usual care (unrestricted by study protocol or rules)	Primary outcome: Patient-Specific Functional Scale (PSFS) Other outcomes: Pain; self-reported physical function; patient engagement
Registered Protocols in Trial Databases				

Study Design Country Registration #	Target Sample Size Recruitment Target Population Planned Duration	Intervention	Comparator	Primary Outcome Other Outcomes
Barton, 2019[25] Noninferiority RCT Australia Recruiting ACTRN12619000235101	Adults 45+ with knee OA 60 minutes twice a week; 8 weeks	The telerehabilitation intervention will be delivered via a validated system that allows clinicians to provide services to their patients via real-time videoconferencing into the home. Intervention details will include an 8-week exercise therapy and education program for people with OA (GLA:DTM), supported by evidence and clinical guidelines.	Active control (face-to-face)	Primary outcome: Knee-related burden (KOOS4)
Bayley, 2019[24] RCT US Active, not recruiting NCT04074109	Veterans 18+ years with chronic musculoskeletal pain 12 weeks	At home tele-yoga for musculoskeletal pain using tablet.	In-person yoga	Primary outcome: Treatment satisfaction; attrition
Groves-Williams, 2020[22] RCT UK Ongoing ISRCTN15564385	Age 45+, knee pain, and ability to connect to Skype/Zoom video calls. 7 sessions over 12 weeks; 45-60 minutes each	Group E-Rehab is an internet-delivered group exercise program. A physiotherapist will conduct sessions over Skype/Zoom. Attendees will be given lower limb strengthening exercises to complete 3 times a week at home. The intervention also includes self-paced interactive educational sessions via internet (4 modules).	Usual Care: one or two sessions with physiotherapist (may not be conducted face-to-face given COVID-19 restrictions)	Primary outcome: Feasibility
Palfai, 2020[23] RCT US Recruiting NCT04441593	Adults aged 18+ years engaged in HIV care, who exhibit heavy drinking and have chronic pain	Integrated behavioral telehealth intervention for heavy drinking & chronic pain delivered via videoconferencing. Intervention includes motivational and cognitive-	Usual care with psychoeducation and information about treatment resources	Primary outcome: Pain severity; pain interference; heavy drinking episodes; average drinks per week

Study Design Country Registration #	Target Sample Size Recruitment Target Population Planned Duration	Intervention	Comparator	Primary Outcome Other Outcomes
	3- and 6-month assessments	behavioral management of pain and alcohol.		
Damush, 2020[21] RCT US Recruiting NCT04613362	Veterans with chronic migraine 3 months	Intervention includes 6 sessions of telehealth-delivered cognitive behavioral therapy for migraines in addition to standard educational and self-management materials.	Usual Care Outpatient Cognitive Behavioral Therapy for Migraines Face to Face	Primary outcome: # of days of pain; implementation
Bell, 2021[20] RCT Australia Not yet recruiting ACTRN12621000267853	Diagnosis of knee osteoarthritis for participation in GLA:D is performed by a trained physiotherapist and guided by the NICE guidelines, that is: i) Aged >45 years ii) Activity-related knee pain iii) Morning stiffness of the knee which lasts less than 30 minutes or no knee stiffness; Have completed GLA:D in the past 12 months at time of recruitment Sessions occur in weeks 1,2,4,7,10	Motivational interviewing sessions led by physiotherapist. Sessions are individualized and may include components of engagement, focusing, evoking, and planning. Discussions may include personal barriers and enablers to physical activity and strategies to navigate these, reflections about personal change, and managing pain. Patients will receive Zoom or phone call depending on preference.	Controls do not have access to feedback website	Primary outcome: Feasibility

[a] While we identified protocol NCT03385083 registered by Zwibel in 2017, this protocol was listed as terminated in clintrials.gov and not included in the horizon scan table.

DISCUSSION

In the United States, approximately 100 million adults live with some form of chronic pain.[4] Chronic pain disproportionately impacts older adults, those living in rural areas, women, and people living in poverty.[6] To curb excessive opioid prescribing for pain-related conditions, nonpharmacological approaches such as movement-based therapies (*eg*, physical therapy) and psychologically informed behavioral approaches (*eg*, cognitive behavioral therapy) have been adopted.[7,8] Nonpharmacological approaches to pain management may be well suited for the virtual care environment. Yet it is not widely understood if the effectiveness of this treatment modality translates to the virtual environment when delivered via videoconferencing. Videoconferencing, and telehealth more broadly, present unique limitations associated with these platforms. Barriers such as limited internet connection, lack of access to technology, or lack of education on use of associated technology may impact clinicians' ability to provide nonpharmacologic treatment as well as patients' ability to access care remotely. Thus, the purpose of this review was to examine the comparative effectiveness of videoconferencing to in-person care for patients with chronic pain.

KEY QUESTION 1 SUMMARY

Only 1 study met inclusion criteria for nonpharmacological pain interventions delivered over videoconferencing. Specifically, the study evaluated acceptance and commitment therapy (ACT) in-person compared with video teleconferencing. No difference was detected between arms. The outcomes reported included 5 pain measures, 2 quality-of-life measures, and 1 function measure. Findings from this single study indicate that the impact of virtually delivered pain management is a possible substitute for in-person care. Overall, the evidence was rated as low certainty. These categories were rated down for possible risk of bias and imprecision. Additional research in this area is likely to change the GRADE ratings.

HORIZON SCAN SUMMARY

We identified 1 pilot study that assessed videoconferencing delivered prehabilitation. While underpowered to detect differences between arms for pain, function, disability, physical performance, or satisfaction outcomes, this study found the in-person and videoconferencing delivery to be equivalent. The 3 protocol papers identified on this topic indicate that future research will focus on real-time physiotherapy, group exercise, guided exercise, reflection, and relaxation techniques. Of the 6 protocols identified via trial registration databases, 2 are psychologically informed intervention studies, and 4 are movement-based intervention studies. These protocols similarly suggest that this is a burgeoning field of research likely to yield results in coming years.

Table 5. Certainty of Evidence

Outcome	Number of Studies (N)	Findings	Certainty of Evidence (Rationale)
Psychologically Informed Interventions			
Pain	1 (128)	BPI interference: 0.70 (95% CI -0.07 to 1.48) BPI severity: -0.06 (95% CI -0.72 to 0.60) PHQ-9: 1.22 (95% CI 0.88 to 3.32) PASS-20: -4.01 (95% CI -11.01 to 3.00) PSQI: -0.14 (95% CI 1.69 to 1.42)	**Low certainty** (rated down for serious risk of bias and serious imprecision)
Quality of life	1 (128)	SF12-MCS: 0.46 (95% CI 3.59 to 4.50) SF12-PCS: -1.56 (95% CI -4.54 to 1.42)	**Low certainty** (rated down for serious risk of bias and serious imprecision)
Functionality	1 (128)	MPI-activity: 0.31 (95% CI 0.02 to 0.60)	**Low certainty** (rated down for serious risk of bias and serious imprecision)
Patient engagement	0	–	–
Movement-based Interventions			
Pain	0	–	–
Quality of life	0	–	–
Functionality	0	–	–
Patient engagement	0	–	–

Abbreviations. BPI=Brief Pain Inventory Short Form Interference Scale; MPI=West Haven-Yale Multidimensional Pain Inventory; PASS=Pain Anxiety Symptoms Scale-Short Form; PCS=Physical Component Summary; PHQ=Patient Health Questionnaire; PSQI=Pittsburgh Sleep Quality Index; SF=Medical Outcomes Study 12-Item Short Form Health Survey

PRIOR SYSTEMATIC REVIEWS

To our knowledge, there is only 1 prior review of the effects of videoconferencing on chronic pain.[26] This recent review focused on group-based format and identified only 3 studies. All were deemed to be of low methodological quality due to study designs (*ie*, nonrandomized, pre-post only). Only 1 of the included studies reported outcome data on effectiveness; the other 2 were focused on program descriptions. Thus, this review provides little information on the impacts of nonpharmacological pain management delivered via videoconferencing. When comparing our findings to reviews of non-videoconference telemedicine on chronic pain, our findings are consistent with prior reviews evaluating effectiveness.[27,28] Adamse and colleagues identified 14 unique trials reporting that telemedicine was noninferior compared with usual care or in addition to usual care for chronic pain.[27] Eight studies were included in the meta-analysis, which revealed a significant effect (mean difference [MD] -0.57; 95% CI -0.81 to -.034) of telemedicine compared with no intervention on pain. Telemedicine compared with usual care (MD -0.08; 95%

CI -0.41 to 0.26) or in addition to usual care (MD -0.25; 95% CI -1.50 to 1.00) showed no significant difference. However, no studies were included that used videoconferencing as the intervention. The included studies that assessed telemedicine interventions were delivered asynchronously through telephone, email, or website. Additionally, Dario and colleagues identified 8 unique trials reporting that telehealth-based interventions were noninferior to minimal intervention (*eg*, non-health or low back pain information) for non-specific low back pain.[28] Four studies were included in the meta-analysis that revealed a short-term effect (MD -2.61; 95% CI -5.23 to 0.01) and medium-term effect (MD -0.94; 95% CI -6.71 to 4.84) on pain compared with minimal intervention. However, interventions in the included trials were delivered asynchronously through e-mail, web-based self-management programs, and telephone. There were no included trials that evaluated videoconferencing for non-specific low back pain. Our review identified 1 study assessing videoconferencing for chronic pain reporting noninferior effectiveness compared to in-person therapy.

CLINICAL AND POLICY IMPLICATIONS

Our review identified limited evidence on the use of videoconferencing to deliver nonpharmacological behavioral and movement-based interventions for chronic pain. The horizon scan identified 6 protocols of relevant studies that will likely contribute evidence on the acceptability, feasibility, and effectiveness of these types of interventions. The 1 included study indicated that delivering a behavioral-based videoconference intervention for Veterans with chronic pain was no less beneficial than the in-person intervention.[15] While videoconferencing interventions offer the opportunity to improve access to specialty care and are potentially not inferior to in-person care, gaps exist with patient engagement in these interventions. For example, in the included study, 56% of individuals randomized to the videoconference intervention arm did not start the intervention, discontinued it, or were lost to follow-up. Factors contributing to the attrition of participants in this study included lack of interest, time demands, and development of medical illness. Beyond this single study, known factors that contribute to barriers engaging in technology-based interventions include lack of internet or sufficient cellular data, digital device access, and digital health literacy.[29] Understanding barriers to engage or continue engagement in videoconferencing is especially prudent among at-risk populations with higher prevalence of chronic pain, such as those living in rural settings and low-income populations.[30-32]

LIMITATIONS

Our review has several strengths, including a protocol-driven design, a comprehensive search, broad inclusion of chronic pain etiology, careful quality assessment via established risk of bias tools, and key input from an expert panel consisting of clinicians and researchers with expertise in virtual care and experts in approaches to nonpharmacological pain management. Yet our findings should be considered within the context of limitations of the included studies and of our methodologic approach. We identified only 1 study that met our eligibility criteria. Given the small number of studies, statistical methods to detect publication bias are not useful. Other strategies, such as searching ClinicalTrials.gov for completed but unpublished studies, are not a particularly effective way to identify publication bias.[33] Thus, we did not conduct a formal analysis of publication bias. To combat this scant literature, we conducted a prior horizon scan of forthcoming studies on this topic, which yielded 10 potentially relevant studies in the planning phase.

Despite these strengths, limitations exist to our approach. Informed by the information needs of our stakeholder partners from VA operations, we only included randomized studies and those that compared videoconferencing to in-person or telephone nonpharmacological pain-management care. Yet, other comparative study designs may have findings relevant to the provision of nonpharmacological pain management via videoconferencing. We excluded a relatively small number of articles for study design, and a recent rapid review on videoconferencing for group-based chronic pain management with no exclusions for study designs yielded only 3 papers.[26] Of these papers, only 1 presented outcome data on effects of the intervention. It is possible that there may be a proliferation of additional studies conducted since the onset of the COVID-19 pandemic that may provide useful information. However, our horizon scan identified only 10 potentially eligible studies. Thus, we feel confident we identified the most relevant information to address the key questions of this review.

Applicability of Findings to the VA Population

The findings of this review are highly relevant to the VA population. The single included study was conducted with Veterans and in the VHA. Of the 10 planned studies identified in the horizon scan, most will be conducted in countries with nationalized health care, which may make findings of these studies more applicable to the VHA health care environment. Additionally, 2 planned studies will be conducted within the VHA.

FUTURE RESEARCH

We identified several areas in need of further exploration in order to strengthen future research in this area. To systematically identify these gaps in the current literature, we used an existing framework by Robinson and colleagues[34] that proposes to identify gaps categorically using the PICOTS framework (population, intervention, comparator, outcome, timing, and setting). In addition, they include standardized reasons that the current literature is insufficient to answer the question at hand (insufficient or imprecise information, biased information, inconsistency, and/or not the right information).

Overall, there is scant comparative literature that assesses the impact of nonpharmacological pain-management approaches delivered via videoconferencing. We identified no published studies of movement-based approaches and only 1 published study of an intervention that used psychologically informed behavioral approaches (*ie*, ACT). In our horizon scan, we identified 6 studies in the planning phase that will focus on movement-based approaches and 2 that will assess videoconferencing interventions using a combination of movement and behavioral approaches. Further studies are needed, and these studies need to have complete descriptions of interventions (*eg*, content, dose, frequency) and details on implementation considerations, including training of the interventionist and patients on maximizing the virtual care environment. Such details will be needed to implement approaches into practice. Our prior work details several implementation considerations for remotely delivered health care that may serve as a useful blueprint.[35]

While the focus of this review was on comparing the effectiveness of videoconferencing to other synchronous care modalities (*eg*, in-person care), future studies may want to investigate how best to blend virtual and in-person care to optimize patient, provider, and system outcomes. Contextualizing videoconferencing care as adjunctive or replacement care has different implications for how that care is constructed and by whom it is delivered. Another key

consideration of future studies is the need to include system-important and patient-important outcomes in the evaluation of approaches. In collaboration with our operations stakeholder partners, we prioritized pain, function, quality of life, and patient engagement as key patient-level outcomes. At a minimum, future studies should seek to explore these. Yet there are key provider and system outcomes that should also be considered in future studies to optimize. When assessing key outcomes, careful attention should be paid to designing studies that are powered to detect subgroup difference by key populations such as women, underrepresented racial and ethnic groups, those living in rural areas, or by severity and length of chronic pain conditions to assure that the potential benefits of such approaches are shared across populations. Such careful attention to designing future studies could help in developing videoconferencing approaches to chronic pain management that maximize ability to attain the quadruple aim of improving the patient care experience, improving the health of a population, reducing per capita health care costs, and improving the work life of health care providers, including clinicians and staff.[36] Table 6 describes some of these future research considerations.

