Please cite this guideline as:

Abstract:
A clinical practice guideline on telerehabilitation was developed by an American Physical Therapy Association volunteer guideline development group consisting of international physical therapists and physiotherapists, a physician, and a consumer. The guideline was based on systematic reviews of current scientific literature, clinical information, and accepted approaches to telerehabilitation in physical therapist practice. Seven recommendations address the impact of, preparation for, and implementation of telerehabilitation in physical therapist practice. Research recommendations identify current gaps in knowledge. Overall, with shared decision-making between clinicians and patients to inform patients of service delivery options, direct and indirect costs, barriers, and facilitators of telerehabilitation, the evidence supports the use of telerehabilitation by physical therapists for both examination and intervention.

The Spanish version of this clinical practice guideline and the French version of the seven recommendations are available as supplements.
Disclaimer

This clinical practice guideline was developed by an American Physical Therapy (APTA) volunteer guideline development group consisting of international physical therapists and physiotherapists, a physician, and a consumer. It was based on systematic reviews of current scientific literature, clinical information, and accepted approaches to telerehabilitation in physical therapist practice. This clinical practice guideline is not intended to be a fixed protocol, as some individual patient needs may call for more or fewer interventions, as well as services delivered in-person, via telerehabilitation, or a combination. Patients seeking care may not be the same as participants in a clinical trial or in the literature used to inform this guideline. Patient care and treatment should always be based on a shared decision-making process with the patient, adjusting for the clinician’s independent clinical judgment, the individual patient’s clinical circumstances and preferences, and local regulatory and cultural factors.

Disclosure Requirement

In accordance with APTA policy, all individuals whose names appear as authors or contributors to this clinical practice guideline filed a disclosure statement as part of the submission process. All panel members provided full disclosure of potential conflicts of interest prior to voting on the recommendations contained within this clinical practice guideline.

Funding Source

This clinical practice guideline was funded exclusively by APTA, which funded the ECRI services and provided coordination, but played no role in the design, conduct, and reporting of the recommendations; neither was any funding received from outside commercial sources to support its development.

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## Table 1. Summary of Recommendations

<table>
<thead>
<tr>
<th>Telerehabilitation Practice, Preparation, and Implementation</th>
<th>Quality of Evidence</th>
<th>Strength of Recommendation</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telerehabilitation in physical therapist practice</td>
<td>Moderate</td>
<td>♦♦♦◊</td>
<td>Recommendation 1: Physical therapists should recommend telerehabilitation or hybrid care, as they are at least equivalent to in-person physical therapy with respect to patient acceptability and satisfaction and are superior to in-person physical therapy with respect to adherence and attendance for certain health conditions.</td>
</tr>
<tr>
<td>Telerehabilitation preparation</td>
<td>Moderate</td>
<td>♦♦♦</td>
<td>Recommendation 2: Physical therapists and patients should discuss whether telerehabilitation is a cost-effective option compared with in-person care in the context of the patient’s circumstances and conditions.</td>
</tr>
<tr>
<td>Telerehabilitation implementation</td>
<td>Moderate to High</td>
<td>♦♦♦</td>
<td>Recommendation 3: Physical therapists should identify and work to reduce barriers and promote facilitators identified from the patient’s perspectives and experiences when planning and providing telerehabilitation services.</td>
</tr>
<tr>
<td>Telerehabilitation implementation</td>
<td>Low</td>
<td>♦◊◊</td>
<td>Recommendation 5: When physical therapists perform components of an examination via telerehabilitation they may use the results to inform the diagnosis with comparable accuracy to an in-person visit for certain health conditions.</td>
</tr>
<tr>
<td>Telerehabilitation implementation</td>
<td>Low</td>
<td>♦♦◊♦</td>
<td>Recommendation 6: Physical therapists should use telerehabilitation to achieve outcomes similar to in-person care for certain health conditions. <em>(Weak upgraded to moderate due to consistent results and inability to blind patients for clinicians.)</em></td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>♦♦♦♦</td>
<td>Recommendation 7: Physical therapists should anticipate, prevent, manage, and document occurrences of adverse events specific to telerehabilitation as the mode of delivery. <em>(Recommendation strength upgraded from Weak to Strong to be consistent with professional codes of ethics to ensure patient safety.)</em></td>
</tr>
</tbody>
</table>
# TABLE 2. STRENGTH OF RECOMMENDATIONS

<table>
<thead>
<tr>
<th>Strength of Recommendations</th>
<th>Language of Obligation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong ✫✫✫✫</td>
<td>Must or should</td>
<td>A high level of certainty of <em>moderate to substantial</em> benefit, harm, or cost, or a <em>moderate</em> level of certainty for <em>substantial</em> benefit, harm, or cost (based on a preponderance of Level 1 or 2 evidence(^1) with at least 1 level 1 study).</td>
</tr>
<tr>
<td>Moderate ✫✫✫</td>
<td>Should</td>
<td>A high level of certainty of <em>slight to moderate</em> benefit, harm, or cost, or a <em>moderate</em> level of certainty for a <em>moderate</em> level of benefit, harm, or cost (based on a preponderance of level 2 evidence, or a single high-quality RCT).</td>
</tr>
<tr>
<td>Weak ✫✫</td>
<td>May</td>
<td>A moderate level of certainty of <em>slight</em> benefit, harm, or cost, or a weak level of certainty for moderate to substantial benefit, harm, or cost (based on Level 2 thru 5 evidence).</td>
</tr>
<tr>
<td>Theoretical / foundational ✫✫</td>
<td>May</td>
<td>A preponderance of evidence from animal or cadaver studies, from conceptual/theoretical models/principles, or from basic science/bench research, or published expert opinion in peer-reviewed journals that supports the recommendation.</td>
</tr>
<tr>
<td>Best practice ✫✫</td>
<td>May or should</td>
<td>Recommended practice based on current clinical practice norms, exceptional situations in which validating studies have not or cannot be performed yet there is a clear benefit, harm, or cost, expert opinion.</td>
</tr>
<tr>
<td>Research</td>
<td>N/A</td>
<td>An absence of research on the topic or disagreement among conclusions from higher-quality studies on the topic.</td>
</tr>
</tbody>
</table>
GUIDELINE DEVELOPMENT GROUP ROSTER

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**GDG Conflicts of Interest**

1. Alan C. Lee serves as a telehealth advisor for Bluejay Mobile Health, Inc.

2. Trevor Russell is the founder of NeoRehab, a telerehabilitation solution that features in some manuscripts referenced in these guidelines.

3. Lesley Holdsworth is a clinical advisor and digital lead at the Scottish government and contributes to the development of strategy, policy, and delivery of digital solutions in Scotland (including the assessment and choice of commercial partners).

4. Michelle Sigmund-Gaines was involved in the development of physical therapy telepractice regulations in Oregon and served on the Ethics and Legislation Committee for the Federation of State Boards of Physical Therapy.

5. Kelly Sanders is president and an employee owner of Everflex Health, a digital tool that employs an algorithm to create exercise support plans that help individuals stay on their path toward wellness and manage pain.

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Introduction

Overview

This clinical practice guideline (CPG) is based on a systematic review of published studies involving the delivery of physical therapist services via telerehabilitation for various health conditions. In addition to providing practice recommendations, this guideline highlights limitations in the literature, intentional vagueness, potential benefits, risks, harms, and costs of implementing each recommendation, and areas for future research.

This CPG is intended to be used by all qualified and appropriately trained physical therapists and physical therapist assistants involved in the delivery of telerehabilitation. It also is intended to be an information resource for decision makers, health care professionals, consumers, funders, and regulatory people of interest. The guideline is intended for an international audience. Of note, the synonymous terms “physical therapy” and “physiotherapy” are used only in reference to services that are provided by or under the direction and supervision of a licensed physical therapist or physiotherapist.

In the United States, the Health Resource Services Administration (HRSA) defines telehealth as the use of electronic information and telecommunication technologies to support long-distance clinical health care, patient and professional health-related education, public health, and health administration. Recently, the World Health Organization (WHO) defined digital health as the field of knowledge and practice associated with the development and use of digital technologies to improve health. It is often used as a broad umbrella term encompassing eHealth and other developing fields of “big data”, genomics, and artificial intelligence. Various health disciplines use other terms to describe the use of digital health in clinical practice, such as telemedicine, telepractice, and digital practice. In this CPG, “licensed health care professional” refers to a person who licensed, registered, or certified under a jurisdictional state or national law while engaged in the professional or trade practices conducted under authority of that law. To be licensed, a health care professional must meet minimum standards for education, training, and experience, and in certain countries and states pass professional exams and criminal background checks. The term “clinician” refers to a health care provider qualified in the clinical discipline who provides principal care for a patient. Clinicians may be physical therapists, physical therapist assistants, physicians, nurses, pharmacists, or other allied healthcare professionals. In this CPG, telerehabilitation will be defined as the use of telehealth technologies by physical therapists, or physical therapist assistants under the supervision of a PT, who provide patient and client management, which includes diagnosis, prognosis and intervention to optimize physical function, movement, performance, health, quality of life, and well-being across the lifespan. The term “patient” may refer to an adult or a child. When the term “patient” refers to a child, it implies both the child and their guardian, as appropriate.
Goals and Rationale

The purpose of this CPG is to guide the delivery of physical therapist services via telerehabilitation (either 100% telerehabilitation or a hybrid of in-person and telerehabilitation) to individuals with health conditions, based on the current best evidence. Current practice standards demand that clinicians use the best available evidence in their clinical decision-making, incorporate clinical expertise, and consider the patient’s wants and needs. To assist clinicians, this CPG is based on a systematic review of the literature regarding physical therapist services delivered via telerehabilitation. This review included randomized controlled trials (RCTs), systematic reviews (SRs) and qualitative studies published between January 1, 2010, and March 28, 2022, and identifies where there is strong evidence, where evidence is lacking, and topics that future research must target to improve the management of individuals with health conditions via telerehabilitation or a hybrid of in-person and telerehabilitation services. It is noteworthy that evidence in this CPG supports comparable outcomes for in-person and telerehabilitation services.

This CPG is an educational tool to guide qualified clinicians through a series of management decisions to improve service quality and efficiency and to reduce unwarranted variations in care. This CPG should not be construed as including all proper methods of care or excluding methods of care reasonably directed at obtaining the same treatment results. The ultimate judgment regarding the application of any specific procedure or treatment delivered through telerehabilitation must consider all circumstances presented by the patient, including safety, preferences, and health condition, and the needs and resources particular to the locality or institution. Processes and outcomes that expand or deviate from those expected when adhering to the CPG recommendations should be published to add to the evidence.

Intended Users

This CPG is intended to be used by physical therapists, and physical therapist assistants under the direction and supervision of physical therapists, for the delivery of physical therapist services via telerehabilitation. Physical therapists are licensed health care professionals who help individuals develop, maintain, restore, and improve movement, activity, and functioning to enable optimal performance and enhance health, well-being, and quality of life.1 Physicians, rehabilitation medicine providers and administrators, nurse practitioners, physician assistants, occupational therapists, speech language pathologists, and other health care professionals who utilize telehealth and telemedicine in various practice settings also may benefit from this guideline. This guideline is not intended to determine insurance benefits or payment policies for health care agencies, payors, professional organizations, or government entities.

Telerehabilitation as a means of physical therapist practice is based on decisions made by the health care team with an individual patient (or advocate). Use of technologies in telerehabilitation may require collaboration with information technology (IT) and cybersecurity specialists to manage and audit data for privacy and security.
Once the individual (or advocate) has been informed of the nature of the available therapies and has discussed options with their health care professional, an informed and shared decision can be made as to whether to utilize telerehabilitation.

Patient Population

This CPG addresses the physical therapists’ uses of telerehabilitation in the management of individuals of all ages with various health conditions.

Methods

The methods used to develop this CPG aimed to minimize bias and enhance transparency in the selection, appraisal, and analysis of the available evidence. These processes are vital to the development of reliable, transparent, and accurate clinical recommendations for telerehabilitation in physical therapist practice. Methods from the APTA Clinical Practice Guideline Manual were used in development of this CPG.

Guideline Development Group (GDG): The Telerehabilitation Clinical Practice GDG consisted of physical therapist members from different APTA academies and sections (pediatrics, private practice, orthopedics, neurology, leadership and innovation, and research); and representatives from international professional associations in Argentina, Australia, Canada, and the United Kingdom; a physician from Virginia Tech Carilion School of Medicine; and a consumer from the Oregon Board of Physical Therapy who had experienced telerehabilitation as a patient. All GDG members, APTA staff, and methodologists were free of financial conflicts of interest relevant to the topic under study, as recommended by the National Academies of Sciences and Medicine’s Clinical Guidelines We Can Trust. GDG members with intellectual conflicts, due to authorship on articles included for review, abstained from appraising those articles and voting on recommendations that included their evidence. The GDG began meeting January 20, 2021, to define the CPG scope and create PICOT questions (e.g., population, intervention, comparison, outcome, and time) to direct the literature search (see supplementary detail).

Outcome Prioritization: The GDG identified and prioritized outcomes of interest based on a preliminary literature search and clinical expertise of the GDG. It is noted that most studies did not report on many of the predefined outcomes. The body of evidence for this CPG reports on the best approximation of these critical outcomes. Outcomes pertaining to activities and participation were considered critical, and those pertaining to body functions and structures were considered important.

Literature Search: APTA sought the expertise of ECRI’s Evidence-Based Practice Center as paid consultants to assist the GDG with its literature search and study appraisal. Information
professionals performed literature searches within the ECRI Health Technology Assessment/EPC Information Center following established guidelines and procedures as identified by the director of the Information Center. Consistent with the ECRI evidence-based searching protocol, all key questions were searched for SRs and RCTs (see Supplementary information: Search Strategy) in these databases: MEDLINE and EMBASE (via EMBASE.com), In Process Medline and PubMed-unique content (via PubMed.gov), and Cumulative Index to Nursing and Allied Health Literature (CINAHL) for the time-period of January 1, 2010, through July 26, 2021. Search terms were identified by: (1) reviewing relevant systematic reviews on similar topics identified by members of the research staff; (2) reviewing how other relevant studies are indexed, their subject-heading terms, and their keywords; (3) reviewing MeSH, EMTREE, and the PsycINFO thesaurus for relevant and appropriate terms; (4) reviewing the search strategies for previously published relevant guidelines and publications; and (5) discussions with the GDG. Once search terms were established, combinations of subject headings and key words were used in both phases of the literature search to retrieve SRs, RCTs, comparative studies, and qualitative studies that addressed the key questions.

As ECRI limited its search to SRs, RCTs, comparative studies, and qualitative studies, and to ensure currency, GDG members conducted supplementary searches for Recommendations 1, 3, and 4. Details are below.

**Literature Search Results:** Literature searches in phase 1 identified 5,085 citations potentially addressing the key questions of interest to this evidence review. Of those, 4,235 were excluded upon title review for clearly not meeting inclusion criteria (e.g., not pertinent to the topic, not published in English, published prior to study inclusion publication date, or not a full-length article). Overall, 850 abstracts were reviewed with 363 of those being excluded for the following reasons: not a SR or clinical study, did not address a key question of interest to this review, did not enroll a population of interest, or published prior to January 1, 2010. A total of 487 full-length articles were reviewed. Of those, 347 were excluded at a first pass review for the following: did not address a key question of interest, did not enroll the population of interest, did not meet inclusion criteria for clinical study or SR, did not meet inclusion criteria for any key question, or was a duplicate. A total of 140 full-length articles were thought to address one or more key questions and were further reviewed. Of these, 110 ultimately were excluded with reasons presented in Figure 1.