Table 6. Evidence Gaps and Areas for Future Research Consideration

Evidence Gap/Area for Future Exploration	Reason	Types of Studies to Consider
Population		
• Patients with various levels of comfort with technology or have other telehealth equity issues (*eg*, bandwidth, hardware) • Patients from rural areas • Patients from traditionally underrepresented racial and ethnic backgrounds • Patients who are earlier in their experiences with chronic pain	Insufficient information/not the right information	Well-designed subgroup analyses or individual patient-data meta-analysis from randomized trials Qualitative and mixed methods studies
Interventions		
• Therapeutic exercise and movement interventions (*eg.*, physical therapy) delivered via videoconferencing • Interventions that combine therapeutic exercise /movement and behavioral health approaches delivered via videoconferencing • Videoconferencing care to replace *some portion* of in-person chronic pain management care • Videoconferencing to replace *all* of in-person or telephone-delivered chronic pain management care • Different models of combining video-based and telephone-based care with in-person care for chronic pain management • Interventions using currently available and widely used virtual care platforms • Videoconferencing interventions using group classes or peer-led models	Insufficient or imprecise information	Randomized trials Non-randomized trials Qualitative and mixed methods studies
Comparators		

• Routine in-person care • Telephone-based care • Static website or video recorded session • Group-based sessions	Insufficient information	Randomized trials Non-randomized trials
Outcomes		
• Patient engagement (*eg*, session attendance, home practice, patient satisfaction, therapeutic alliance) • Patient utilization (*eg,* downstream in-person care including hospitalization, urgent care visits, opioid use) • Process variables (*eg,* time providing direct and indirect care, number of missed visits, consultation time) • Costs (including infrastructure and implementation costs, staff training costs) • Clinician satisfaction • Clinical workflow • Harms (delayed care, falls/injury, depression) • Fidelity to treatment delivered (*eg,* topics covered, care delivered)	Insufficient information/imprecise information; inconsistent information	Randomized trials Non-randomized trials Qualitative and mixed methods studies
Setting		
• Community gym or wellness centers • Variety of clinical settings (*eg*, large health care systems, smaller community-based practices)	Insufficient information	Randomized trials Non-randomized Trials

CONCLUSIONS

The VHA is the largest integrated health system and largest provider of telehealth in the country. As such, the VHA has a keen interest in optimizing the use of virtual care modalities, such as videoconferencing. The VHA has been a leader in the deployment of virtual care due to the mission to provide quality health care for all who have served in in the military. This review sought to identify and synthesize the evidence on the impact of deploying chronic pain management care via videoconferencing technologies. Yet, we found scant research. Prior systematic reviews showed that telephone-delivered care or other asynchronous modalities are noninferior to usual care approaches for pain management.[27,28] It is likely that videoconferencing may also be noninferior to usual care approaches.

In non-pandemic times, telehealth technologies were utilized to bridge barriers surrounding physical distance and to increase the quality of care available to patients in rural communities, where specialized health care was often unavailable or difficult to access.[37] These benefits are likely to extend into the post-COVID era, and can be hypothesized to have more widespread utilization after such extensive efforts have been made to establish these practices. Yet, a central consideration about the accelerated implementation of virtual modalities to deliver care is the possibility that such changes may serve to increase health inequities and disparities, especially among patient groups who have experienced historical and structural bias and racism by the health care system. Populations already on the margins due to existing health care access

disparities and technology barriers (*eg*, lack of broadband, computer cameras, comfort in using technology) will no doubt have greater barriers to meaningfully engaging in videoconferencing as a modality of care delivery.

Further research is needed to investigate the effectiveness of behavioral and movement-based videoconferencing interventions for chronic pain. Likely research is also needed to understand patient preferences as well as the facilitators and barriers for successful implementation and scalability of such interventions within a variety of settings. The VHA is well positioned to conduct needed evaluations of chronic pain management care delivered via videoconferencing given its mission-driven focus, diverse patient populations, robust virtual care infrastructure, and wealth of administrative data. Such evaluations will be needed to guide clinical and operations practice to optimize equitable deployment and access to high-quality health care delivered via videoconferencing.

REFERENCES

1. Centers for Disease Control and Prevention. COVID-19 guidance. Website. Available at: https://www.cdc.gov/coronavirus/2019-ncov/index.html. Accessed January 26, 2022.

2. Baum A, Kaboli PJ, Schwartz MD. Reduced In-Person and Increased Telehealth Outpatient Visits During the COVID-19 Pandemic. *Ann Intern Med*. 2021;174(1):129-131.

3. Connolly SL, Stolzmann KL, Heyworth L, et al. Rapid Increase in Telemental Health Within the Department of Veterans Affairs During the COVID-19 Pandemic. *Telemed J E Health*. 2021;27(4):454-458.

4. Institute of Medicine Committee on Advancing Pain Research C, Education. The National Academies Collection: Reports funded by National Institutes of Health. *Relieving Pain in America: A Blueprint for Transforming Prevention, Care, Education, and Research*. Washington (DC): National Academies Press (US); 2011.

5. Johannes CB, Le TK, Zhou X, et al. The prevalence of chronic pain in United States adults: results of an Internet-based survey. *J Pain*. 2010;11(11):1230-9.

6. Dahlhamer J, Lucas J, Zelaya C, et al. Prevalence of Chronic Pain and High-Impact Chronic Pain Among Adults - United States, 2016. *MMWR Morb Mortal Wkly Rep*. 2018;67(36):1001-1006.

7. Chou R, Turner JA, Devine EB, et al. The effectiveness and risks of long-term opioid therapy for chronic pain: a systematic review for a National Institutes of Health Pathways to Prevention Workshop. *Ann Intern Med*. 2015;162(4):276-86.

8. Finley EP, Schneegans S, Curtis ME, et al. Confronting challenges to opioid risk mitigation in the U.S. health system: Recommendations from a panel of national experts. *PLoS One*. 2020;15(6):e0234425.

9. Qaseem A, Wilt TJ, McLean RM, et al. Noninvasive Treatments for Acute, Subacute, and Chronic Low Back Pain: A Clinical Practice Guideline From the American College of Physicians. 2017(1539-3704 (Electronic)).

10. Hanlon PA-O, Daines LA-O, Campbell CA-O, et al. Telehealth Interventions to Support Self-Management of Long-Term Conditions: A Systematic Metareview of Diabetes, Heart Failure, Asthma, Chronic Obstructive Pulmonary Disease, and Cancer. 2017(1438-8871 (Electronic)).

11. Johnston B, Wheeler L, Deuser J, et al. Outcomes of the Kaiser Permanente Tele-Home Health Research Project. *Arch Fam Med*. 2000;9(1):40-5.

12. Barlow J, Wright C, Sheasby J, et al. Self-management approaches for people with chronic conditions: a review. *Patient Educ Couns*. 2002;48(2):177-87.

13. Cochrane. RoB 2 tool: a revised Cochrane risk of bias tool for randomized trials. Available at: https://sites.google.com/site/riskofbiastool/welcome/rob-2-0-tool?authuser=0. Accessed February 4, 2022.

14. The GRADE handbook. Available at: https://gdt.gradepro.org/app/handbook/handbook.html. Accessed February 4, 2022.

15. Herbert MS, Afari N, Liu L, et al. Telehealth Versus In-Person Acceptance and Commitment Therapy for Chronic Pain: A Randomized Noninferiority Trial. *Journal of Pain*. 2017;18(2):200-211.

16. Doiron-Cadrin P, Kairy D, Vendittoli PA, et al. Feasibility and preliminary effects of a tele-prehabilitation program and an in-person prehablitation program compared to usual care for total hip or knee arthroplasty candidates: a pilot randomized controlled trial. *Disability and rehabilitation*. 2020;42(7):989-998.

17. Hale L, Devan H, Davies C, et al. Clinical and cost-effectiveness of an online-delivered group-based pain management programme in improving pain-related disability for people with persistent pain-protocol for a non-inferiority randomised controlled trial (iSelf-help trial). *BMJ Open*. 2021;11(2):e046376.

18. Mesa-Castrillon CI, Simic M, Ferreira ML, et al. EHealth to empower patients with musculoskeletal pain in rural Australia (EMPoweR) a randomised clinical trial: study protocol. *BMC Musculoskeletal Disorders*. 2021;22(1):11.

19. Hinman RS, Kimp AJ, Campbell PK, et al. Technology versus tradition: a non-inferiority trial comparing video to face-to-face consultations with a physiotherapist for people with knee osteoarthritis. Protocol for the PEAK randomised controlled trial. *BMC Musculoskeletal Disorders*. 2020;21(1):522.

20. ACTRN12621000267853. Investigating the effect of supported motivational interviewing on physical activity for people with knee osteoarthritis who have already completed a widespread exercise-therapy program (GLA: D(R)). A pilot study. Available at: https://trialsearch.who.int/?TrialID=ACTRN12621000267853. Accessed February 3, 2022. 2021.

21. NCT04613362. TelemEdiciNe-bAsed Cognitive TherapY for Migraines. Available at: https://clinicaltrials.gov/ct2/show/NCT04613362. Accessed February 3, 2022. 2020.

22. ISRCTN15564385. E-rehab for Knee Pain. Available at: https://trialsearch.who.int/?TrialID=ISRCTN15564385. Accessed February 3, 2022. 2020.

23. NCT04441593. Internet-based Video-conferencing to Address Alcohol Use and Pain: a Pilot Trial. Available at: https://clinicaltrials.gov/ct2/show/NCT04441593. Accessed February 3, 2022. 2020.

24. NCT04074109. Feasibility of At-Home Telehealth Yoga for Treating Chronic Pain. Available at: https://clinicaltrials.gov/ct2/show/NCT04074109. Accessed February 3, 2022. 2019.

25. ACTRN12619000235101. Exercise-therapy and education for knee osteoarthritis: comparison of telerehabilitation with face-to-face delivery. Available at: https://trialsearch.who.int/?TrialID=ACTRN12619000235101. Accessed February 3, 2022. 2019.

26. Walumbe J, Belton J, Denneny D. Pain management programmes via video conferencing: a rapid review. *Scand J Pain*. 2021;21(1):32-40.

27. Adamse C, Dekker-Van Weering MG, van Etten-Jamaludin FS, et al. The effectiveness of exercise-based telemedicine on pain, physical activity and quality of life in the treatment of chronic pain: A systematic review. *J Telemed Telecare*. 2018;24(8):511-526.

28. Dario AB, Moreti Cabral A, Almeida L, et al. Effectiveness of telehealth-based interventions in the management of non-specific low back pain: a systematic review with meta-analysis. *Spine J*. 2017;17(9):1342-1351.

29. Van Winkle B, Carpenter N, Moscucci M. Why Aren't Our Digital Solutions Working for Everyone? AMA J Ethics. 2017;19(11):1116-1124. doi: 10.1001/journalofethics.2017.19.11.stas2-1711.

30. Gray DM, II, Joseph JJ, Olayiwola JN. Strategies for Digital Care of Vulnerable Patients in a COVID-19 World—Keeping in Touch. *JAMA Health Forum*. 2020;1(6):e200734-e200734.

31. Prego-Domínguez J, Khazaeipour Z, Mallah N, et al. Socioeconomic status and occurrence of chronic pain: a meta-analysis. *Rheumatology (Oxford)*. 2021;60(3):1091-1105.

32. Zelaya CE, Dahlhamer JM, Lucas JW, et al. Chronic Pain and High-impact Chronic Pain Among U.S. Adults, 2019. *NCHS Data Brief*. 2020(390):1-8.

33. Adam GP, Springs S, Trikalinos T, et al. Does information from ClinicalTrials.gov increase transparency and reduce bias? Results from a five-report case series. *Syst Rev*. 2018;7(1):59.

34. Robinson KA, Saldanha IJ, McKoy NA. Development of a framework to identify research gaps from systematic reviews. *J Clin Epidemiol*. 2011;64(12):1325-30.

35. Lewinski AA, Rushton S, Van Voorhees E, et al. Implementing remote triage in large health systems: A qualitative evidence synthesis. *Res Nurs Health*. 2021;44(1):138-154.

36. Bodenheimer T, Sinsky C. From triple to quadruple aim: care of the patient requires care of the provider. *Ann Fam Med*. 2014;12(6):573-6.

37. Eaton LH, Gordon DB, Wyant S, et al. Development and implementation of a telehealth-enhanced intervention for pain and symptom management. *Contemp Clin Trials*. 2014;38(2):213-20.

APPENDIX A. SEARCH STRATEGIES

Database: Medline (via Ovid, ALL 1946 to June 9, 2021)
Search date: 6/10/2021

Search set	Search strategy	Results
#1 Chronic pain terms and conditions	exp chronic pain/ or exp neuralgia/ or exp fibromyalgia/ or exp arthritis, rheumatoid/ or exp arthritis, psoriatic/ or exp gout/ or exp lupus erythematosus, systemic/ or exp complex regional pain syndromes/ or exp migraine disorders/ or exp cluster headache/ or exp tension-type headache/ or exp cystitis, interstitial/ or exp multiple sclerosis/ or exp ehlers-danlos syndrome/ or exp musculoskeletal pain/ or exp neck pain/ or exp back pain/ or exp low back pain/ or exp pelvic girdle pain/ or exp flank pain/ or exp pelvic pain/ or exp shoulder pain/ or exp patellofemoral pain syndrome/ or exp arthralgia/ or exp abdominal pain/ or exp myofascial pain syndromes/ or exp facial pain/ or exp chest pain/ or exp facial neuralgia/ or exp phantom limb/ or exp myalgia/ or exp metatarsalgia/ or exp osteoarthritis/ or ((chronic* or persisten* or long?lasting or long?term or intermittent* or continuous) adj3 (pain* or ache* or myalg* or arthralg* or allodynia or arthrit* or spondyl* or neuropath* or radiculopath*)).ti,ab. or "consistent pain".ti,ab. or "perpetual pain".ti,ab. or neuralgia.ti,ab. or fibromyalgia.ti,ab. or "rheumatoid arthritis".ti,ab. or "psoriatic arthritis".ti,ab. or gout.ti,ab. or "systemic lupus erythematosus".ti,ab. or "complex regional pain".ti,ab. or ((cluster or tension) adj3 headache*).ti,ab. or migrane*.ti,ab. or "interstitial cystitis".ti,ab. or "bladder pain syndrome".ti,ab. or "multiple sclerosis".ti,ab. or "Ehlers-Danlos syndrome".ti,ab. or ((MSK or musculo* or muscular or joint or joints or radicular or shoulder* or "rotator cuff" or elbow* or hip or hips or pelvic or pelvis or flank or buttock or knee* or patell* or myofascial or "phantom limb") adj3 (pain* or ache* or myalg* or arthralg*)).ti,ab. or osteoarthritis.ti,ab. or (degenerative adj joint adj disease).ti,ab. or (frozen adj shoulder*).ti,ab. or metatarsalgia.ti,ab. or "pelvic floor disorder".ti,ab. or "pelvic floor disorders".ti,ab. or ((back or low?back or spine or spinal or thoracic or vertebr* or intervertebr* or sciatic or lumbar or lumbro* or lumbo*) adj3 (pain* or ache* or radiculopath*)).ti,ab. or lumbago.ti,ab. or sciatica.ti,ab. or ((neck or cervical or cervicodynia) adj3 (pain* or ache* or radiculopath*)).ti,ab. or cervicalgia*.ti,ab.	795957
#2 Tele / Video terms	exp Telemedicine/ or exp Remote Consultation/ or Videoconferencing/ or Telephone/ or exp Cell Phone/ or exp Computers, Handheld/ or (videoconferenc* or video-conferenc* or webconferenc* or web-conferenc* or webex or zoom or skype or ooVoo or FaceTime or Tango or GoToMeeting or web-delivered or internet-delivered or computer-delivered).ti,ab. or ((remote* or video* or internet or internet-based or web or web-based or online or online-based or computer or computer-based) adj2 (meet* or call* or chat* or conferenc* or consult* or counsel* or visit*)).ti,ab. or ((video* or remote* or web-based or internet-based) adj2 care).ti,ab. or (virtual or virtually or telepain or tele-pain or telehealth or tele-health or telemedicine or tele-medicine or telemedical or tele-medical or telecare or tele-care or teleconsult* or tele-consult* or telecommunicat* or tele-communicat* or telemanag* or tele-manag* or telehome or tele-home or telepharmac* or tele-pharmac* or telecardiol* or tele-cardiol* or tele-cardiac or tele-rehabilitat* or telerehabilitat* or teleintervention* or tele-intervention* or teleconferenc* or tele-conferenc* or telephon* or tele-phon* or cellphon* or cell-phon* or smartphon* or "mobile phone" or "mobile phones" or e-visit* or evisit* or e-care or ecare or e-consult* or econsult* or e-diagnos* or ediagnos* or e-medicine or emedicine or e-	306186