Overall, 30 studies from phase 1 of the literature search addressed 1 or more of the key questions and were considered as evidence in this CPG (see Figure 1).

Following review of the initial ECRI results, the GDG updated the search for Recommendation 1 and 2 to include RCTs through November 14, 2022. Of the 1223 titles and abstracts screened, 14 additional studies were included.
Following review of the initial ECRI process, the GDG broadened the search criteria for Recommendations 3 and 4 to include cohort, survey and secondary analyses studies and updated the original search through March 28, 2022, resulting in 118 new articles. Of the 118 new articles identified, 35 did not answer the research question and 80 were not related to telerehabilitation. Following both title and abstract and full text reviews, 1 additional qualitative study and 2 additional survey studies were included, for a total of 15 articles.

**Figure 1. Study Flow Diagram**
Literature Appraisal: ECRI staff screened study titles and abstracts and performed full-length article appraisals of the included quantitative studies using the U.S. Preventive Services Task Force (USPSTF)\textsuperscript{10} criteria for RCTs and the Grading of Recommendations Assessment, Development and Evaluation (GRADE)\textsuperscript{11} system for assessing the overall quality (or uncertainty) of the body of evidence for each outcome in the PICOT question. The GRADE system primarily considers the following factors: overall study quality (or overall risk of bias or study limitations), consistency of evidence, directness of evidence, and precision of evidence.\textsuperscript{11} Given time and resources, other factors such as publication bias were considered. The GRADE system rates the overall quality of the body of evidence as high, moderate, low, and very low. A body of evidence consisting of RCTs automatically starts with a rating of high quality. This rating can be downgraded if the RCTs have serious methodological flaws, if the findings are inconsistent, or if effect sizes lack precision. Study designs other than RCTs begin as low evidence and can be upgraded, depending on methodological rigor and consistency of findings across studies.

For Recommendation 1, 4 of the GDG members completed the appraisals of the additional 14 studies using GRADE criteria.

Prior to individual ratings, 1 article was used to establish reliability on the GRADE ratings among the reviewers. Conflicts within appraisal pairs were resolved by a third appraiser.

For Recommendations 3 and 4, GDG members appraised the included 15 articles using the Critical Appraisal Skills Programme (CASP) appraisal tool for qualitative studies,\textsuperscript{12} and the Centre for Evidence Based Medicine Survey tool\textsuperscript{13} for surveys. Reliability was established for each tool at 100% and each article was appraised by paired readers. Conflicts within appraisal pairs were resolved by the third appraiser. Qualitative studies were categorized as high (≥7/10), moderate (5-6/10), or low quality (≤4/10).

Best Evidence Synthesis

ECRI’s Process: Systematic reviews (SR) with quantitative syntheses were the first line of evidence used. For questions in which a previous SR was available, primary studies meeting that published SR’s inclusion criteria were used to supplement or update the earlier SR. For questions where multiple SRs with similar arrays of included individual studies were available, the most comprehensive (in terms of the number of high-quality cited studies) and/or recent SR was chosen to avoid multiple ratings of a similar evidence base. SRs not contributing to the overall grading of evidence were included in ECRI’s narrative summaries, particularly if they contained a small number of unique but high quality, individual studies. For PICOT questions for which no
previous SR was available, individual study summaries of the overall findings for the outcomes of interest were provided.

Teams of GDG members were assigned to PICOT questions to review the ECRI evidence summaries and additional appraised articles if appropriate, and to generate first drafts of a recommendation to address the question. Recommendations and evidence summary profiles were shared with the full GDG for discussion, editing, and eventual voting.

A summary of recommendations is provided in Table 1 and the strength of the recommendations is in Table 2. The strength of recommendation takes into account the quality, quantity, and trade-off between the benefits and harms of a process, measure or intervention, the magnitude of effect, and whether there is data on critical outcomes.

Recommendation strength was based on the body of evidence and could be upgraded if study results were consistent, even when methodologies were considered lower level (weaker RCTs or observational designs), and when the magnitude of potential benefit outweighed potential harm when implementing the recommendation. Each incidence of upgrading or downgrading is noted in its respective recommendation. When reported in studies, specific patient-reported outcomes are presented in the recommendation rationales.

**Structure of the Recommendations**
Each recommendation contains information on the quality of the body of evidence and the strength of each recommendation. Additional categories are also provided for potential benefits, risks, harms, and costs of implementing each recommendation; future research; value judgments; intentional vagueness; exclusions; quality improvement; and implementation and audit. The rationales for each recommendation are intended to provide the reader with an overview of the included studies, highlighting consistencies or discrepancies in results where applicable, and are not intended to provide specific details of each study. References of the included studies for each recommendation are provided in the action statement profiles, and readers are encouraged to search individual studies for details. Additionally, information on quality improvement (what aspect of practice will improve as a result of following the recommendation) and implementation and audit (specific strategies for implementing a particular recommendation and how its implementation might be measured for adherence) is provided for each recommendation.

**Table 3. GRADE Factors Used to Assess the Quality of a Body of Experimental Evidence**

<table>
<thead>
<tr>
<th>Evidence Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study Quality (Internal Validity or Risk of Bias)</td>
<td>Study quality takes into account the overall risk of bias rating of all the studies included in the evidence base. For the purpose of this review, the overall risk of bias would be the</td>
</tr>
<tr>
<td>Evidence Category</td>
<td>Definition</td>
</tr>
<tr>
<td>-------------------</td>
<td>------------</td>
</tr>
<tr>
<td><strong>Evidence Category</strong></td>
<td><strong>Definition</strong></td>
</tr>
<tr>
<td></td>
<td>average or median USPSTF rating for studies comprising an evidence base for a key outcome.</td>
</tr>
<tr>
<td>Consistency of Evidence</td>
<td>Consistency of evidence refers to the degree of similarity in the direction of effects or the degree of similarity in the effect sizes (magnitude of effect) across individual studies within an evidence base.</td>
</tr>
<tr>
<td>Directness of Evidence</td>
<td>Direct evidence directly compares interventions of interest in populations of interest and measures patient-oriented outcomes. Evidence can be indirect if the tested intervention differs from the intervention of interest, the study population differs from the population of interest, the outcomes differ from those of primary interest, or treatment comparisons have not been tested in head-to-head comparisons.</td>
</tr>
<tr>
<td>Precision of Evidence</td>
<td>Precision is the degree of certainty surrounding an estimate of effect with respect to an outcome. Precision is primarily assessed by examining the 95% confidence intervals (CI) around the summary effect size. CIs within the following ranges indicate non-statistical significance but are considered precise and should not be downgraded for precision. Further, if a key question is focused on comparative effectiveness of two interventions’ estimates within these bounds support findings of equivalence or no difference.</td>
</tr>
<tr>
<td></td>
<td>● Summary estimates using ratio statistics: Lower CI: 0.80 to Upper CI: 1.25</td>
</tr>
<tr>
<td></td>
<td>● Summary estimates using standardized mean difference: Lower CI: -0.2 to Upper CI: 0.2</td>
</tr>
<tr>
<td></td>
<td>● Summary estimates using raw mean difference: Depends on measure or</td>
</tr>
</tbody>
</table>
### Evidence Category

<table>
<thead>
<tr>
<th>Evidence Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>instrument; default is 20% difference on each side. Estimates outside of these bounds would be considered imprecise and downgraded for imprecision.</td>
</tr>
</tbody>
</table>

### Recommendation Voting

GDG members voted on the strength and language of each recommendation. A 60% majority was needed for a recommendation to pass; all recommendations received 100% agreement among the quorum of the voting GDG. No disagreements were recorded during recommendation voting.

### External Review: Peer Review and Public Commentary

Following the formation of a final draft, the CPG draft was subjected to a 3-week peer review for additional input from external content experts and interested parties. More than 55 comments from 6 societies were collected via an electronic structured review form. All peer reviewers were required to disclose any potential conflicts of interest, which were recorded and, as necessary, addressed. After modifying the draft in response to peer review, the CPG was subjected to a 2-week public comment period. Commenters consisted of the APTA Board of Directors (Board), the APTA Scientific and Practice Affairs Committee, all relevant APTA sections and academies, interested organizations, and the physical therapy community at large. More than **XX** public comments were received. Draft revisions were made in response to relevant comments before submitting for Journal review and publication.

### Patient Involvement

A consumer representative who had received services via telerehabilitation as a patient and served as executive director of the Oregon Board of Physical Therapy participated in the development of this CPG as a member of the GDG. Three additional consumers who used telerehabilitation services provided draft reviews.
Revision Plans

This CPG represents a cross-sectional view of current management strategies and may become outdated as new evidence becomes available. The original search terms will be used to search and evaluate new literature yearly. Within the next 5 years, APTA will initiate the CPG review process and will either: (1) revise the CPG in accordance with new evidence, changing practice, rapidly emerging treatment options, and new technology; (2) reaffirm; or (3) withdraw the CPG.

Dissemination Plans

The primary purpose of this CPG is to provide interested readers with full documentation of the best available evidence for telerehabilitation in physical therapist practice.

This CPG is published as an open-access article. It is available in Spanish (see Supplementary Appendix – Coming soon) and the Recommendations Summary is available in French (see Supplementary Appendix – Coming soon).

This CPG will be disseminated via online resources, such as webinars, podcasts, pocket guides, https://www.guidelinecentral.com/aptamembers/, continuing education courses at national and international professional annual meetings, and via social media. A CPG+, which includes an appraisal rating using the AGREE II tool, highlights of the CPG, a check-your-practice section, and review comments, is available on APTA’s website (https://www.apta.org/patient-care/evidence-based-practice-resources/cpgs). A knowledge translation task force comprising both international and APTA academy/section members has been formed to create additional implementation tools that will be available on the APTA Evidence-Based Documents web page (https://www.apta.org/patient-care/evidence-based-practice-resources).
Recommendations

Telerehabilitation in Physical Therapist Practice

Recommendation 1. Physical therapists should recommend telerehabilitation or hybrid care, as they are at least equivalent to in-person physical therapy with respect to patient acceptability and satisfaction and are superior to in-person physical therapy with respect to adherence and attendance for certain health conditions.

Evidence Quality:

Moderate, limited by inability to double blind.

Strength of Recommendation:

Moderate

Action Statement Profile

Aggregate evidence quality: 1 moderate quality SR\textsuperscript{14}, 1 high quality RCT\textsuperscript{15}, 4 moderate quality RCTs\textsuperscript{16,17,18,19}, 5 low quality RCTs\textsuperscript{20,21,22,23,24}, and 4 very low quality RCTs\textsuperscript{25,26,27,28}.

Rationale

One SR (n=1904)\textsuperscript{14} comparing telerehabilitation to in-person rehabilitation targeted people living with chronic respiratory diseases. Fourteen additional RCTs in the clinical areas of orthopedics (hip and knee arthroplasty, rotator cuff tendinopathy), heart failure, stroke, chronic obstructive pulmonary disease (COPD), chronic respiratory disease and spinal cord injury were reviewed.

Overall, the quality of evidence comparing telerehabilitation to conventional in-person therapy on satisfaction, treatment adherence and completion varies but the results are consistent. With regard to acceptability and satisfaction, there is consistent evidence to suggest that satisfaction with telerehabilitation interventions in physical therapy is high.

Acceptability/Satisfaction

Nelson et al\textsuperscript{20} in a randomized controlled non-inferiority trial of telerehabilitation versus usual care following total hip replacement found that satisfaction was high (>85%) across both groups for all 14 items of the health care satisfaction questionnaire. The only difference between groups was for the item “my therapy session was easy to attend” in which the telerehabilitation group scored higher (intervention $\bar{x}$=95 ±SD 10, control $\bar{x}$=86 ±SD 18, mean difference 9 (95% CI 2 to 16), P = 0.017). Results were identical for the overall satisfaction item, “in general, were you satisfied with the health care and services you received” (intervention $\bar{x}$ 97 ±SD 10, control $\bar{x}$ 97 ±SD 10, P = 0.96). These results were supported by an RCT by Hwang et al.\textsuperscript{25} where no difference in satisfaction was observed between patients receiving home-based telerehabilitation.
for chronic heart failure compared with usual care (p=0.17). Moffet et al.\textsuperscript{15} demonstrated no
difference in satisfaction between a usual care and telerehabilitation care group in a total knee
arthroplasty sample (p=0.34) a finding supported by an earlier trial by Tousignant et al.\textsuperscript{21} for the
same diagnostic group (p=0.920).

Mixed results have been demonstrated in patients with stroke. Lin et al.\textsuperscript{26} compared
telerehabilitation intervention with usual care intervention for patients with chronic stroke living
in long-term care facilities and found no statistical difference between perceived satisfaction of
the interventions. Cramer et al.\textsuperscript{22} however, found significantly higher satisfaction with an in-
clinic intervention compared with telerehabilitation at the end of week 1: (in-clinic 56.6 ±SD 7.4;
telerehabilitation 52.6 ±SD 8.8; p=0.012) and week 6 (in-clinic 58.5 ±SD 8.0; telerehabilitation
55.2 ±SD 7.7; p=0.015) on a Patient Satisfaction Questionnaire (maximum score 70).

High levels of satisfaction have been demonstrated in other RCTs for telerehabilitation
interventions with Russell et al.\textsuperscript{17} demonstrating rates > 9/10 on satisfaction scales. Dallolio et
al.\textsuperscript{18} compared standard care alone with standard care supplemented with telerehabilitation;
satisfaction was significantly higher (p<0.001) in the telerehabilitation supplemented group (x̄ 7.9; ±SD 1.24) than in the standard care group (x̄ 6.9; ±SD 1.55).

Attendance

For these guidelines, attendance was defined as the rate at which patients attended their
scheduled physical therapy appointments.

A high level of satisfaction with telerehabilitation has been found to translate to a high level of
attendance at telerehabilitation appointments. Attendance rates were found to be at least
equivalent, but often higher for telerehabilitation when compared with in-person appointments.
Hwang et al.\textsuperscript{25} demonstrated that compared with in-person care, participants in the
telerehabilitation group were significantly more likely to be categorized as attending (RR 2.39,
95% CI 1.27 to 4.51) and significantly less likely to be categorized as partly attending
appointments (RR 0.46, 95% CI 0.23 to 0.92). The only participants categorized as non-adherent
(<20% of sessions attended) in that study were in the control group. The telerehabilitation group
had significantly higher attendance rates than the control group, with a mean difference of 6
(95% CI 2 to 9) sessions. This trend was also observed by Cramer et al.\textsuperscript{22} who found that among
patients who initiated at least 1 treatment session, those in the telerehabilitation group attended a
mean of 35.4 of the 36 assigned therapy sessions (98.3%), while those assigned to in-person care
attended a mean of 33.6 of the 36 assigned therapy sessions (93.3%).