Search set	Search strategy	Results
	physician* or ephysician* or eclinician* or e-clinician* or e-pharm* or epharm* or "communication technology" or "communication technologies" or eHealth or e- health or "e health" or mHealth or m-health or "m health" or wireless).ti,ab. or ((mobile or digital) adj health*).ti,ab. or (tele adj (care or diagnos* or health* or intervention* or manag* or therap* or treat* or medicine or medical or prescrib* or prescript* or pain)).ti,ab.	
#3 combining	1 and 2	7539
#4 RCT filter	randomized controlled trial.pt. OR controlled clinical trial.pt. OR randomized.ti,ab. OR randomised.ti,ab. OR randomization.ti,ab. OR randomisation.ti,ab. OR placebo.ti,ab. OR randomly.ti,ab. OR trial.ti,ab. OR groups.ti,ab.	3280926
#5	3 and 4	2388
#6 Animal-only exclusion	5 not (exp animals/ not exp humans/)	2365
#7 Pediatric-only exclusion	6 not ((exp adolescent/ or exp child/ or exp infant/) not exp adult/)	2296
#8 Study design exclusion	7 not (Editorial or Letter or Case Reports or Comment).pt.	2267

Database: Embase (via Elsevier)
Search date: 6/10/2021
Note: Search from the Results page

Search set	Search strategy	Results
#1 Chronic pain terms and conditions	'chronic pain'/exp OR 'neuralgia'/exp OR 'fibromyalgia'/exp OR 'rheumatoid arthritis'/exp OR 'psoriatic arthritis'/exp OR 'gout'/exp OR 'systemic lupus erythematosus'/exp OR 'complex regional pain syndrome'/exp OR 'migraine'/exp OR 'cluster headache'/exp OR 'tension headache'/exp OR 'interstitial cystitis'/exp OR 'multiple sclerosis'/exp OR 'ehlers danlos syndrome'/exp OR 'musculoskeletal pain'/exp OR 'neck pain'/exp OR 'backache'/exp OR 'low back pain'/exp OR 'pelvic girdle pain'/exp OR 'flank pain'/exp OR 'pelvic pain'/exp OR 'shoulder pain'/exp OR 'patellofemoral pain syndrome'/exp OR 'arthralgia'/exp OR 'abdominal pain'/exp OR 'myofascial pain'/exp OR 'face pain'/exp OR 'musculoskeletal chest pain'/exp OR 'facial neuralgia'/exp OR 'phantom pain'/exp OR 'myalgia'/exp OR 'metatarsalgia'/exp OR 'osteoarthritis'/exp OR ((chronic* OR persisten* OR long?lasting OR long?term OR intermittent* OR continuous) NEAR/3 (pain* OR ache* OR myalg* OR arthralg* OR allodynia OR arthrit* OR spondyl* OR neuropath* OR radiculopath*)):ti,ab OR 'consistent pain':ti,ab OR 'perpetual pain':ti,ab OR neuralgia:ti,ab OR fibromyalgia:ti,ab OR 'rheumatoid arthritis':ti,ab OR 'psoriatic arthritis':ti,ab OR gout:ti,ab OR 'systemic lupus erythematosus':ti,ab OR 'complex regional pain':ti,ab OR ((cluster OR tension) NEAR/3 headache*):ti,ab OR migrane*:ti,ab OR 'interstitial cystitis':ti,ab OR 'bladder pain syndrome':ti,ab OR 'multiple sclerosis':ti,ab OR 'Ehlers Danlos syndrome':ti,ab OR ((MSK OR musculo* OR muscular OR joint OR joints OR radicular OR shoulder* OR 'rotator cuff' OR elbow*	1458785

Search set	Search strategy	Results
	OR hip OR hips OR pelvic OR pelvis OR flank OR buttock OR knee* OR patell* OR myofascial OR 'phantom limb') NEAR/3 (pain* OR ache* OR myalg* OR arthralg*)):ti,ab OR osteoarthritis:ti,ab OR (degenerative NEXT/1 joint NEXT/1 disease):ti,ab OR (frozen NEXT/1 shoulder*):ti,ab OR metatarsalgia:ti,ab OR 'pelvic floor disorder':ti,ab OR 'pelvic floor disorders':ti,ab OR ((back OR low?back OR spine OR spinal OR thoracic OR vertebr* OR intervertebr* OR sciatic OR lumbar OR lumbro* OR lumbo*) NEAR/3 (pain* OR ache* OR radiculopath*)):ti,ab OR lumbago:ti,ab OR sciatica:ti,ab OR ((neck OR cervical OR cervicodynia) NEAR/3 (pain* OR ache* OR radiculopath*)):ti,ab OR cervicalgia*:ti,ab	
#2 Tele / Video terms	'Telemedicine'/exp OR 'Teleconsultation'/exp OR 'Videoconferencing'/de OR 'Telephone'/de OR 'Mobile Phone'/exp OR (videoconferenc* OR video?conferenc* OR webconferenc* OR web?conferenc* OR webex OR zoom OR skype OR ooVoo OR FaceTime OR Tango OR GoToMeeting OR web?delivered OR internet?delivered OR computer?delivered):ti,ab OR ((remote* OR video* OR internet OR internet-based OR web OR web-based OR online OR online?based OR computer OR computer?based) NEAR/2 (meet* OR call* OR chat* OR conferenc* OR consult* OR counsel* OR visit*)):ti,ab OR ((video* OR remote* OR web?based OR internet?based) NEAR/2 care):ti,ab OR (virtual OR virtually OR telepain OR tele?pain OR telehealth OR tele?health OR telemedicine OR tele?medicine OR telemedical OR tele?medical OR telecare OR tele?care OR teleconsult* OR tele?consult* OR telecommunicat* OR tele?communicat* OR telemanag* OR tele?manag* OR telehome OR tele?home OR telepharmac* OR tele?pharmac* OR telecardiol* OR tele?cardiol* OR tele?cardiac OR tele?rehabilitat* OR telerehabilitat* OR teleintervention* OR tele?intervention* OR teleconferenc* OR tele?conferenc* OR telephon* OR tele?phon* OR cellphon* OR cell?phon* OR smartphon* OR 'mobile phone' OR 'mobile phones' OR e?visit* OR evisit* OR e?care OR ecare OR e?consult* OR econsult* OR ediagnos* OR e?medicine OR emedicine OR e?physician* OR ephysician* OR eclinician* OR e?clinician* OR e?pharm* OR epharm* OR 'communication technology' OR 'communication technologies' OR eHealth OR "e health" OR 'e health' OR mHealth OR m?health OR 'm health' OR wireless):ti,ab OR ((mobile OR digital) NEXT/1 health*):ti,ab OR (tele NEXT/1 (care OR diagnos* OR health* OR intervention* OR manag* OR therap* OR treat* OR medicine OR medical OR prescrib* OR prescript* OR pain)):ti,ab	401829
#3 combining	#1 AND #2	14,828
#4 RCT filter	'randomized controlled trial'/exp OR 'controlled clinical trial'/exp OR 'single blind procedure'/exp OR 'double blind procedure'/exp OR 'crossover procedure'/exp OR randomized:ti,ab OR randomised:ti,ab OR randomization:ti,ab OR randomisation:ti,ab OR placebo:ti,ab OR randomly:ti,ab OR trial:ti,ab OR groups:ti,ab OR cross?over:ti,ab OR ((single OR double) NEAR/1 blind*):ti,ab	4715525
#5	#3 AND #4	4350
#6 Animal-only exclusion	#5 AND [humans]/lim	4119
#7	#6 NOT ('case report'/exp OR 'case study'/exp OR 'editorial'/exp OR [editorial]/lim OR 'letter'/exp OR [letter]/lim OR 'note'/exp OR [note]/lim OR	2,631

Search set	Search strategy	Results
Study design exclusion	[conference abstract]/lim OR 'conference abstract'/exp OR 'conference abstract'/it)	

Database: Cochrane Central Register of Controlled Trials (via Ovid, May 2021)
Search date: 6/10/2021

Search set	Search strategy	Results
#1 Chronic pain terms and conditions	exp chronic pain/ or exp neuralgia/ or exp fibromyalgia/ or exp arthritis, rheumatoid/ or exp arthritis, psoriatic/ or exp gout/ or exp lupus erythematosus, systemic/ or exp complex regional pain syndromes/ or exp migraine disorders/ or exp cluster headache/ or exp tension-type headache/ or exp cystitis, interstitial/ or exp multiple sclerosis/ or exp ehlers-danlos syndrome/ or exp musculoskeletal pain/ or exp neck pain/ or exp back pain/ or exp low back pain/ or exp pelvic girdle pain/ or exp flank pain/ or exp pelvic pain/ or exp shoulder pain/ or exp patellofemoral pain syndrome/ or exp arthralgia/ or exp abdominal pain/ or exp myofascial pain syndromes/ or exp facial pain/ or exp chest pain/ or exp facial neuralgia/ or exp phantom limb/ or exp myalgia/ or exp metatarsalgia/ or exp osteoarthritis/ or ((chronic* or persisten* or long?lasting or long?term or intermittent* or continuous) adj3 (pain* or ache* or myalg* or arthralg* or allodynia or arthrit* or spondyl* or neuropath* or radiculopath*)).ti,ab. or "consistent pain".ti,ab. or "perpetual pain".ti,ab. or neuralgia.ti,ab. or fibromyalgia.ti,ab. or "rheumatoid arthritis".ti,ab. or "psoriatic arthritis".ti,ab. or gout.ti,ab. or "systemic lupus erythematosus".ti,ab. or "complex regional pain".ti,ab. or ((cluster or tension) adj3 headache*).ti,ab. or migrane*.ti,ab. or "interstitial cystitis".ti,ab. or "bladder pain syndrome".ti,ab. or "multiple sclerosis".ti,ab. or "Ehlers-Danlos syndrome".ti,ab. or ((MSK or musculo* or muscular or joint or joints or radicular or shoulder* or "rotator cuff" or elbow* or hip or hips or pelvic or pelvis or flank or buttock or knee* or patell* or myofascial or "phantom limb") adj3 (pain* or ache* or myalg* or arthralg*)).ti,ab. or osteoarthritis.ti,ab. or (degenerative adj joint adj disease).ti,ab. or (frozen adj shoulder*).ti,ab. or metatarsalgia.ti,ab. or "pelvic floor disorder".ti,ab. or "pelvic floor disorders".ti,ab. or ((back or low?back or spine or spinal or thoracic or vertebr* or intervertebr* or sciatic or lumbar or lumbro* or lumbo*) adj3 (pain* or ache* or radiculopath*)).ti,ab. or lumbago.ti,ab. or sciatica.ti,ab. or ((neck or cervical or cervicodynia) adj3 (pain* or ache* or radiculopath*)).ti,ab. or cervicalgia*.ti,ab.	115124
#2 Tele / Video terms	exp Telemedicine/ or exp Remote Consultation/ or Videoconferencing/ or Telephone/ or exp Cell Phone/ or exp Computers, Handheld/ or (videoconferenc* or video-conferenc* or webconferenc* or web-conferenc* or webex or zoom or skype or ooVoo or FaceTime or Tango or GoToMeeting or web-delivered or internet-delivered or computer-delivered).ti,ab. or ((remote* or video* or internet or internet-based or web or web-based or online or online-based or computer or computer-based) adj2 (meet* or call* or chat* or conferenc* or consult* or counsel* or visit*)).ti,ab. or ((video* or remote* or web-based or internet-based) adj2 care).ti,ab. or (virtual or virtually or telepain or tele-pain or telehealth or tele-health or telemedicine or tele-medicine or telemedical or tele-medical or telecare or tele-care or teleconsult* or tele-consult* or telecommunicat* or tele-communicat* or telemanag* or tele-manag* or telehome or tele-home or telepharmac* or tele-pharmac* or telecardiol* or tele-cardiol* or tele-cardiac or tele-rehabilitat* or telerehabilitat* or teleintervention* or tele-intervention* or teleconferenc* or tele-conferenc* or telephon* or tele-phon* or cellphon* or cell-phon* or smartphon* or "mobile phone" or	49113

Search set	Search strategy	Results
	"mobile phones" or e-visit* or evisit* or e-care or ecare or e-consult* or econsult* or e-diagnos* or ediagnos* or e-medicine or emedicine or e-physician* or ephysician* or eclinician* or e-clinician* or e-pharm* or epharm* or "communication technology" or "communication technologies" or eHealth or e- health or "e health" or mHealth or m-health or "m health" or wireless).ti,ab. or ((mobile or digital) adj health*).ti,ab. or (tele adj (care or diagnos* or health* or intervention* or manag* or therap* or treat* or medicine or medical or prescrib* or prescript* or pain)).ti,ab.	
#3 combining	1 and 2	3332
#4 RCT filter	3 and (randomized.ti,ab. OR randomised.ti,ab. OR randomization.ti,ab. OR randomisation.ti,ab. OR placebo.ti,ab. OR randomly.ti,ab. OR trial.ti,ab. OR groups.ti,ab.OR RCT.ti,ab.)	2863
#5 Pediatric-only exclusion	4 not ((exp adolescent/ or exp child/ or exp infant/) not exp adult/)	2816

Database: CINAHL Complete (via EBSCO)