Cox et al.\textsuperscript{16} showed that the mean number of sessions attended by participants did not differ
significantly between groups (telerehabilitation: 13 ±SD 3 sessions; center-based pulmonary
rehabilitation 13 ±SD 4 sessions (range 1-16 sessions for both groups)); however, the proportion
of telerehabilitation participants who completed ≥70% of prescribed sessions was higher (84%
telerehabilitation versus 79% center-based rehabilitation, p=0.4).
Some RCTs have not statistically compared attendance between groups but give weight to the observation that attendance with telerehabilitation is not worse than usual in-person care. Hansen et al.\textsuperscript{23} conducted an RCT comparing telerehabilitation with in-person care for pulmonary rehabilitation in severe COPD. While a significant difference between groups was not reported for attendance, participants in the telerehabilitation group attended a median of 25 sessions (IQR 20 to 28) compared with a median of 16 (IQR 8 to 19) by the in-person group. Doiron-Cadrin et al.\textsuperscript{27} reported a similar rate of attendance for both groups of adult patients with nonprogressive, complete, or incomplete spinal cord injury, (77% in the telerehabilitation trial group and 80% in the control trial group).

**Adherence**

For these guidelines, adherence is defined as the rate at which patients completed their prescribed home management/exercise program.

Evidence suggests that completion of the home management program for patients who are receiving telerehabilitation may be higher than completion rates seen with in-person care. While non-significant, Russell et al.\textsuperscript{17} observed that adherence with the home exercise program, evaluated through the completion of an exercise diary, revealed a mean adherence (and standard deviation) of 1.7 ± 0.8 exercise sessions per day in the control group compared with 2.2 ±SD 0.5 sessions per day in the telerehabilitation group ($Z = -1.55$, $p = 0.12$). Nelson et al.\textsuperscript{20} also demonstrated that the telerehabilitation group was more compliant with their home exercise program with an overall compliance of 86% (SD 20%) compared with 74% (SD 26%) for the control group (mean difference 12% (95% CI 1% to 23%), ($P = 0.048$). Bettger et al.\textsuperscript{24} observed a significantly higher exercise program adherence rate of 88% in patients receiving telerehabilitation compared with 65.4% of patients receiving traditional physical therapy care ($p < 0.001$). Cox et al.\textsuperscript{16} found more participants in the telerehabilitation group, n=68 (97%), engaged with education and self-management training versus n=59 (84%) participants receiving center-based pulmonary rehabilitation ($\chi^2(1) = 6.9$, $p=0.009$).

Non-significant differences in adherence between telerehabilitation and in-person management has been reported in a number of studies. Asano et al.\textsuperscript{19} found no significant differences in median exercise time spent in a 3-month telerehabilitation intervention compared with usual care ($p=0.847$). They reported a median of 2,577 minutes (interquartile range (IQR) 159 to 4832) in the telerehabilitation group compared with 2,565 minutes (IQR 1504 to 5040) in the usual care group. Similarly, Cramer et al.\textsuperscript{22} found no significant difference ($p=0.73$) in the number of assigned unsupervised sessions in which participants demonstrated adherence (completed > 40 minutes of the 70-minute session) between the usual care and home-based telerehabilitation groups.

Malliaras et al.\textsuperscript{28} compared the management of patients with rotator cuff-related shoulder pain in 3 groups: advice only, recommended care without telerehabilitation, and recommended care with telerehabilitation. While not compared statistically, acceptable adherence (defined as greater than 70% of participants performing exercises 2 or 3 times/week) was found only in the
telerehabilitation group (92% adherent) compared with recommended care without
telerehabilitation (67% adherent). While not compared statistically, similar rates of adherence
were reported by Doiron-Cadrin et al.\textsuperscript{27} for a prehabilitation program delivered via
telerehabilitation (77% adherence) compared with an in-person prehabilitation program (80%
adherence).

Potential Benefits, Risks, Harms, and Costs to Implementing This Recommendation

Benefits

- Improves adherence to treatment and completion of prescribed tasks (e.g., home exercise,
  scar massage, mobilization)
- Greater flexibility in care models (e.g., increases patient and clinician choice of delivery
  method such as videoconferencing, store-and-forward, hybrid).
- Improves satisfaction for patients.

Risks, harms, and/or costs

- None identified for acceptability, satisfaction, attendance, or adherence

Benefit-harm assessment: The benefits outweigh the risks, harms, and costs of providing
telerehabilitation as compared with in-person services for certain health conditions.

Value Judgments

None.

Intentional Vagueness

The recommendation is vague with respect to specific patients and clients; however, it is noted
that consistent results are seen across health conditions including orthopedics (hip and knee
arthroplasty), heart failure, stroke, breast cancer, incontinence, COPD, chronic respiratory
disease, and Parkinson disease. These conditions may not be representative of the broader
population nor of their social determinants of health.

Role of Patient Preferences

Patients may appreciate engaging with clinicians in shared decision making to determine if
telerehabilitation is an acceptable mode of delivery.

Exclusions

Exclusions include when the patient indicates a preference for in-person care, when the clinician
is not trained in telerehabilitation, or when health conditions preclude safe delivery of
telerehabilitation services.
Quality Improvement

Organizations could use documentation of patient experiences to determine acceptability, satisfaction, adherence, and attendance to inform service improvement strategies.

Implementation and Audit

Physical therapists should consider when to recommend telerehabilitation or hybrid care, document adherence and attendance rates for telerehabilitation and non-telerehabilitation sessions, and routinely collect and review acceptability and satisfaction ratings.

Future Research

Studies are needed with additional patient health conditions and age groups (including pediatric patients) to further evaluate acceptability, satisfaction, attendance, and adherence when using telerehabilitation in clinical practice and to understand the influential factors.
**Telerehabilitation Preparation**

**Recommendation 2:** Physical therapists and patients should discuss whether telerehabilitation is a cost-effective option compared with in-person care in the context of their circumstances and conditions.

**Evidence Quality:** Moderate

**Strength of Recommendation:** Moderate

**Action Statement Profile:**

Aggregate evidence quality: 1 moderate-quality SR, 1 moderate-quality RCT and 1 low-quality RCT.

**Rationale**

For this recommendation, 1 SR with 9 RCTs (n=1,266), 1 RCT targeting patients with total hip arthroplasty/total knee arthroplasty (THA/TKA, n=306), and 1 RCT targeting patients with heart failure (n=53) were examined. Within the SR, only 4 of the 9 RCTs evaluated resource utilization. According to Janssen et al., study quality of the included RCTs was predominantly affected by the lack of blinding. Of note, blinding is particularly challenging when performing comparative research with telerehabilitation.

The number of studies comparing telerehabilitation versus conventional in-person therapy is limited in number yet consistent results suggest that overall health care costs are lower for telerehabilitation. These findings are limited to patients with THA/TKA and patients with chronic heart failure. Generalizability to other patient populations may be limited at this time.

Physical therapists should consider differentiating costs to patients, providers, and society for telerehabilitation during discussions on overall cost effectiveness of treatment options.

For example, Hwang et al. reported “telerehabilitation appears to be a cost-saving intervention for the health care provider, compared to traditional centre based rehabilitation.” (pg. 1801)

However, they further reported the use of “relatively low-cost technologies in the home, including resistance bands and laptop computers, versus the technologies used in the centers.” (pg. 1802) They also reported the “inclusion of hospital costs only” and the “exclusion of other health system costs such as costs related to general practitioner visits or medications (ancillary costs).”

Jansson et al. reported significant differences in costs only when the distance from home to the healthcare center was more than 30 km (18.64 miles). This moderate-quality evidence indicates that costs per session are lower with telerehabilitation than with in-person care for patients with THA/TKA who live at least 30 km from the health care center. When looking at patients who...
live closer than 30 km to the health care center, cost per session did not vary between treatment conditions in rural and urban regions\textsuperscript{29}.