Search date: 6/10/2021

Search set	Search strategy	Results
#1 Chronic pain terms and conditions	(MH "chronic pain") OR (MH "neuralgia+") OR (MH "fibromyalgia") OR (MH "arthritis, rheumatoid+") OR (MH "arthritis, psoriatic") OR (MH "gout") OR (MH "lupus erythematosus, systemic+") OR (MH "complex regional pain syndromes+") OR (MH "migraine") OR (MH "cluster headache") OR (MH "tension headache") OR (MH "interstitial cystitis") OR (MH "multiple sclerosis+") OR (MH "ehlers-danlos syndrome") OR (MH "neck pain") OR (MH "back pain+") OR (MH "low back pain") OR (MH "knee pain+") OR (MH "pelvic pain+") OR (MH "shoulder pain+") OR (MH "patellofemoral pain syndrome+") OR (MH "arthralgia+") OR (MH "abdominal pain+") OR (MH "myofascial pain syndromes+") OR (MH "facial pain+") OR (MH "chest pain+") OR (MH "facial neuralgia") OR (MH "phantom pain") OR (MH "muscle pain") OR (MH "metatarsalgia") OR (MH "osteoarthritis+") OR (((TI chronic* OR AB chronic*) OR (TI persisten* OR AB persisten*) OR (TI long-lasting OR AB long-lasting) OR (TI long-term OR AB long-term) OR (TI intermittent* OR AB intermittent*) OR (TI continuous OR AB continuous)) N3 ((TI pain* OR AB pain*) OR (TI ache* OR AB ache*) OR (TI myalg* OR AB myalg*) OR (TI arthralg* OR AB arthralg*) OR (TI allodynia OR AB allodynia) OR (TI arthrit* OR AB arthrit*) OR (TI spondyl* OR AB spondyl*) OR (TI neuropath* OR AB neuropath*) OR (TI radiculopath* OR AB radiculopath*))) OR (TI "consistent pain" OR AB "consistent pain") OR (TI "perpetual pain" OR AB "perpetual pain") OR (TI neuralgia OR AB neuralgia) OR (TI fibromyalgia OR AB fibromyalgia) OR (TI "rheumatoid arthritis" OR AB "rheumatoid arthritis") OR (TI "psoriatic arthritis" OR AB "psoriatic arthritis") OR (TI gout OR AB gout) OR (TI "systemic lupus erythematosus" OR AB "systemic lupus erythematosus") OR (TI "complex regional pain" OR AB "complex regional pain") OR (((TI cluster OR AB cluster) OR (TI tension OR AB tension)) N3 (TI headache* OR AB headache*)) OR (TI migrane* OR AB migrane*) OR (TI "interstitial cystitis" OR AB "interstitial cystitis") OR (TI "bladder pain syndrome" OR AB "bladder pain syndrome") OR (TI "multiple sclerosis" OR AB "multiple sclerosis") OR (TI "Ehlers-Danlos syndrome" OR AB "Ehlers-Danlos syndrome") OR (((TI MSK OR AB MSK) OR (TI musculo* OR AB	288921

Search set	Search strategy	Results
	musculo*) OR (TI muscular OR AB muscular) OR (TI joint OR AB joint) OR (TI joints OR AB joints) OR (TI radicular OR AB radicular) OR (TI shoulder* OR AB shoulder*) OR (TI "rotator cuff" OR AB "rotator cuff") OR (TI elbow* OR AB elbow*) OR (TI hip OR AB hip) OR (TI hips OR AB hips) OR (TI pelvic OR AB pelvic) OR (TI pelvis OR AB pelvis) OR (TI flank OR AB flank) OR (TI buttock OR AB buttock) OR (TI knee* OR AB knee*) OR (TI patell* OR AB patell*) OR (TI myofascial OR AB myofascial) OR (TI "phantom limb" OR AB "phantom limb")) N3 ((TI pain* OR AB pain*) OR (TI ache* OR AB ache*) OR (TI myalg* OR AB myalg*) OR (TI arthralg* OR AB arthralg*))) OR (TI osteoarthritis OR AB osteoarthritis) OR ((TI degenerative OR AB degenerative) N1 (TI joint OR AB joint) N1 (TI disease OR AB disease)) OR ((TI frozen OR AB frozen) N1 (TI shoulder* OR AB shoulder*)) OR (TI metatarsalgia OR AB metatarsalgia) OR (TI "pelvic floor disorder" OR AB "pelvic floor disorder") OR (TI "pelvic floor disorders" OR AB "pelvic floor disorders") OR (((TI back OR AB back) OR (TI low-back OR AB low-back) OR (TI spine OR AB spine) OR (TI spinal OR AB spinal) OR (TI thoracic OR AB thoracic) OR (TI vertebr* OR AB vertebr*) OR (TI intervertebr* OR AB intervertebr*) OR (TI sciatic OR AB sciatic) OR (TI lumbar OR AB lumbar) OR (TI lumbro* OR AB lumbro*) OR (TI lumbo* OR AB lumbo*)) N3 ((TI pain* OR AB pain*) OR (TI ache* OR AB ache*) OR (TI radiculopath* OR AB radiculopath*))) OR (TI lumbago OR AB lumbago) OR (TI sciatica OR AB sciatica) OR (((TI neck OR AB neck) OR (TI cervical OR AB cervical) OR (TI cervicodynia OR AB cervicodynia)) N3 ((TI pain* OR AB pain*) OR (TI ache* OR AB ache*) OR (TI radiculopath* OR AB radiculopath*))) OR (TI cervicalgia* OR AB cervicalgia*)	
#2 Tele / Video terms	(MH "Telemedicine+") OR (MH "Telerehabilitation") OR (MH "Telepyschiatry") OR (MH "Telehealth+") OR (MH "Remote Consultation") OR (MH "Videoconferencing+") OR (MH "Telenursing") OR (MH "Telephone") OR (MH "Cell Phone+") OR (MH "Computers, Hand-held+") OR ((TI videoconferenc* OR AB videoconferenc*) OR (TI video-conferenc* OR AB video-conferenc*) OR (TI webconferenc* OR AB webconferenc*) OR (TI web-conferenc* OR AB web-conferenc*) OR (TI webex OR AB webex) OR (TI zoom OR AB zoom) OR (TI skype OR AB skype) OR (TI ooVoo OR AB ooVoo) OR (TI FaceTime OR AB FaceTime) OR (TI Tango OR AB Tango) OR (TI GoToMeeting OR AB GoToMeeting) OR (TI web-delivered OR AB web-delivered) OR (TI internet-delivered OR AB internet-delivered) OR (TI computer-delivered OR AB computer-delivered)) OR (((TI remote* OR AB remote*) OR (TI video* OR AB video*) OR (TI internet OR AB internet) OR (TI internet-based OR AB internet-based) OR (TI web OR AB web) OR (TI web-based OR AB web-based) OR (TI online OR AB online) OR (TI online-based OR AB online-based) OR (TI computer OR AB computer) OR (TI computer-based OR AB computer-based)) N2 ((TI meet* OR AB meet*) OR (TI call* OR AB call*) OR (TI chat* OR AB chat*) OR (TI conferenc* OR AB conferenc*) OR (TI consult* OR AB consult*) OR (TI counsel* OR AB counsel*) OR (TI visit* OR AB visit*))) OR (((TI video* OR AB video*) OR (TI remote* OR AB remote*) OR (TI web-based OR AB web-based) OR (TI internet-based OR AB internet-based)) N2 (TI care OR AB care)) OR ((TI virtual OR AB virtual) OR (TI virtually OR AB virtually) OR (TI telepain OR AB telepain) OR (TI tele-pain OR AB tele-pain) OR (TI telehealth OR AB telehealth) OR (TI tele-health OR AB tele-health) OR (TI telemedicine OR AB telemedicine) OR (TI tele-medicine OR AB tele-medicine) OR (TI telemedical OR AB telemedical) OR (TI tele-medical OR AB tele-medical) OR (TI telecare OR AB telecare) OR (TI tele-care OR AB tele-care) OR	131328

Search set	Search strategy	Results
	(TI teleconsult* OR AB teleconsult*) OR (TI tele-consult* OR AB tele-consult*) OR (TI telecommunicat* OR AB telecommunicat*) OR (TI tele-communicat* OR AB tele-communicat*) OR (TI telemanag* OR AB telemanag*) OR (TI tele-manag* OR AB tele-manag*) OR (TI telehome OR AB telehome) OR (TI tele-home OR AB tele-home) OR (TI telepharmac* OR AB telepharmac*) OR (TI tele-pharmac* OR AB tele-pharmac*) OR (TI telecardiol* OR AB telecardiol*) OR (TI tele-cardiol* OR AB tele-cardiol*) OR (TI tele-cardiac OR AB tele-cardiac) OR (TI tele-rehabilitat* OR AB tele-rehabilitat*) OR (TI telerehabilitat* OR AB telerehabilitat*) OR (TI teleintervention* OR AB teleintervention*) OR (TI tele-intervention* OR AB tele-intervention*) OR (TI teleconferenc* OR AB teleconferenc*) OR (TI tele-conferenc* OR AB tele-conferenc*) OR (TI telephon* OR AB telephon*) OR (TI tele-phon* OR AB tele-phon*) OR (TI cellphon* OR AB cellphon*) OR (TI cell-phon* OR AB cell-phon*) OR (TI smartphon* OR AB smartphon*) OR (TI "mobile phone" OR AB "mobile phone") OR (TI "mobile phones" OR AB "mobile phones") OR (TI e-visit* OR AB e-visit*) OR (TI evisit* OR AB evisit*) OR (TI e-care OR AB e-care) OR (TI ecare OR AB ecare) OR (TI e-consult* OR AB e-consult*) OR (TI econsult* OR AB econsult*) OR (TI e-diagnos* OR AB e-diagnos*) OR (TI ediagnos* OR AB ediagnos*) OR (TI e-medicine OR AB e-medicine) OR (TI emedicine OR AB emedicine) OR (TI e-physician* OR AB e-physician*) OR (TI ephysician* OR AB ephysician*) OR (TI eclinician* OR AB eclinician*) OR (TI e-clinician* OR AB e-clinician*) OR (TI e-pharm* OR AB e-pharm*) OR (TI epharm* OR AB epharm*) OR (TI "communication technology" OR AB "communication technology") OR (TI "communication technologies" OR AB "communication technologies") OR (TI eHealth OR AB eHealth) OR (TI "e- health" OR AB "e- health") OR (TI "e health" OR AB "e health") OR (TI mHealth OR AB mHealth) OR (TI m-health OR AB m-health) OR (TI "m health" OR AB "m health") OR (TI wireless OR AB wireless)) OR (((TI mobile OR AB mobile) OR (TI digital OR AB digital)) W1 (TI health* OR AB health*)) OR ((TI tele OR AB tele) W1 ((TI care OR AB care) OR (TI diagnos* OR AB diagnos*) OR (TI health* OR AB health*) OR (TI intervention* OR AB intervention*) OR (TI manag* OR AB manag*) OR (TI therap* OR AB therap*) OR (TI treat* OR AB treat*) OR (TI medicine OR AB medicine) OR (TI medical OR AB medical) OR (TI prescrib* OR AB prescrib*) OR (TI prescript* OR AB prescript*) OR (TI pain OR AB pain)))	
#3 combining	S1 AND S2	4,153
#4 RCT filter	(ZT "randomized controlled trial") OR (MH "Randomized Controlled Trials") OR TI ("randomized controlled trial" OR "controlled clinical trial" OR randomized OR randomised OR randomization OR randomisation OR placebo OR randomly OR trial OR trials OR groups OR "single blind" OR "single blinded" OR "double blind" OR "double-blinded) OR AB ("randomized controlled trial" OR "controlled clinical trial" OR randomized OR randomised OR randomization OR randomisation OR placebo OR randomly OR trial OR trials OR groups OR "single blind" OR "single blinded" OR "double blind" OR "double-blinded)	295687
#5	S3 AND S4	607
#6 Animal-only exclusion	S5 NOT (((MH "Animals+") OR (MH "Animal Studies") OR (TI "animal model*")) NOT (MH "human"))	607

Search set	Search strategy	Results
#7 Pediatric-only exclusion	S6 NOT ((MH "Adolescence+" OR MH "Infant+" OR MH "Child+") NOT (MH "Adult+"))	585
#8 Study design exclusion	S7 NOT PT (Abstract OR Book OR Book Chapter OR Book Review OR Case Study OR Commentary OR Editorial OR Letter OR Masters Thesis OR Pamphlet OR Pamphlet Chapter OR Poetry)	538

APPENDIX B. EXCLUDED STUDIES

Exclude reasons: 1= Ineligible publication type, 2=Non-OECD, 3=Ineligible population, 4=Ineligible intervention, 5=Ineligible comparator, 6=Ineligible study design. (Reference list follows the table.)

Citation	Exclusion Reason
Ahn, 2020[1]	5
Amorim, 2016[2]	4
Azma, 2018[3]	2
Bekkelund, 2019[4]	4
Bennell, 2020[5]	5
Bennell, 2017[6]	5
Berglind, 2018[7]	3
Boersma, 2019[8]	4
Buhrman, 2004[9]	4
Buhrman, 2013[10]	4
Burke, 2019[11]	4
Carlos-Vivas, 2020[12]	5
Castro-Sanchez, 2020[13]	4
Cavalera, 2019[14]	3
Cooper, 2017[15]	4
Cottrell, 2019[16]	6
Dadarkhah, 2020[17]	2
Dagenais, 2021[18]	4
Davins Riu, 2018[19]	4
Day, 2020[20]	5
De Bruijn, 2007[21]	3
De Oliveira Silva, 2020[22]	4
de Thurah, 2018[23]	4
Dear, 2018[24]	4
Dear, 2015[25]	4
Dear, 2021[26]	4
Dear, 2016[27]	4
Dear, 2013[28]	4
Devineni, 2005[29]	4
Dobson, 2014[30]	5
Doiron-Cadrin, 2016[31]	6
Doiron-Cadrin, 2020[32]	6
Domenech, 2013[33]	4
Domenech, 2018[34]	4
Fanning, 2020[35]	4

Citation	Exclusion Reason
Fatoye, 2020[36]	2
Faux, 2018[37]	4
Finkelstein, 2020[38]	3
Fioratti, 2020[39]	2
Fjeldstad, 2016[40]	3
Flynn, 2017[41]	4
Fowler, 2019[42]	4
Friedman, 2019[43]	4
Friesen, 2017[44]	4
Galea Holmes, 2019[45]	4
Gannon, 2019[46]	5
Geraghty, 2020[47]	4
Gialanella, 2017[48]	4
Gohir, 2021[49]	4
Hale, 2021[50]	6
Hayes, 2014[51]	4
Heapy, 2020[52]	4
Heapy, 2017[53]	4
Hearn, 2018[54]	4
Hemphill, 2021[55]	4
Hernando-Garijo, 2021[56]	4
Hinman, 2020[57]	6
Isrctn, 2020[58]	1
Jacobs, 2021[59]	6
Jay, 2014[60]	3
Jongen, 2020[61]	3
Khan, 2020[62]	4
Klaren, 2014[63]	3
Kline, 2019[64]	4
Konstantinou, 2020[65]	4
Kosterink, 2010[66]	4
Kowatsch, 2021[67]	5
Kristjansdottir, 2013[68]	4
Kristjansdottir, [69]	4
Kroenke, 2019[70]	4
Lamargue, 2020[71]	3
Landtblom, 2019[72]	3
Lee, 2016[73]	1
Lee, 2018[74]	2
Licciardone, 2020[75]	4

Citation	Exclusion Reason
Lowe, 2021[76]	1
Mace, 2021[77]	5
Malliaras, 2020[78]	6
Mariano, 2021[79]	6
Martin, 2019[80]	4
Mayer, 2020[81]	4
Mbada, 2019[82]	4
McDonald, 2013[83]	5
McDonald, 2012[84]	4
Mecklenburg, 2018[85]	4
Mesa-Castrillon, 2021[86]	6
Moessner, 2012[87]	4
Moessner, 2014[88]	4
Monreal-Bartolome, 2019[89]	5
Moss-Morris, 2015[90]	3
Motl, 2018[91]	3
Motl, 2019[92]	3
Moumane, 2015[93]	1
Muller, 2016[94]	4
Müller, 2017[95]	4
Nct, 2021[96]	1
Nct, 2020[97]	4
Nct, 2020[98]	6
Nelligan, 2019[99]	4
Palacin-Marin, 2013[100]	4
Palyo, 2012[101]	6
Pardo, 2016[102]	3
Paul, 2019[103]	4
Peolsson, 2017[104]	4
Peolsson, 2019[105]	4
Peters, 2017[106]	4
Petrozzi, 2019[107]	4
Pilutti, 2014[108]	3
Prvu Bettger, 2020[109]	3
Raiszadeh, 2021[110]	4
Rickardsson, 2021[111]	4
Rickardsson, 2020[112]	4
Robb, 2019[113]	3
Robb, 2016[114]	3
Robson, 2019[115]	4

Citation	Exclusion Reason
Rutledge, 2018[116]	5
Sandsjo, 2010[117]	4
Sarig Bahat, 2018[118]	4
Shaw, 2017[119]	1
Shebib, 2019[120]	4
Shigaki, 2013[121]	4
Slattery, 2019[122]	4
Smith, 2019[123]	4
Steiner, 2020[124]	3
Tam, 2019[125]	3
Tan, 2015[126]	4
Tarakci, 2021[127]	3
Taylor-Gjevre, 2018[128]	4
Thurah, 2017[129]	1
Toelle, 2019[130]	4
Trompetter, 2015[131]	4
Trompetter, 2015[132]	4
Vallejo, 2015[133]	4
van Beek, 2020[134]	3
van den Berg, 2007[135]	3
van Tilburg, 2021[136]	4
Vranceanu, 2021[137]	3
Williamson, 2017[138]	1
Yeo, 2021[139]	4
Yilmaz Yelvar, 2017[140]	4
Ziegenfuss, 2018[141]	1

EXCLUDED STUDIES REFERENCE LIST

1. Ahn H, Galle K, Mathis KB, et al. Feasibility and efficacy of remotely supervised cranial electrical stimulation for pain in older adults with knee osteoarthritis: A randomized controlled pilot study. *Journal of Clinical Neuroscience.* 2020;77:128-133.

2. Amorim AB, Pappas E, Simic M, et al. Integrating Mobile health and Physical Activity to reduce the burden of Chronic low back pain Trial (IMPACT): a pilot trial protocol. *BMC Musculoskeletal Disorders.* 2016;17:36.

3. Azma K, RezaSoltani Z, Rezaeimoghaddam F, Dadarkhah A, Mohsenolhosseini S. Efficacy of tele-rehabilitation compared with office-based physical therapy in patients with knee osteoarthritis: A randomized clinical trial. *Journal of Telemedicine & Telecare.* 2018;24(8):560-565.

4. Bekkelund SI, Müller KI. Video consultations in medication overuse headache. A randomized controlled trial. *Brain and Behavior.* 2019;9(7).

5. Bennell KL, Keating C, Lawford BJ, et al. Better Knee, Better Me TM: effectiveness of two scalable health care interventions supporting self-management for knee osteoarthritis - protocol for a randomized controlled trial. *BMC Musculoskeletal Disorders.* 2020;21(1):160.

6. Bennell KL, Nelligan R, Dobson F, et al. Effectiveness of an Internet-Delivered Exercise and Pain-Coping Skills Training Intervention for Persons With Chronic Knee Pain: A Randomized Trial. *Annals of Internal Medicine.* 2017;166(7):453-462.

7. Berglind D, Nyberg G, Willmer M, Persson M, Wells M, Forsell Y. An eHealth program versus a standard care supervised health program and associated health outcomes in individuals with mobility disability: study protocol for a randomized controlled trial. *Trials [Electronic Resource].* 2018;19(1):258.

8. Boersma K, Sodermark M, Hesser H, Flink IK, Gerdle B, Linton SJ. Efficacy of a transdiagnostic emotion-focused exposure treatment for chronic pain patients with comorbid anxiety and depression: a randomized controlled trial. *Pain.* 2019;160(8):1708-1718.

9. Buhrman M, Faltenhag S, Strom L, Andersson G. Controlled trial of Internet-based treatment with telephone support for chronic back pain. *Pain.* 2004;111(3):368-377.

10. Buhrman M, Skoglund A, Husell J, et al. Guided internet-delivered acceptance and commitment therapy for chronic pain patients: a randomized controlled trial. *Behaviour Research & Therapy.* 2013;51(6):307-315.

11. Burke D, Lennon O, Blake C, et al. An internet-delivered cognitive behavioural therapy pain management programme for spinal cord injury pain: A randomized controlled trial. *European Journal of Pain.* 2019;23(7):1264-1282.

12. Carlos-Vivas J, Perez-Gomez J, Delgado-Gil S, et al. Cost-Effectiveness of "Tele-Square Step Exercise" for Falls Prevention in Fibromyalgia Patients: A Study Protocol. *International Journal of Environmental Research & Public Health [Electronic Resource].* 2020;17(3):21.

13. Castro-Sanchez AM, Mataran-Penarrocha GA, Gomez-Garcia S, et al. Study protocol randomised controlled trial comparison of cost-utility and cost-effectiveness of a face-to-face rehabilitation programme versus a telemedicine programme in the treatment of patients with chronic low back pain. *BMJ Open.* 2020;10(12):e040633.

14. Cavalera C, Rovaris M, Mendozzi L, et al. Online meditation training for people with multiple sclerosis: A randomized controlled trial. *Multiple Sclerosis.* 2019;25(4):610-617.

15. Cooper K, Klein S, Smith BH, Schofield P. Peer support for community dwelling older adults with chronic low back pain: a mixed-methods feasibility study. *Physiotherapy.* 2017;103:e117-e118.

16. Cottrell MA, O'Leary SP, Raymer M, Hill AJ, Comans T, Russell TG. Does telerehabilitation result in inferior clinical outcomes compared with in-person care for the

management of chronic musculoskeletal spinal conditions in the tertiary hospital setting? A non-randomised pilot clinical trial. *Journal of telemedicine and telecare.* 2019:1357633X19887265.

17. Dadarkhah A, Rezaimoghadam F, Najafi S, Mohebi B, Azarakhsh A, Rezasoltani Z. Remote Versus in-Person Exercise Instruction for Chronic Nonspecific Low Back Pain Lasting 12 Weeks or Longer: A Randomized Clinical Trial. *Journal of the National Medical Association.* 2020;18:18.

18. Dagenais S, Hayflinger DC, Mayer JM. Economic Evaluation of an Extended Telehealth Worksite Exercise Intervention to Reduce Lost Work Time from Low Back Pain in Career Firefighters. *Journal of Occupational Rehabilitation.* 2021;31(2):431-443.

19. Davins Riu M, Borràs Pérez X, Artigas Raventós V, Palomera Fanegas E, Serra Prat M, Alós Villacrosa J. Use of Telehealth as a New Model for Following Intermittent Claudication and Promoting Patient Expertise. *Telemedicine journal and e-health : the official journal of the American Telemedicine Association.* 2018;24(10):773-781.

20. Day MA, Ehde DM, Burns J, et al. A randomized trial to examine the mechanisms of cognitive, behavioral and mindfulness-based psychosocial treatments for chronic pain: Study protocol. *Contemporary Clinical Trials.* 2020;93:106000.

21. De Bruijn C, de Bie R, Geraets J, et al. General practitioners apply the usual care for shoulder complaints better than expected--analysis of videotaped consultations. *BMC Family Practice.* 2007;8:13.

22. De Oliveira Silva D, Pazzinatto MF, Crossley KM, Azevedo FM, Barton CJ. Novel Stepped Care Approach to Provide Education and Exercise Therapy for Patellofemoral Pain: Feasibility Study. *Journal of Medical Internet Research.* 2020;22(7):e18584.

23. de Thurah A, Stengaard-Pedersen K, Axelsen M, et al. Tele-Health Followup Strategy for Tight Control of Disease Activity in Rheumatoid Arthritis: Results of a Randomized Controlled Trial. *Arthritis care & research.* 2018;70(3):353-360.

24. Dear BF, Gandy M, Karin E, et al. The Pain Course: 12- and 24-Month Outcomes From a Randomized Controlled Trial of an Internet-Delivered Pain Management Program Provided With Different Levels of Clinician Support. *Journal of Pain.* 2018;19(12):1491-1503.

25. Dear BF, Gandy M, Karin E, et al. The Pain Course: a randomised controlled trial examining an internet-delivered pain management program when provided with different levels of clinician support. *Pain.* 2015;156(10):1920-1935.

26. Dear BF, Karin E, Fogliati R, et al. A Cost-effectiveness Analysis of an Internet-delivered Pain Management Program Delivered With Different Levels of Clinician Support: Results From a Randomised Controlled Trial. *Journal of Pain.* 2021;22(3):344-358.

27. Dear BF, Gandy M, Karin E, et al. The Pain Course: exploring predictors of clinical response to an Internet-delivered pain management program. *Pain.* 2016;157(10):2257-2268.

28. Dear BF, Titov N, Perry KN, et al. The Pain Course: a randomised controlled trial of a clinician-guided Internet-delivered cognitive behaviour therapy program for managing chronic pain and emotional well-being. *Pain.* 2013;154(6):942-950.

29. Devineni T, Blanchard EB. A randomized controlled trial of an internet-based treatment for chronic headache. *Behaviour Research & Therapy.* 2005;43(3):277-292.

30. Dobson F, Hinman RS, French S, 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 Musculoskeletal Disorders.* 2014;15:279.

31. Doiron-Cadrin P, Kairy D, Vendittoli PA, Lowry V, Poitras S, Desmeules F. Effects of a tele-prehabilitation program or an in-person prehabilitation program in surgical candidates awaiting total hip or knee arthroplasty: Protocol of a pilot single blind randomized controlled trial. *Contemporary Clinical Trials Communications.* 2016;4:192-198.

32. Doiron-Cadrin P, Kairy D, Vendittoli PA, Lowry V, Poitras S, Desmeules F. Feasibility and preliminary effects of a tele-prehabilitation program and an in-person prehablitation program compared to usual care for total hip or knee arthroplasty candidates: a pilot randomized controlled trial. *Disability and rehabilitation.* 2020;42(7):989-998.

33. Domenech J, Banos R, Penalver L, et al. Design considerations of a randomized clinical trial on a cognitive behavioural intervention using communication and information technologies for managing chronic low back pain. *BMC Musculoskeletal Disorders.* 2013;14:142.

34. Domenech J, Penalver L, Rio ED, et al. Cognitive behavioural therapy supported with information and communication technologies in the treatment of chronic low back pain: a randomized clinical trial. *European spine journal.* 2018;27.

35. Fanning J, Brooks AK, Ip E, et al. A Mobile Health Behavior Intervention to Reduce Pain and Improve Health in Older Adults With Obesity and Chronic Pain: The MORPH Pilot Trial. *Frontiers in Digital Health.* 2020;2.

36. Fatoye F, Gebrye T, Fatoye C, et al. The Clinical and Cost-Effectiveness of Telerehabilitation for People With Nonspecific Chronic Low Back Pain: Randomized Controlled Trial. *JMIR MHealth and UHealth.* 2020;8(6):e15375.

37. Faux SG, Gardner T, Schultz R, et al. 'Reboot Online': a randomised controlled trial demonstrating that an internet-delivered multidsipclinary pain management program is effective in chronic pain. *Neurorehabilitation and neural repair.* 2018;32(4-5):354-355.

38. Finkelstein J, Jeong I, Karpatkin H. Physical telerehabilitation ameliorates impact of multiple sclerosis in a randomized control trial. *Multiple sclerosis journal.* 2020;26(1 SUPPL):159-.

39. Fioratti I, Saragiotto BT, Reis FJJ, et al. Evaluation of the efficacy of an internet-based pain education and exercise program for chronic musculoskeletal pain in comparison with online self-management booklet: a protocol of a randomised controlled trial with assessor-blinded, 12-month follow-up, and economic evaluation. *BMC Musculoskeletal Disorders.* 2020;21(1):404.

40. Fjeldstad C, Thiessen A, Pardo G. Telerehabilitation in multiple sclerosis: results of a randomized, 3-arm, rater blinded, feasibility and efficacy pilot study; patient-reported outcomes report. *Multiple sclerosis.* 2016;22(390).

41. Flynn DM, Eaton LH, McQuinn H, et al. TelePain: Primary Care Chronic Pain Management through Weekly Didactic and Case-based Telementoring. *Contemporary Clinical Trials Communications.* 2017;8:162-166.

42. Fowler CA, Ballistrea LM, Mazzone KE, et al. A virtual reality intervention for fear of movement for Veterans with chronic pain: protocol for a feasibility study. *Pilot & Feasibility Studies.* 2019;5:146.

43. Friedman DI, Rajan B, Seidmann A. A randomized trial of telemedicine for migraine management. *Cephalalgia.* 2019;39(12):1577-1585.

44. Friesen LN, Hadjistavropoulos HD, Schneider LH, Alberts NM, Titov N, Dear BF. Examination of an Internet-Delivered Cognitive Behavioural Pain Management Course for Adults with Fibromyalgia: A Randomized Controlled Trial. *Pain.* 2017;158(4):593-604.

45. Galea Holmes MN, Weinman JA, Bearne LM. A randomized controlled feasibility trial of a home-based walking behavior-change intervention for people with intermittent claudication. *Journal of vascular nursing : official publication of the Society for Peripheral Vascular Nursing.* 2019;37(2):135-143.

46. Gannon J, Atkinson JH, Chircop-Rollick T, et al. Telehealth Therapy Effects of Nurses and Mental Health Professionals From 2 Randomized Controlled Trials for Chronic Back Pain. *Clinical Journal of Pain.* 2019;35(4):295-303.

47. Geraghty AWA, Roberts L, Hill J, et al. Supporting self-management of low back pain with an internet intervention in primary care: a protocol for a randomised controlled trial of clinical and cost-effectiveness (SupportBack 2). *BMJ Open.* 2020;10(8):e040543.