This cost difference could be viewed from the patient perspective, i.e., the further the travel, the higher the savings for the patient, or from the provider perspective when the comparisons include clinicians traveling to conduct home health visits. Bettger, et al.\textsuperscript{24} reported costs from the patient perspective, noting “lower total post-hospital costs at 12 weeks” following hospital discharge. Physician, urgent care, emergency room, home health, and outpatient physical therapy visits, and inpatient hospital, rehabilitation, and skilled nursing facility stays, reported by patients and participating sites, were assigned costs based on Medicare fee-for-service rates. Since telerehabilitation services were not reimbursable services, a \textit{total intervention cost} was assigned to include telerehabilitation direct (clinical encounter) and indirect (technology setup) time. The study did not include the technology costs to patients and therapists, home equipment installation and removal, or patient co-pays, deductibles, travel, and clinic wait time.\textsuperscript{24}

Tousignant et al.\textsuperscript{21} defined costs as an economic evaluation following international guidelines for conducting cost analysis alongside a clinical RCT. The economic analysis was based solely on a health center perspective and not patient related costs. Additionally, only costs related to the delivery of the two services, telerehabilitation and in-person visits, were counted. More specifically, the costs were divided into two categories: (1) costs related to the clinical aspects, and (2) costs related to the technology. For these cost categories, direct costs (i.e., therapist and patient encounter time) were defined as essential for delivering clinical intervention, and indirect costs (i.e., travel distance/km from the clinic) were related to the intervention without being part of it.\textsuperscript{21}

Overall, telerehabilitation direct and indirect costs were poorly outlined in the available evidence, or not defined with standardized methods.

\textbf{Potential Benefits, Risks, Harms, and Costs to Implementing This Recommendation}

\textbf{Benefits:}

- Patient discussions with a provider on telerehabilitation may improve informed decision making.
- Cost transparency may remove presuppositions and improve access to care.
- Improved flexibility for workforce and practice management of health care providers.
- Greater adherence with treatment plan completion and better clinical outcomes may result in better reimbursement models with certain payers.

\textbf{Risks, harms, and/or costs:}
Individuals receiving care, and/or health care providers, might find unexpected cost barriers to providing care, which may limit the individual’s participation in their treatment plan. Some cost barriers might include:

- Lack of insurance coverage for telerehabilitation
- Complex payment policies
- Lack of access to appropriate or affordable technology and/or connectivity

*Benefit-harm assessment: The benefits outweigh the risks, harms, and costs of discussing the costs of telerehabilitation as compared with in-person services for certain health conditions and patient populations in the context of individual circumstances.*

**Value Judgments**

The APTA Physical Therapist Standards of Practice\(^3\) state that fiscal management must allow for cost-effective resource utilization. Even so, the value placed on cost effectiveness discussions with patients may vary among individuals, organizations, and society.

The total cost of care is a factor in achieving optimal patient outcomes. This factor disproportionately impacts patients in lower socioeconomic situations or with geographic challenges. For this reason, it is even more important to define and discuss the burden of direct health care costs, as well as indirect costs, such as those associated with time away from work or home, travel challenges, childcare, and unintended factors that may limit access, despite an individual’s commitment to participate in the treatment plan.

Physical therapists must consider these costs of care, inclusive of individual social determinants, when offering in-person or tele rehabilitation options.

**Intentional Vagueness**

None

**Role of Patient Preferences**

Patients should engage in shared decision making with their clinicians to determine if telerehabilitation is a cost-effective mode of delivery for the patient’s condition and specific treatment session.

**Exclusions**

None.

**Quality Improvement**
Telerehabilitation costs may be impacted by access, service delivery options, staffing capacity, geography, and patient choice. Quality of service delivery may be improved through shared decision making between patients and service providers.

**Implementation and Audit**

Clinicians may need training on the actual costs of both service delivery modes and culturally sensitive methods of discussing costs with patients. Audit the frequency of documented shared decision-making about the costs of telerehabilitation versus in-person care delivery.

**Future Research**

Studies are needed to define the total cost of care, including direct and indirect costs to patients and providers, potential cost savings from rehospitalizations, earlier triage to care, duration and completion of care, and caregiver burden, and across more health conditions, as a result of receiving physical therapy through telerehabilitation.
Recommendation 3. Physical therapists should identify and work to reduce barriers and promote facilitators identified from the patient’s perspectives and experiences when planning and providing telerehabilitation services.

Evidence Quality
High

Recommendation Strength
Strong

Action Statement Profile
Aggregate evidence quality: 1 high quality SR\textsuperscript{32} and 5 high-quality descriptive studies.\textsuperscript{33-37}

Rationale
The SR\textsuperscript{32} examined 16 studies (429 patients) of multiple designs using a framework for implementation studies (Consolidation Framework for Implementation Research-CFIR). The remaining 5 studies (243 patients) \textsuperscript{33-37} were qualitative and involved semi-structured provider interviews, with some studies including self-reported questionnaires, surveys and/or focus groups. All studies compiled, analyzed, and categorized participant interview/survey results according to themes or domains.\textsuperscript{33-37}

Studies were conducted across the globe (Australia, Netherlands, Singapore, UK) on adults with chronic conditions, such as amyotrophic lateral sclerosis (ALS), low back pain, COPD, whiplash, knee osteoarthritis (OA), and acute conditions, such as post-stroke. The studies examined various modalities for telerehabilitation delivery, including telephone-based exercise therapy, video conferencing, and home-based self-monitoring.

Common facilitators identified by patients in all studies included better access to care, increased flexibility with scheduling, and convenience of in-person care for patients in rural areas or with conditions that limited travel ability. Some patients felt telerehabilitation served as a self-motivator to perform exercises on their own or to incorporate exercise into their daily activities. The Lawford et al.\textsuperscript{35} study only used telephone-based therapy; patients felt more comfortable and less anxious engaging with their therapists over the phone than with in-person consultations. These patients also felt that their care was more personalized because their therapists focused solely on them.

Barriers identified by patients frequently corresponded with their health conditions and severity levels, comorbidities, ages, familiarity with technology, and social demands. Some patients, acute post-stroke, found setting up the required equipment too cumbersome, which served as a de-motivator to engage in telerehabilitation sessions.\textsuperscript{37} The main human factor barrier reported in all studies was the lack of or a desire for human contact. This included patients wanting hands-on...
guided exercise demonstrations, and patients who required caregiver assistance to perform exercises, which may not always be possible. Technology was a barrier cited in all studies including lack of digital literacy, software and hardware issues, connectivity challenges, and slow data extraction in the case of using home or self-monitoring devices.

Potential Benefits, Risks, Harms, and Costs to Implementing This Recommendation

Benefits:

- Accurate identification of barriers and facilitators may clarify which patients will benefit from telerehabilitation.
- Improved adherence to treatment and completion of prescribed tasks (e.g., home exercise, scar massage, mobilization).
- Increase in patient confidence, ease, and reduced anxiety with physical therapist services if barriers can be accommodated.

Risks, harms, and/or costs:

- Lack of identifying barriers (e.g., lack of access to connectivity and suitable technology) to telerehabilitation may limit successful service provision.
- Breach of privacy and cybersecurity concerns (e.g., when people not related to the treatment may be co-located).
- Ineffective referral or service provision when patients’ barriers to receiving telerehabilitation are not predetermined.

Benefit-harm assessment: The benefit of assessing and addressing facilitators and barriers experienced by patients seeking or receiving physical therapist services via telerehabilitation outweigh the risks, harms, and costs of assessing and addressing barriers and facilitators.

Value Judgments

Patients need to be assessed on an individual basis, taking into consideration their health condition, personal and environmental factors, ability to afford, access, and navigate technology and therapeutic equipment, motivation and desire to perform therapy on their own, the home environment, and their social support networks.

Intentional Vagueness

None.

Exclusions

None.

Quality Improvement
Identifying barriers and facilitators to telerehabilitation as an optional mode of delivery for patients in the service delivery locale may enhance screening efficiency to determine appropriate candidates.

**Implementation and Audit**

Organizations may benefit from comparing the types of technology used to deliver telerehabilitation to track those technologies that are successful.

Standardized assessments may be needed to document patients’ characteristics, available technology, human factors, and access barriers and facilitators to ensure patient readiness for telerehabilitation.

Audit the frequency of typical barriers in the geographic service area in order to develop appropriate solutions or supports.