48. Gialanella B, Ettori T, Faustini S, et al. Home-Based Telemedicine in Patients with Chronic Neck Pain. *American Journal of Physical Medicine & Rehabilitation.* 2017;96(5):327-332.

49. Gohir SA, Eek F, Kelly A, Abhishek A, Valdes AM. Effectiveness of Internet-Based Exercises Aimed at Treating Knee Osteoarthritis: The iBEAT-OA Randomized Clinical Trial. *JAMA Network Open.* 2021;4(2):e210012.

50. Hale L, Devan H, Davies C, et al. Clinical and cost-effectiveness of an online-delivered group-based pain management programme in improving pain-related disability for people with persistent pain-protocol for a non-inferiority randomised controlled trial (iSelf-help trial). *BMJ Open.* 2021;11(2):e046376.

51. Hayes S, Hogan M, Dowd H, et al. Comparing the clinical-effectiveness and cost-effectiveness of an internet-delivered Acceptance and Commitment Therapy (ACT) intervention with a waiting list control among adults with chronic pain: study protocol for a randomised controlled trial. *BMJ Open.* 2014;4(7):e005092.

52. Heapy AA, Driscoll MA, Buta E, et al. Co-Operative Pain Education and Self-management (COPES) Expanding Treatment for Real-World Access (ExTRA): Pragmatic Trial Protocol. *Pain Medicine.* 2020;21(12 Suppl 2):S21-S28.

53. Heapy AA, Higgins DM, Goulet JL, et al. Interactive Voice Response-Based Self-management for Chronic Back Pain: The COPES Noninferiority Randomized Trial. *JAMA Internal Medicine.* 2017;177(6):765-773.

54. Hearn JH, Finlay KA. Internet-delivered mindfulness for people with depression and chronic pain following spinal cord injury: a randomized, controlled feasibility trial. *Spinal Cord.* 2018;56(8):750-761.

55. Hemphill S, Rodriguez S, Wang E, et al. Virtual Reality Augments Movement during Physical Therapy: A Pragmatic Randomized Trial. *American Journal of Physical Medicine & Rehabilitation.* 2021;30:30.

56. Hernando-Garijo I, Ceballos-Laita L, Mingo-Gomez MT, et al. Immediate Effects of a Telerehabilitation Program Based on Aerobic Exercise in Women with Fibromyalgia. *International Journal of Environmental Research & Public Health [Electronic Resource].* 2021;18(4):20.

57. Hinman RS, Kimp AJ, Campbell PK, et al. Technology versus tradition: a non-inferiority trial comparing video to face-to-face consultations with a physiotherapist for people with knee osteoarthritis. Protocol for the PEAK randomised controlled trial. *BMC Musculoskeletal Disorders.* 2020;21(1):522.

58. Isrctn. E-rehab for Knee Pain. *http://www.who.int/trialsearch/Trial2.aspx?TrialID=ISRCTN15564385.* 2020.

59. Jacobs CA, Mace RA, Greenberg J, et al. Development of a mind body program for obese knee osteoarthritis patients with comorbid depression. *Contemporary Clinical Trials Communications.* 2021;21:100720.

60. Jay K, Schraefel MC, Brandt M, Andersen LL. Effect of video-based versus personalized instruction on errors during elastic tubing exercises for musculoskeletal pain: a randomized controlled trial. *BioMed Research International.* 2014;2014:790937.

61. Jongen PJ, Ter Veen G, Lemmens W, Donders R, van Noort E, Zeinstra E. The Interactive Web-Based Program MSmonitor for Self-Management and Multidisciplinary Care in Persons With Multiple Sclerosis: Quasi-Experimental Study of Short-Term Effects on Patient Empowerment. *Journal of Medical Internet Research.* 2020;22(3):e14297.

62. Khan F, Granville N, Malkani R, Chathampally Y. Health-Related Quality of Life Improvements in Systemic Lupus Erythematosus Derived from a Digital Therapeutic Plus Tele-Health Coaching Intervention: Randomized Controlled Pilot Trial. *Journal of Medical Internet Research.* 2020;22(10):e23868.

63. Klaren RE, Hubbard EA, Motl RW. Efficacy of a behavioral intervention for reducing sedentary behavior in persons with multiple sclerosis: a pilot examination. *American Journal of Preventive Medicine*. 2014;47(5):613-616.

64. Kline PW, Melanson EL, Sullivan WJ, et al. Improving Physical Activity Through Adjunct Telerehabilitation Following Total Knee Arthroplasty: Randomized Controlled Trial Protocol. *Physical Therapy*. 2019;99(1):37-45.

65. Konstantinou K, Lewis M, Dunn KM, et al. Stratified care versus usual care for management of patients presenting with sciatica in primary care (SCOPiC): a randomised controlled trial. *The Lancet Rheumatology*. 2020;2(7):e401-e411.

66. Kosterink SM, Huis in 't Veld RM, Cagnie B, Hasenbring M, Vollenbroek-Hutten MM. The clinical effectiveness of a myofeedback-based teletreatment service in patients with non-specific neck and shoulder pain: a randomized controlled trial. *Journal of Telemedicine & Telecare*. 2010;16(6):316-321.

67. Kowatsch T, Lohse KM, Erb V, et al. Hybrid Ubiquitous Coaching With a Novel Combination of Mobile and Holographic Conversational Agents Targeting Adherence to Home Exercises: Four Design and Evaluation Studies. *Journal of Medical Internet Research.* 2021;23(2):e23612.

68. Kristjansdottir OB, Fors EA, Eide E, et al. A smartphone-based intervention with diaries and therapist-feedback to reduce catastrophizing and increase functioning in women with chronic widespread pain: randomized controlled trial. *Journal of Medical Internet Research.* 2013;15(1):e5.

69. Kristjansdottir OB, Fors EA, Eide E, et al. The effect of web-based diaries and situational feedback on catastrophizing in women with chronic widespread pain - A randomized trial. *European Journal of Pain Supplements*.5(1):259-260.

70. Kroenke K, Baye F, Lourens SG, et al. Automated Self-management (ASM) vs. ASM-Enhanced Collaborative Care for Chronic Pain and Mood Symptoms: the CAMMPS Randomized Clinical Trial. *Journal of General Internal Medicine.* 2019;34(9):1806-1814.

71. Lamargue D, Koubiyr I, Deloire M, et al. Effect of cognitive rehabilitation on neuropsychological and semiecological testing and on daily cognitive functioning in multiple sclerosis: The REACTIV randomized controlled study. *Journal of the Neurological Sciences.* 2020;415:116929.

72. Landtblom AM, Guala D, Martin C, et al. RebiQoL: A randomized trial of telemedicine patient support program for health-related quality of life and adherence in people with MS treated with Rebif. *PLoS ONE [Electronic Resource]*. 2019;14(7):e0218453.

73. Lee MH, Wu HC, Chen WC, Chen YF. Multidisciplinary self-management telecare system may improve quality of life in patients with interstitial cystitis / bladder pain syndrome (IC/BPS)-a randomized controlled trial. *Neurourology and urodynamics.* 2016;35:S94-S95.

74. Lee MH, Wu HC, Tseng CM, Ko TL, Weng TJ, Chen YF. Health Education and Symptom Flare Management Using a Video-based m-Health System for Caring Women With IC/BPS. *Urology.* 2018;119:62-69.

75. Licciardone JC, Pandya V. Feasibility Trial of an eHealth Intervention for Health-Related Quality of Life: Implications for Managing Patients with Chronic Pain during the COVID-19 Pandemic. *Healthcare.* 2020;8(4):01.

76. Lowe R, Barlow C, Lloyd B, et al. Lifestyle, Exercise and Activity Package for People living with Progressive Multiple Sclerosis (LEAP-MS): adaptions during the COVID-19 pandemic and remote delivery for improved efficiency. *Trials.* 2021;22(1):286.

77. Mace RA, Doorley JD, Popok PJ, Vranceanu AM. Live Video Adaptations to a Mind-Body Activity Program for Chronic Pain and Cognitive Decline: Protocol for the Virtual Active Brains Study. *JMIR Research Protocols.* 2021;10(1):e25351.

78. Malliaras P, Cridland K, Hopmans R, et al. Internet and Telerehabilitation-Delivered Management of Rotator Cuff-Related Shoulder Pain (INTEL Trial): Randomized Controlled Pilot and Feasibility Trial. *JMIR MHealth and UHealth.* 2020;8(11):e24311.

79. Mariano TY, Wan L, Edwards RR, Lazaridou A, Ross EL, Jamison RN. Online group pain management for chronic pain: Preliminary results of a novel treatment approach to teletherapy. *Journal of Telemedicine & Telecare.* 2021;27(4):209-216.

80. Martin KR, Bachmair EM, Aucott L, et al. Protocol for a multicentre randomised controlled parallel-group trial to compare the effectiveness of remotely delivered cognitive-behavioural and graded exercise interventions with usual care alone to lessen the impact of fatigue in inflammatory rheumatic diseases (LIFT). *BMJ Open.* 2019;9(1).

81. Mayer JM, Lane CL, Brady O, et al. Comparison of Supervised and Telehealth Delivery of Worksite Exercise for Prevention of Low Back Pain in Firefighters: A Cluster Randomized Trial. *Journal of Occupational & Environmental Medicine.* 2020;62(10):e586-e592.

82. Mbada CE, Olaoye MI, Dada OO, et al. Comparative Efficacy of Clinic-Based and Telerehabilitation Application of Mckenzie Therapy in Chronic Low-Back Pain. *International Journal of Telerehabilitation.* 2019;11(1):41-58.

83. McDonald DD, Walsh S, Vergara C, Gifford T. Effect of a virtual pain coach on pain management discussions: a pilot study. *Pain Management Nursing.* 2013;14(4):200-209.

84. McDonald DD, Walsh S, Vergara C, Gifford T, Weiner DK. The effect of a Spanish virtual pain coach for older adults: a pilot study. *Pain Medicine.* 2012;13(11):1397-1406.

85. Mecklenburg G, Smittenaar P, Erhart-Hledik JC, Perez DA, Hunter S. Effects of a 12-Week Digital Care Program for Chronic Knee Pain on Pain, Mobility, and Surgery Risk: Randomized Controlled Trial. *Journal of Medical Internet Research.* 2018;20(4):e156.

86. Mesa-Castrillon CI, Simic M, Ferreira ML, et al. EHealth to empower patients with musculoskeletal pain in rural Australia (EMPoweR) a randomised clinical trial: study protocol. *BMC Musculoskeletal Disorders.* 2021;22(1):11.

87. Moessner M, Schiltenwolf M, Neubauer E. Internet-based aftercare for patients with back pain-a pilot study. *Telemedicine Journal & E-Health.* 2012;18(6):413-419.

88. Moessner M, Aufdermauer N, Baier C, et al. [Efficacy of an internet-delivered aftercare program for patients with chronic back pain]. *Psychotherapie, Psychosomatik, Medizinische Psychologie.* 2014;64(2):47-53.

89. Monreal-Bartolome A, Barcelo-Soler A, Castro A, et al. Efficacy of a blended low-intensity internet-delivered psychological programme in patients with multimorbidity in primary care: study protocol for a randomized controlled trial. *BMC Psychiatry.* 2019;19(1):66.

90. Moss-Morris R, Bogosian A, Chadwick P, McCrone P, Norton S. A pilot randomized controlled trial of the clinical and cost effectiveness of a skype delivered group mindfulness intervention for distressed people with progressive multiple sclerosis. *Psychosomatic medicine.* 2015;77(3):A20-A21.

91. Motl RW, Sandroff BM, Wingo BC, et al. Phase-III, randomized controlled trial of the behavioral intervention for increasing physical activity in multiple sclerosis: Project BIPAMS. *Contemporary Clinical Trials.* 2018;71:154-161.

92. Motl RW, Backus D, Neal WN, et al. Rationale and design of the STEP for MS Trial: Comparative effectiveness of Supervised versus Telerehabilitation Exercise Programs for Multiple Sclerosis. *Contemporary Clinical Trials.* 2019;81:110-122.

93. Moumane N, Lozeron P, Viala K, et al. A medico-economic study with the stepped wedge cluster randomized controlled trial design to assess efficiency (cost-effectiveness) of a telemedicine system for the management of home-based ivig treated patients with chronic inflammatory neuropathies. *Journal of the peripheral nervous system : JPNS.* 2015;20(2):195-196.

94. Muller KI, Alstadhaug KB, Bekkelund SI. Acceptability, Feasibility, and Cost of Telemedicine for Nonacute Headaches: A Randomized Study Comparing Video and Traditional Consultations. *Journal of Medical Internet Research.* 2016;18(5):e140.

95. Müller KI, Alstadhaug KB, Bekkelund SI. Telemedicine in the management of non-acute headaches: A prospective, open-labelled non-inferiority, randomised clinical trial. *Cephalalgia.* 2017;37(9):855-863.

96. Nct. Feasibility and Impact of a Tele-rehabilitation Program in Patients With Chronic and Non-specific Neck Pain. *https://clinicaltrials.gov/show/NCT04841642.* 2021.

97. Nct. TelemEdiciNe-bAsed Cognitive TherapY for Migraines. *https://clinicaltrials.gov/show/NCT04613362.* 2020.

98. Nct. EMG Biofeedback Treatment for Chronic Low Back Pain. *https://clinicaltrials.gov/show/NCT04607460.* 2020.

99. Nelligan RK, Hinman RS, Kasza J, Bennell KL. Effectiveness of internet-delivered education and home exercise supported by behaviour change SMS on pain and function for people with knee osteoarthritis: a randomised controlled trial protocol. *BMC Musculoskeletal Disorders.* 2019;20(1):342.

100. Palacin-Marin F, Esteban-Moreno B, Olea N, Herrera-Viedma E, Arroyo-Morales M. Agreement between telerehabilitation and face-to-face clinical outcome assessments for low back pain in primary care. *Spine.* 2013;38(11):947-952.

101. Palyo SA, Schopmeyer KA, McQuaid JR. Tele-pain management: Use of videoconferencing technology in the delivery of an integrated cognitive-behavioral and physical therapy group intervention. *Psychological Services.* 2012;9(2):200-202.

102. Pardo G, Thiessen A, Fjeldstad C. Telerehabilitation in multiple sclerosis: results of a randomized, 3-arm, rater blinded, feasibility and efficacy pilot study; gait and balance report. *Multiple sclerosis.* 2016;22(30).

103. Paul L, Renfrew L, Freeman J, et al. Web-based physiotherapy for people affected by multiple sclerosis: a single blind, randomized controlled feasibility study. *Clinical Rehabilitation.* 2019;33(3):473-484.

104. Peolsson A, Landen Ludvigsson M, Peterson G. Neck-specific exercises with internet-based support compared to neck-specific exercises at a physiotherapy clinic for chronic whiplash-associated disorders: study protocol of a randomized controlled multicentre trial. *BMC Musculoskeletal Disorders.* 2017;18(1):524.

105. Peolsson A, Peterson G, Hermansen A, Ludvigsson ML, Dedering A, Lofgren H. Physiotherapy after anterior cervical spine surgery for cervical disc disease: study protocol of a prospective randomised study to compare internet-based neck-specific exercise with prescribed physical activity. *BMJ Open.* 2019;9(2):e027387.

106. Peters ML, Smeets E, Feijge M, et al. Happy Despite Pain: A Randomized Controlled Trial of an 8-Week Internet-delivered Positive Psychology Intervention for Enhancing Well-being in Patients With Chronic Pain. *Clinical Journal of Pain.* 2017;33(11):962-975.

107. Petrozzi MJ, Leaver A, Ferreira PH, Rubinstein SM, Jones MK, Mackey MG. Addition of MoodGYM to physical treatments for chronic low back pain: A randomized controlled trial. *Chiropractic & manual therapies.* 2019;27:54.

108. Pilutti LA, Dlugonski D, Sandroff BM, Klaren R, Motl RW. Randomized controlled trial of a behavioral intervention targeting symptoms and physical activity in multiple sclerosis. *Multiple Sclerosis.* 2014;20(5):594-601.

109. Prvu Bettger J, Green CL, Holmes DN, et al. Effects of Virtual Exercise Rehabilitation In-Home Therapy Compared with Traditional Care After Total Knee Arthroplasty: VERITAS, a

Randomized Controlled Trial. *Journal of Bone & Joint Surgery - American Volume.* 2020;102(2):101-109.

110. Raiszadeh K, Tapicer J, Taitano L, Wu J, Shahidi B. In-Clinic Versus Web-Based Multidisciplinary Exercise-Based Rehabilitation for Treatment of Low Back Pain: Prospective Clinical Trial in an Integrated Practice Unit Model. *Journal of Medical Internet Research.* 2021;23(3):e22548.

111. Rickardsson J, Gentili C, Holmstrom L, et al. Internet-delivered acceptance and commitment therapy as microlearning for chronic pain: A randomized controlled trial with 1-year follow-up. *European Journal of Pain.* 2021;25(5):1012-1030.

112. Rickardsson J, Zetterqvist V, Gentili C, et al. Internet-delivered acceptance and commitment therapy (iACT) for chronic pain-feasibility and preliminary effects in clinical and self-referred patients. *Began with 2015.* 2020;6:27.

113. Robb JF, Hyland MH, Goodman AD. Comparison of telemedicine versus in-person visits for persons with multiple sclerosis: A randomized crossover study of feasibility, cost, and satisfaction. *Multiple Sclerosis and Related Disorders.* 2019;36:101258.

114. Robb JF, Hyland MH, Goodman AD. Comparison of cost, feasibility and satisfaction of telemedicine versus in-person visits for multiple sclerosis patients: a randomised cross-over study. *Multiple sclerosis.* 2016;22(147).

115. Robson EK, Kamper SJ, Davidson S, et al. Healthy Lifestyle Program (HeLP) for low back pain: protocol for a randomised controlled trial. *BMJ Open.* 2019;9(9):e029290.

116. Rutledge T, Atkinson JH, Holloway R, et al. Randomized Controlled Trial of Nurse-Delivered Cognitive-Behavioral Therapy Versus Supportive Psychotherapy Telehealth Interventions for Chronic Back Pain. *Journal of Pain.* 2018;19(9):1033-1039.

117. Sandsjo L, Larsman P, Huis in 't Veld RM, Vollenbroek-Hutten MM. Clinical evaluation of a myofeedback-based teletreatment service applied in the workplace: a randomized controlled trial. *Journal of Telemedicine & Telecare.* 2010;16(6):329-335.

118. Sarig Bahat H, Croft K, Carter C, Hoddinott A, Sprecher E, Treleaven J. Remote kinematic training for patients with chronic neck pain: a randomised controlled trial. *European Spine Journal.* 2018;27(6):1309-1323.

119. Shaw M, Dobbs B, Pawlak N, Pau W, Charvet L. At-home transcranial direct current stimulation (tDCS) improves mood in multiple sclerosis: results from a randomized, sham-controlled trial. *Multiple sclerosis journal.* 2017;23(3):962-.

120. Shebib R, Bailey JF, Smittenaar P, Perez DA, Mecklenburg G, Hunter S. Randomized controlled trial of a 12-week digital care program in improving low back pain. *npj Digital Medicine.* 2019;2(1).

121. Shigaki CL, Smarr KL, Siva C, Ge B, Musser D, Johnson R. RAHelp: an online intervention for individuals with rheumatoid arthritis. *Arthritis care & research.* 2013;65(10):1573-1581.

122. Slattery BW, O'Connor LL, Haugh S, et al. Investigating the effectiveness of an online acceptance and commitment therapy (ACT) intervention versus a waiting list control condition on pain interference and quality of life in adults with chronic pain and multimorbidity: protocol for a randomised controlled trial. *BMJ Open.* 2019;9(5):e012671.

123. Smith J, Faux SG, Gardner T, et al. Reboot Online: A Randomized Controlled Trial Comparing an Online Multidisciplinary Pain Management Program with Usual Care for Chronic Pain. *Pain Medicine.* 2019;20(12):2385-2396.

124. Steiner B, Elgert L, Saalfeld B, et al. Health-Enabling Technologies for Telerehabilitation of the Shoulder: A Feasibility and User Acceptance Study. *Methods of Information in Medicine.* 2020;59(S 02):e90-e99.

125. Tam J, Lacaille D, Liu-Ambrose T, et al. Effectiveness of an online self-management tool, OPERAS (an On-demand Program to EmpoweR Active Self-management), for people with rheumatoid arthritis: a research protocol. *Trials [Electronic Resource].* 2019;20(1):712.

126. Tan G, Rintala DH, Jensen MP, Fukui T, Smith D, Williams W. A randomized controlled trial of hypnosis compared with biofeedback for adults with chronic low back pain. *European Journal of Pain.* 2015;19(2):271-280.

127. Tarakci E, Tarakci D, Hajebrahimi F, Budak M. Supervised exercises versus telerehabilitation. Benefits for persons with multiple sclerosis. *Acta Neurologica Scandinavica.* 2021;07:07.

128. Taylor-Gjevre R, Nair B, Bath B, et al. Addressing rural and remote access disparities for patients with inflammatory arthritis through video-conferencing and innovative inter-professional care models. *Musculoskeletal Care.* 2018;16(1):90-95.

129. Thurah A, Steengaard-Pedersen K, Axelsen M, et al. A TELE-health follow-up strategy for tight control of disease activity in rheumatoid arthritis: results of the non-inferiority randomised controlled trail (the Tera study). *Annals of the rheumatic diseases.* 2017;76:454-455.

130. Toelle TR, Utpadel-Fischler DA, Haas KK, Priebe JA. App-based multidisciplinary back pain treatment versus combined physiotherapy plus online education: a randomized controlled trial. *Npj Digital Medicine.* 2019;2:34.

131. Trompetter HR, Bohlmeijer ET, Fox JP, Schreurs KM. Psychological flexibility and catastrophizing as associated change mechanisms during online Acceptance & Commitment Therapy for chronic pain. *Behaviour Research & Therapy.* 2015;74:50-59.

132. Trompetter HR, Bohlmeijer ET, Veehof MM, Schreurs KM. Internet-based guided self-help intervention for chronic pain based on Acceptance and Commitment Therapy: a randomized controlled trial. *Journal of Behavioral Medicine.* 2015;38(1):66-80.

133. Vallejo MA, Ortega J, Rivera J, Comeche MI, Vallejo-Slocker L. Internet versus face-to-face group cognitive-behavioral therapy for fibromyalgia: A randomized control trial. *Journal of Psychiatric Research.* 2015;68:106-113.

134. van Beek JJW, van Wegen EEH, Rietberg MB, et al. Feasibility of a Home-Based Tablet App for Dexterity Training in Multiple Sclerosis: Usability Study. *JMIR MHealth and UHealth.* 2020;8(6):e18204.

135. van den Berg MH, Ronday HK, Peeters AJ, et al. Engagement and satisfaction with an Internet-based physical activity intervention in patients with rheumatoid arthritis. *Rheumatology.* 2007;46(3):545-552.

136. van Tilburg ML, Kloek CJJ, Pisters MF, et al. Stratified care integrated with eHealth versus usual primary care physiotherapy in patients with neck and/or shoulder complaints: protocol for a cluster randomized controlled trial. *BMC Musculoskeletal Disorders.* 2021;22(1):143.

137. Vranceanu AM, Bakhshaie J, Reichman M, et al. A Live Video Program to Prevent Chronic Pain and Disability in At-Risk Adults With Acute Orthopedic Injuries (Toolkit for Optimal Recovery): Protocol for a Multisite Feasibility Study. *JMIR Research Protocols.* 2021;10(4):e28155.

138. Williamson OD. 2017 - An online exercise program plus automated coping skills raining improved pain and function in chronic knee pain. *ACP Journal Club.* 2017;166(12):6-6.

139. Yeo SM, Lim JY, Do JG, Lim JY, In Lee J, Hwang JH. Effectiveness of interactive augmented reality-based telerehabilitation in patients with adhesive capsulitis: protocol for a multi-center randomized controlled trial. *BMC Musculoskeletal Disorders.* 2021;22(1):386.

140. Yilmaz Yelvar GD, Cirak Y, Dalkilinc M, Parlak Demir Y, Guner Z, Boydak A. Is physiotherapy integrated virtual walking effective on pain, function, and kinesiophobia in patients with non-specific low-back pain? Randomised controlled trial. *European Spine Journal.* 2017;26(2):538-545.

141. Ziegenfuss J, Benitez GV, Lawson K, Whitebird R, Grossman E, Fricton JR. PACT-a transformative selfmanagement program for chronic pain utilizing online education and telehealth coaching. *Global advances in health and medicine.* 2018;7:223-224.

APPENDIX C. OUTCOMES REPORTED IN IDENTIFIED LITERATURE

Study	Type of outcome	Outcomes
Psychologically Informed Intervention		
Herbert, 2017[15]	Pain outcomes	- Brief Pain Inventory Short Form Interference Scale (BPI) - interference - Brief Pain Inventory Short Form Interference Scale (BPI) -severity - Patient Health Questionnaire (PHQ) - 9 - Chronic Pain Acceptance Questionnaire-revised (CPAQ) - Pain Anxiety Symptoms Scale-Short Form (PASS-20)
	Patient-reported functional measures	- West Haven-Yale Multidimensional Pain Inventory (MPI) - Activity
	Quality-of-life outcomes	- Medical Outcomes Study 12-Item Short Form Health Survey (SF12) - Mental Component Summary - Medical Outcomes Study 12-Item Short Form Health Survey (SF12) - Physical Component Summary
	Other patient-reported outcomes	- Depressive symptoms (PHQ-9) - Pittsburgh Sleep Quality Index (PSQI) - Credibility and Expectancy Questionnaire-Participant expectancies for improvement - Client Satisfaction Questionnaire (CSQ)
Pilot Study		
Doiron-Cadrin, 2020[16]	Patient-reported functional measures	- Total Lower Extremity Functional Scale (LEFS) - Total Western Ontario and McMaster universities osteoarthritis index (WOMAC) - pain (0–20) - Total Western Ontario and McMaster universities osteoarthritis index (WOMAC)-function (0–68) - Total Medical Outcomes Study 12-Item Short Form Health Survey (SF36) - physical component summary - Total Medical Outcomes Study 12-Item Short Form Health Survey (SF-36) - mental component summary
	Physical performance measures	- Total timed up and go - Total stair test - Total self-paced walk
	Other objective outcomes	- Adverse events - Recruitment rate

Study	Type of outcome	Outcomes
	Other patient-reported outcomes	- Technical issues using the software - Patient satisfaction - Number of telerehabilitation sessions - Compliance with the prehabilitation programs -The Global Rating of Change scale (GRC) -- patients perceived improvement/deterioration
Protocol Studies		
Hinman, 2020[19]	Pain outcomes	- Numerical rating scale
	Self-reported physical function outcomes	- Western Ontario and McMaster universities osteoarthritis index (WOMAC)
	Patient engagement outcomes	- Session completion rates - Adherence with strengthening program: 11-point numeric rating scale - Adherence with physical activity plan - 11-point numeric rating scale
	Quality-of-life outcomes	- Assessment of Quality of Life (AQoL)-6D
	Other patient-reported outcomes	- Physical Activity Scale for the Elderly (PASE) - Arthritis Self Efficacy Scale (8-item) - Participant-perceived global change (7-point Likert Scale) - Satisfaction with the physiotherapy consultations (7-point Likert scale) - Working Alliance Inventory Short Form - Convenience 11-point numeric rating scale - Co-interventions (self-report medications or any other treatments for knee pain) - Adverse events - Health service usage (self-report) - Participant time (self-report) - Physiotherapist time (self-report) - Participant travel (self-report) - Descriptive measures (self-report) (demographics, geographic residential location, employment, confidence with technology, etc.)
Hale, 2021[17]	Pain outcomes	- Brief Pain Inventory - Roland Morris Disability Questionnaire - Pain self-efficacy questionnaire - Pain catastrophizing scale
	Patient engagement outcomes	- Patient-reported engagement

Study	Type of outcome	Outcomes
	Quality-of-life outcomes	- Descriptive system for health-related quality of life (EQ-5D-5L)
	Other patient-reported outcomes	- Depression, Anxiety, Stress Scale (DASS-21) - Chronic pain acceptance questionnaire - Tampa scale for kinesiophobia - Current medications - Health care use - Acceptability and satisfaction - Adverse events
Mesa-Castrillon, 2021[18]	Pilot outcomes	- Acceptability (Self-reported satisfaction on overall experience with the study, accessibility of reaching mental health professional, time to get an appointment, cost of intervention, distance traveled, app and exercise equipment received)
	Pain outcomes	- Numerical rating scale - Pain self-efficacy questionnaire
	Self-reported physical function outcomes	- Patient-Specific Functional Scale - Western Ontario and McMaster universities osteoarthritis index (WOMAC) - IPAQ-short form
	Patient engagement outcomes	- Home practice - Session completion rates - Quality of life
	Other objective outcomes	- Recruitment rate - Follow-up rate
	Other patient-reported outcomes	- Roland-Morris Disability Questionnaire (RDQ) - International Physical Activity Questionnaire-Short Form (IPAQ-SF) - Adverse events - Medication and health care use - Distance travelled to utilize health care
Registered Protocols in Trial Databases		
Barton, 2019[25]	Primary outcome	- Knee-related burden (KOOS4)
Bayley, 2019[24]	Primary outcome	- Treatment satisfaction - Attrition
Groves-Williams, 2020[22]	Primary outcome	- Feasibility
Palfai, 2020[23]	Primary outcome	- Pain severity - Pain interference - Heavy drinking episodes - Average drinks per week
Damush, 2020[21]	Primary outcome	- Number of days of pain - Implementation
Bell, 2021[20]	Primary outcome	- Feasibility