**Future Research**

Research on patient barriers and facilitators across the lifespan may enhance service delivery. Development of psychometrically sound telerehabilitation readiness questionnaires for patients may enhance care.
Recommendation 4. Physical therapists should identify and work to reduce clinician and organizational barriers and promote facilitators to support the delivery of telerehabilitation services.

Evidence Quality:
High to moderate

Strength of Recommendation:
Strong

Action Statement Profile:
Aggregate evidence quality: 1 high quality SR$^{32}$, 1 high-quality$^{38}$, 2 moderate$^{39,40}$ and 1 low-quality$^{41}$ survey studies, and 6 high-quality qualitative studies.$^{33,36,37,42-44}$

Rationale:
One SR and 10 descriptive studies were identified. The SR$^{32}$ examined 16 studies of multiple designs (37 health care providers) using an implementation framework (Consolidation Framework for Implementation Research-CFIR). The remaining 10 studies (1,687 physical therapists and 63 other health care providers including nurses, occupational therapists, respiratory therapists, physicians, and technicians) were descriptive, with some studies including self-reported questionnaires, surveys, focus groups, and/or semi-structured provider interviews.
All studies compiled, analyzed, and categorized participant interview/survey results according to themes or domains. All studies were cross-sectional except a longitudinal study by Rayce et al.$^{36}$

Studies were conducted across the globe, in Australia, the United States, Denmark, Kuwait, Ireland, the Netherlands, Saudi Arabia, Singapore, Switzerland, and UK, in public and private settings. Patient populations included adults and children, with chronic health conditions, such as ALS, low back pain, COPD, whiplash, and knee OA, and acute conditions such as post-stroke, along with unspecified health conditions.

All studies addressed facilitators and barriers of using telerehabilitation from the healthcare provider perspective. The SR$^{32}$ focused on physical therapists serving patients with ALS. This study included videoconferencing, home-based self-monitoring, and non-invasive ventilation monitoring as the telerehabilitation delivery mechanisms. Two studies$^{33,42}$ surveyed providers who treated patients with musculoskeletal conditions/injuries and included telerehabilitation delivered through videoconferencing. Three studies$^{36,43,44}$ addressed telerehabilitation delivery for patients with chronic respiratory conditions and one addressed telerehabilitation for persons...
in the acute post-stroke phase.\textsuperscript{37} Four studies\textsuperscript{38-41} addressed delivery of telerehabilitation to patients with unspecified conditions; one was targeted toward the pediatric population.\textsuperscript{40} Three studies addressed telerehabilitation implementation during the COVID-19 pandemic.\textsuperscript{38-40}

\textit{Patient Facilitators as Perceived by Physical Therapists}

Providers in the majority of studies reported that telerehabilitation improved patient access to care and was convenient, especially for patients who needed to travel long distances or had difficulty leaving their home to attend in-person appointments.\textsuperscript{32,33,37,39,42,43} Telerehabilitation was viewed as an option for assessing patients and a desirable intervention delivery mode between in-person appointments.\textsuperscript{32,33,37,39,42} Indirect cost savings to the patients were cited when patients had to request time off from work, arrange/pay for childcare to attend in-person therapy sessions, or pay for transportation.\textsuperscript{33,37} Facilitators to telerehabilitation provision included having caregiver assistance,\textsuperscript{33,37,40} use of simple technology interfaces,\textsuperscript{32} and a robust internet connection.\textsuperscript{32,40}

\textit{Patient Barriers as Perceived by the Physical Therapists}

Therapists’ perceived patient barriers to telerehabilitation included access to the appropriate equipment,\textsuperscript{33,39,40,42} poor (or lack of) internet connectivity,\textsuperscript{32,39,40,42} limited ability to navigate the technology,\textsuperscript{33,39,42,44} inability to perform the exercises without hands-on assistance,\textsuperscript{33,37,39,40,42} and overall receptiveness to participate in telerehabilitation.\textsuperscript{33,37,39,40,42} Therapists cited low health literacy and low digital literacy as barriers to effective treatment via telerehabilitation.\textsuperscript{33,39,42,44} Cultural and social barriers, specifically gender issues, were reported in the Kuwaiti study.\textsuperscript{39} The Singapore study using telerehabilitation to treat patients with acute stroke noted cultural issues surrounding the expectations of domestic help hired to assist patients.

\textit{Provider Facilitators}

Provider characteristics that facilitated telerehabilitation use were clinician attitudes, skills and knowledge, the setting for telerehabilitation delivery, assessment standardization, and support for care delivery for both staff and patients. Having clinicians who valued and were willing to provide telerehabilitation services were identified as facilitators.\textsuperscript{39} Skills in and knowledge of technology, in particular reading remote monitoring data,\textsuperscript{32} staff training,\textsuperscript{39,42} and training and support for patients\textsuperscript{32} facilitated telerehabilitation delivery. Finally, providing telerehabilitation from a clinical setting where one could consult with other clinicians\textsuperscript{41} and having a standardized assessment\textsuperscript{32} also facilitated telerehabilitation.

\textit{Provider Barriers}

Clinicians consistently reported being unable to perform comprehensive assessments.\textsuperscript{32,36,38,39,42} Specifically, the lack of physical contact hindered both the assessment\textsuperscript{32,37,38} and treatment.\textsuperscript{33,38,42} Further, they felt they could not fully observe patients.\textsuperscript{36,37} These issues were exacerbated with high clinical complexity or when patients’ sensory deficiencies commonly associated with aging
interfered with communication quality.\textsuperscript{33, 37} The need for an engaged caregiver was deemed essential in providing care via telerehabilitation for pediatric\textsuperscript{40} and acute neurological cases\textsuperscript{37}. Concerns were raised about patient safety and well-being in relation to undertaking neurological assessments.\textsuperscript{42} Clinicians expressed concerns about the lack of evidence to support telerehabilitation.\textsuperscript{42, 44} It is worth noting that therapists with more telerehabilitation experience generally reported fewer barriers (e.g., “lack of connection” through the screen, and “pushing patients”) than inexperienced therapists.\textsuperscript{43}

Technology was a major barrier identified by providers across studies. Technical barriers included: poor connectivity,\textsuperscript{32, 37, 40, 42} complicated user interfaces,\textsuperscript{37} cumbersome protocols,\textsuperscript{32} and slow internet speeds that resulted in prolonged periods of data extraction during remote monitoring.\textsuperscript{32} Therapists cited lack of specific training in telerehabilitation service delivery and inadequate IT support as barriers to effective telerehabilitation service delivery.\textsuperscript{39, 41}

Providers were concerned about the costs associated with telerehabilitation services\textsuperscript{32, 39, 41} as well as adequate reimbursement for those services.\textsuperscript{32, 36, 40} Workload was perceived as increased with telerehabilitation, either with the delivery of therapy\textsuperscript{39} or with the amount of un-reimbursed time to prepare for therapy sessions (e.g., training, preparation of materials, etc.).\textsuperscript{33}

Both patient and clinician characteristics and expectations were noted as possible facilitators and barriers to effective telerehabilitation delivery.\textsuperscript{33, 37, 39, 40} Depending on the severity of patient conditions, both barriers and facilitators were identified: When mild they were viewed by clinicians as facilitators and when moderate they were considered barriers.\textsuperscript{37, 40} Patient and clinician care expectations and previous telerehabilitation experience were noted as influencers on whether clinicians considered the telerehabilitation sessions to be effective.\textsuperscript{33, 37, 40} As with other forms of therapy, telerehabilitation may be more appropriate for some therapists and patients than others and is heavily influenced by skills, knowledge, and previous experience with telerehabilitation.