APPENDIX D. PEER REVIEW DISPOSITION

Question Text	Reviewer Number	Comment	Response
Are the objectives, scope, and methods for this review clearly described?	1	Yes	Thank you.
	3	Yes	Thank you
	4	Yes	Thank you
	5	Yes	Thank you
	6	Yes	Thank you
	7	Yes	Thank you
	8	Yes	Thank you
Is there any indication of bias in our synthesis of the evidence?	1	No	Thank you
	3	No	Thank you
	4	No	Thank you
	5	No	Thank you
	6	No	Thank you
	7	No	Thank you
	8	No	Thank you
Are you aware of any published or unpublished studies that we may have overlooked?	1	No	Thank you
	3	No	Thank you
	4	No	Thank you
	5	No	Thank you
	6	No	Thank you
	7	Yes - o Schulz-Heik R.J., Meyer H., Mahoney L., et. al.: Results from a clinical yoga program for veterans: yoga via telehealth provides comparable satisfaction and health improvements to in-person yoga. BMC Complement Altern Med 2017; 17: pp. 198 o Results from a clinical yoga program for veterans: yoga via telehealth provides comparable satisfaction and health improvements to in-person yoga - PubMed (nih.gov)	Thank you. In collaboration with the VA operations leaders who nominated this topic, and the Technical Expert Panel who advised us on this review, we focused this review on *effectiveness of videoconference-delivered* non-pharmacological chronic pain intervention. These groups guided us on our eligibility for

			this review. The study on yoga would not meet eligibility for several reasons (*eg*, population exposed to intervention of unknow chronic pain status, inclusion of hospitalized patients, not a randomized trial, not required to be more than one session).
	8	Yes - A potential suggestion to improve the Evidence Synthesis Report is to broaden the inclusion criteria of the studies. Currently, the inclusion criteria leads to only 1 completed study included in the manuscript and thus the utility of this paper becomes limited for the intended audience. By broadening the inclusion criteria to include all studies that include videoconferencing of nonpharmacological interventions for chronic pain. Examples of additional articles that can be included are: Palyo, S. A., Schopmeyer, K. A., & McQuaid, J. R. (2012). Tele-pain management: Use of videoconferencing technology in the delivery of an integrated cognitive–behavioral and physical therapy group intervention. Psychological Services, 9(2), 200–202. https://doi.org/10.1037/a0025987 Glynn, L. H., Chen, J. A., Dawson, T. C., Gelman, H., & Zeliadt, S. B. (2021). Bringing chronic-pain care to rural veterans: A telehealth pilot program description. Psychological Services, 18(3), 310–318. https://doi.org/10.1037/ser0000408 Evaluating distance education of a mindfulness-based meditation programme for chronic pain management by Jacqueline Gardner-Nix et al., 2008 (https://doi.org/10.1258/jtt.2007.070811)	Thank you for these suggested studies. We included studies that were of greatest value to answer the key areas of uncertainty of our nominating VA operations partners. Their main focus was on effectiveness of videoconferencing compared to in-person non-pharmacological pain management. That is, the focus was on “Does this work?’ and not “How this works?”. As such, we limited to comparative study designs best suited to address individual-level outcomes. We did not include descriptive studies (eg., no data on relevant outcomes) and quasi-experimental designs. We added a horizon scan to this review as our TEP advised us that this literature on effectiveness was

			likely nascent at this time.
Additional suggestions or comments can be provided below. If applicable, please indicate the page and line numbers from the draft report.	1	Page v, line 54, please list Dr Beck's title as: Deputy Under Secretary for Health for Policy and Services	Thank you, this change has been made.
	3	This is an excellent report. I'm wondering if the authors might want the report to cite on p. 6 the most recent CPGs for non-pharmacological options for pain management, the evidence that was used to shape the CPGs, and the National Pain Strategy: Skelly AC, Chou R, Dettori JR, et al. Noninvasive Nonpharmacological Treatment for Chronic Pain: A Systematic Review Update. Agency for Healthcare Research and Quality (US); 2020. http://www.ncbi.nlm.nih.gov/books/NBK556229/ Qaseem A, Wilt TJ, McLean RM, Forciea MA, et al. Clinical Guidelines Committee of the American College of Physicians. Noninvasive Treatments for Acute, Subacute, and Chronic Low Back Pain: A Clinical Practice Guideline from the American College of Physicians. Ann Intern Med. 2017;166(7):514-530. doi:10.7326/M16–2367 Department of Health and Human Services, Interagency Pain Research Coordinating Committee. National Pain Strategy – A Comprehensive Population Health-Level Strategy for Pain. NIH Interagency Pain Research Coordinating Committee. HHS National Pain Strategy 508C.	We have added these references. Thank you.
	4	This review is on a timely and important topic to the VHA and general population. The report is thorough and well written. Unfortunately, very little literature meeting the review criteria was found. The authors made the most of what was found and provided a fair and informative overview. I have a few minor issues for editorial consideration.	Thank you.
	4	• KQ1 focuses on "psychologically informed behavioral interventions." This term is shortened to "behavioral interventions" throughout the report. The term "behavioral" has a specific meaning, especially within the psychotherapy literature. The term would not bring to mind acceptance and commitment therapy, as the focus of ACT is largely on changing thinking (i.e., cognitive). Perhaps a different term would be more clear?	We have made this suggested wording change.

	4	• Page 15, lines 5-9. The first two lines of the Conclusions section identify the need for research on effectiveness of videoconference interventions for chronic pain, patient preferences, and facilitators and barriers for implementation. I would note that this review did not explore those exact questions, but rather the comparative effectiveness of videoconference interventions and in-person services. Because the authors did not explicitly seek out and systematically review the literature on the overall effectiveness, patient preferences regarding, and implementation of videoconference pain interventions, they may wish to deemphasize or otherwise soften these sentences.	We have revised this wording per the reviewer's suggestions.
	4	• Page 30, line 58. "prehabilitation" is a novel term and should be defined.	We have defined this term in the report.
	4	• There are a few minor typos. Page 12, line 50 should read "study risk of bias." Page 31, line 53 should read "in-person or via videoconferencing."	Thank you, these changes have been made.
	5	vi-13 Please correct spelling and credentials to Kristin Eneberg-Boldon, PT, DPT	These changes have been made
	5	p28-line 34 'with via'; line 35 'form' should be 'from'	Thank you, these typos have been corrected.
	6	The authors have summitted a well written and concise manuscript. They adequately defined two questions, provided a thorough search strategy. The results were unexpected. Based on the importance of the question, the inadequate answer that the results provide is still worthy of publication. And an update and new information is expected in several years. The authors should be commended for their quality work.	Thank you.
	6	I do, however, have a few recommends: 1) the title of the manuscript be more precise. Videoconferencing of Nonpharmacological Interventions for Chronic Pain, implies it is covering nonpharmacological interventions. The interventions of interest are nonpharmacological interventions, however it is not inclusive of all nonpharmacological interventions. And there are some studies in which a self-administered non-pharmacological intervention, such as an electrotherapy, was excluded. The VHA convened a state-of-the-art (SOTA)	Thank you, we changed the title to Videoconferencing of Movement-based and Psychologically Informed Interventions for Chronic Pain: A Systematic Review and Horizon Scan.

		conference on non-pharmacological management of chronic musculoskeletal pain defined four areas of focus: psychological/behavioral therapies; exercise/movement therapies; manual therapies; and multimodal delivery of care. This paper clearly looks at psychological/behavioral therapies; exercise/movement therapies, but may exclude other non-pharmacological treatments. Just a recommendation.	
	6	2) Table 1. Lack of comparator had 12 studies excluded. I agree with the exclusion of those studies as I do not believe those studies had an adequate comparator. However, Treatment as usual may include some form of in person care or telephone follow-up. Perhaps expanding the definition to be a "similar" or "like" intervention / "a like or similar" psychological/behavioral therapy; exercise/movement therapy delivered in person without any videoconference delivery, telephone or combination of in-person and telephone.	Thank you for these thoughtful comments. We have tried to clarify the comparator eligibility criteria in table 1. To isolate the impact of videoconferencing, the ideal study for inclusion would compare the same treatment delivered by videoconferencing compared to in-person (or telephone or the combination of in-person and telephone). Yet, we did not want to further limit studies that did not have perfect parity in the non-videoconferencing conditions.
	6	One requested clarification, multiple sclerosis was excluded because it is not a chronic pain condition?	We excluded studies that only recruited based on a diagnosis of multiple sclerosis. Many patients who have multiple sclerosis do have associated pain, but pain is not a marker or defining characteristic in diagnosing multiple sclerosis. This phenomena was similarly discussed for studies recruiting

		participants based on a diagnosis of osteoarthritis. However, the diagnosis of osteoarthritis is defined by the presence of pain or stiffness, so therefore patients with OA will have pain or stiffness. Many studies investigating multiple sclerosis were looking at fatigue, function, etc. If a study was recruiting for patients with multiple sclerosis and chronic pain, we would have included the study because the study would have been looking for only patients with multiple sclerosis and chronic pain.
	7 I was surprised by the lack of research/studies in this area. Hopefully this can help support the need for me in VA.	Agreed, thank you.
	7 In KQ1 - I don't recall the term "psychologically informed behavioral interventions" as a category	We have clarified this language throughout the report.
	7 Were clinical hypnosis, biofeedback, or guided imagery included as non-pharm approaches for pain? I didn't see them referenced. Would recommend using "movement-based" over "exercise-based" throughout.	We took a broad approach to the included modalities of treatments for non-pharmacological pain management. This would include any evidence-based approaches for non-pharmacological pain. We have changed the wording throughout the report to “movement-based”

			to improve clarity per your suggestion.
	7	I know this is focused on live video visits compared to in person care, but wonder if there would be room to discuss recorded content, use of mobile apps, or use of virtual reality in delivering some of these approaches compared to in-person care? I know that these are growing modalities for delivering care (see examples below) - Blödt S., Pach D., von Eisenhart-Rothe S., et. al.: Effectiveness of app-based self-acupressure for women with menstrual pain compared to usual care: a randomized pragmatic trial. Am J Obstet Gynecol 2018; 218: pp. 227.e1-e9. - Rousseaux F., Bicego A., Ledoux D., et. al.: Hypnosis associated with 3D immersive virtual reality technology in the management of pain: a review of the literature. J Pain Res 2020; 13: pp. 1129-1138. - Askay S.W., Patterson D.R., Sharar S.R.: Virtual reality hypnosis. Contemp Hypn 2009; 26: pp. 40-47.	Thank you but these modalities are beyond the scope of the review and the focus of the VA operations partners who commissioned this systematic review.
	7	I know this is an ESP report, but I know that VA is doing a lot in the area of Tele-health including Tele-CIH and other non-pharm approaches to care. Would it be appropriate to add any of that into the report as background?	This is an excellent point and we have added this information to the report.
	8	Major overall comments: The ESP report is very well done, but the utility of this work needs to be better communicated. As part of an evidence synthesis program, the overall purpose of this paper should be to inform current healthcare providers with actionable suggestions based on the current literature. This particular report included only 1 completed study with fairly inconclusive findings and had some concerns about its risk of bias, leaving the reader wondering about the utility of this study. Using the horizontal scan to mention how there are upcoming studies is greatly appreciated, however, there needs to be more included studies in this report to support conclusions that will be meaningful to healthcare workers in the VA and generally today (see methods section for suggestions).	Thank you for this comment. We too are frustrated by the low yield of relevant studies to address the areas of uncertainty of the VA operations partners. Including other studies that do not address effectiveness likely would provide limited guidance on the impact of this innovation on outcomes that are meaningful to clinicians and patients.
	8	Introduction - The introduction section is well organized and follows a great flow to give background information about the importance of chronic pain management through nonpharmacological	Thank you

		treatments and why videoconferencing may be feasible.	
	8	- In paragraph 3 (page 7, line 11), it is mentioned that telehealth delivery has been examined for other chronic conditions. Elaborate upon this comment so that the author gets an idea of the different types of benefits videoconferencing provides for other chronic conditions and how this may relate to videoconferencing becoming an appropriate modality for chronic pain.	Thank you and we have added this information.
	8	- Page 7 line 12 has a typo: currently the sentence reads “the benefits of virtual care the for nonpharmacological…” and could be changed to “the benefits of virtual care for the nonpharmacological…”	Thank you, this typo has been corrected.
	8	Methods - The methods overall are well-written and clearly describe the steps taken to gather the data. I especially appreciated the PICOTS table included as well as the analytic framework depiction. - A potential suggestion to improve the Evidence Synthesis Report is to broaden the inclusion criteria of the studies. Currently, the inclusion criteria leads to only 1 completed study included in the manuscript and thus the utility of this paper becomes limited for the intended audience. By broadening the inclusion criteria to include all studies that include videoconferencing of nonpharmacological interventions for chronic pain. Examples of additional articles that can be included are: Palyo, S. A., Schopmeyer, K. A., & McQuaid, J. R. (2012). Tele-pain management: Use of videoconferencing technology in the delivery of an integrated cognitive–behavioral and physical therapy group intervention. Psychological Services, 9(2), 200–202. https://doi.org/10.1037/a0025987 Glynn, L. H., Chen, J. A., Dawson, T. C., Gelman, H., & Zeliadt, S. B. (2021). Bringing chronic-pain care to rural veterans: A telehealth pilot program description. Psychological Services, 18(3), 310–318. https://doi.org/10.1037/ser0000408 Evaluating distance education of a mindfulness-based meditation programme for chronic pain management by Jacqueline Gardner-Nix et al., 2008 (https://doi.org/10.1258/jtt.2007.070811) - If the authors choose not to take the approach to broaden their inclusion criteria, then further justification is required.	Thank you. Please see comments above about scoping of this report to meet the needs of the VA operations partners who commissioned this review. The scope of this review is focused on effectiveness of the interventions. Broadening the scope to include all studies that include videoconferencing of nonpharmacological interventions for chronic pain would not be feasible on our programmatic timelines and budgets. Further, such a review scope would not meet the key information needs of the VA nominating operations partners.

	8 To make it easier for the reader to follow along, include the initials of the researchers who were involved in the tasks described in the methods section.	Thank you. This is not part of our ESP style guide for reporting. We take a team science approach; nearly every investigator is involved in all steps of the review process.
	8 Results I appreciate the use of the included Tables and the Appendix, which are clearly written and provide digestible and relevant information.	Thank you
	8 Include a table in the Appendix with the different outcomes assessed and include a brief description of what those outcomes are and what they mean in a clinical setting.	Thank you, we have added all of the outcomes from the identified literature into Appendix C.
	8 The inclusion of the horizontal scan to shed light on the different research projects that are currently being conducted is very beneficial to this study and strengthens the overall paper.	Thank you
	8 Discussion Mention limitations to videoconferencing as a platform for chronic pain treatment. Issues such as limited internet connection, lack of access to technology, or lack of education on how to use technology may negatively impact a patient's experience using videoconferencing.	Thank you and we have added this information.
	8 I appreciate the mention of future research that can be explored based on the results from the study including specifics regarding system-level studies, patient-important outcomes, and looking at the differences in outcomes across patient-level subgroups.	Thank you