### Potential Benefits, Risks, Harms, and Costs to Implementing This Recommendation

#### Benefits:

- Increase in skills, knowledge, and confidence in using telerehabilitation with clinicians’ ability to assess barriers and facilitators.
- Improved access to care when in-person services are unavailable or less convenient (e.g., geographic distance, cost, social distancing specific to the pandemic) and barriers can be accommodated.
- If barriers are identified and accommodated, indirect costs for patients may be reduced (e.g., need to take time off from work, arrange or pay for childcare, or pay for transportation).
- Identifying organizational barriers may support strategies to increase patient access to services and decrease unwarranted variations in service quality.
Risks, harms and/or costs:

- Potential for poorer patient outcomes and experiences if barriers compromise physical therapists’ ability to effectively manage a plan of care via telerehabilitation.
- Physical therapist dissatisfaction and disengagement with telerehabilitation as a viable service delivery option if too many barriers exist.
- Reduction of patient choice and disadvantage to certain sectors of the population if barriers prevent spatial access to services such as specialty care.

Benefit-harm assessment: The benefit of assessing and addressing facilitators and barriers experienced by therapists when providing telerehabilitation outweigh the risks, harms, and costs of assessing and addressing barriers and facilitators.

Value Judgments:

Physical therapists need to have the knowledge, skills, infrastructure, tools, and support to perform telerehabilitation assessments and effectively deliver therapist services to their clients.

Intentional Vagueness:

None.

Exclusions:

None.

Quality Improvement:

Organizations can evaluate whether using standardized assessments aids the efficacy, efficiency, and costs of determining barriers and facilitators to telerehabilitation service delivery.

Implementation and Audit:

Clinicians may require formal technical and clinical education for telerehabilitation to effectively deliver telerehabilitation services. International resources exist to support this type of education.45,46

Clinicians must be aware of practice regulations or patient location to avoid providing illegal or unreimbursed telerehabilitation services.
Organizations may audit documentation of standardized assessments, care plans and the reported barriers and facilitators to delivering care.

Clinician digital literacy, knowledge of, confidence in, and satisfaction with using telerehabilitation should be regularly reviewed to inform educational and organizational strategies.

**Future Research:**

Research that addresses barriers identified by clinicians, and the hands-on skills essential for the delivery of quality care would be useful. This may clarify which patient groups are or are not suitable for telerehabilitation. Validating reported facilitators, such as standardized assessments or checklists, would further enhance telerehabilitation delivery. Research about the education and development of clinicians in telerehabilitation practice may address perceived or real barriers.
**Telerehabilitation Implementation**

**Recommendation 5.** When physical therapists perform components of an examination via telerehabilitation they may use the results to inform the diagnosis with comparable accuracy to an in-person visit for certain health conditions.

Evidence Quality: Low

Strength of Recommendation: Weak

**Action Statement Profile**

Aggregate evidence quality: 8 Low-quality RCTs.\(^{47-54}\)

**Rationale**

Overall, the evidence comparing telerehabilitation’s diagnostic accuracy with in-person assessment of patients entering into physical therapy is consistent but limited. Eight small randomized studies reported moderate concurrent validity between telerehabilitation and in-person assessments of adults with low back pain (LBP),\(^{49,54}\) other musculoskeletal conditions (e.g., ankle, shoulder, elbow),\(^{47,48,50,52,53}\) and Parkinson’s disease.\(^{51}\) There was strong concurrent validity for decisions to refer adult patients for physical therapy, psychology and dietetics.\(^{47}\) The studies were all small but adequately powered, with sample sizes <50 patients; information was lacking regarding sample and study setting representativeness.

Very-low-quality evidence supports telerehabilitation for assessing range of motion, symptoms as measured by the straight leg raise (SLR) test, and pain with motion in patients with LBP\(^ {54}\) but postural assessment of adults with LBP is less likely to be as accurate as in-person assessments.\(^ {54}\) Very-low-quality evidence suggests that overall assessments of adults with LBP may have some agreement between telerehabilitation and in-person physical therapy, but these assessments are highly variable.

Very-low-quality evidence with consistent results supports using telerehabilitation for diagnosing patients with musculoskeletal conditions.\(^ {47,48,50,52,53}\) These studies showed substantial to almost perfect agreement between telerehabilitation and in-person physical examination findings, suggesting reasonable utility of telerehabilitation across a range of populations. The consistent methodology used across studies strengthens these findings.

The papers all share common investigators and were carried out in laboratory or clinical settings rather than in real-world settings. It is unclear how the high level of agreement seen in experimental settings would translate to real-world settings.

Very-low-quality evidence supports using telerehabilitation to assess patients with PD.\(^ {51}\) Agreement was high for all ordinal assessment items (i.e., step test, steps in 360° turn, and total Berg Balance Scale score), with the exception of the total Berg Balance Scale scores. Further
analysis showed that the individual item “Standing on one leg” scored the lowest (50.0 %). The limits of agreement for all continuous data variables (functional and lateral reach, timed up and go test, timed stance test) fell within the clinically acceptable criteria for adequate agreement. This study employed methodology and technology similar to the studies assessing musculoskeletal injury \(^47,48,50,52,53\) and 1 study assessing low back pain.\(^54\) In this study, however, in-person investigators were present at all times to ensure participant safety.

**Potential Benefits, Risks, Harms, and Costs to Implementing This Recommendation**

**Benefits:**

- Patient examinations via telerehabilitation may extend services or service delivery options to those who experience difficulty attending in-person, or when in-person care is challenging (e.g., extreme weather, natural disasters, lack of transportation).
- Ability to conduct examinations via telerehabilitation may increase patient and clinician choice of delivery methods.
- Potential improvement in the timeliness of service delivery.
- Ability for examination to be conducted in a patient’s environment providing relevant contextual information.

**Risks, harms, and/or costs:**

- Potential costs of equipment, software, and internet access by patient and provider if not currently available.
- Potential risks to patient safety that may occur during an examination if a caregiver is unable to assist the patient at home.
- Potential requirement for increased caregiver support for individuals with cognitive, communication, and safety deficits.
- Increased administrative burden to secure and organize a telerehabilitation encounter.
- Potential payment inequity or lack of parity based on geographic locations.

*Benefit-harm assessment: The benefits outweigh the risks, harms, and costs of providing telerehabilitation to inform a physical therapist diagnosis as compared with in-person examination for certain health conditions.*

**Role of Patient and Client Preferences**

Patients and clients may need to assume a more active role in the telerehabilitation examination process. For example, they may need to set up the telerehabilitation environment and technology, self-palpate during a telerehabilitation examination, and find alternative equipment. Some telerehabilitation examinations may require caregiver assistance to ensure patient safety, or to access and use telerehabilitation technology.
Value Judgements

Telerehabilitation examinations are of value if available for patients who would benefit from physical therapist services and who otherwise would not seek services because they are unable to access physical therapy in person.

Intentional Vagueness

Given the limited research available across the entire spectrum of ages and diagnoses, recommendations regarding other health conditions, age groups, standalone telerehabilitation or hybrid combinations, types of telerehabilitation systems, and supervised versus unsupervised telerehabilitation cannot be made.

Exclusions

Regulations or payers for certain locales may not permit examination via telerehabilitation. Clinicians must check with their local regulatory agencies.

Quality Improvement

Using telerehabilitation for physical therapist examinations may increase the ability to serve a wider patient clientele, with improved timeliness, and greater patient satisfaction.

Implementation and Audit

To maintain patient confidentiality and privacy, organizations must use telerehabilitation systems with adequate security (e.g., HIPAA or GDPR - Gen Data Protection Regulation) that are compliant with required standards and documentation processes.

Physical therapists providing telerehabilitation examinations for patients younger than 18 will need to ensure that a parent or guardian is in attendance and recognize that published reliability may not apply, depending on the nature of the condition and the level of patient cooperation.

Physical therapists and clinicians will need to self-assess their levels of comfort and effectiveness for telerehabilitation examination processes, including their ability to establish a positive ‘webside’ manner.

Training in telerehabilitation technology and processes may be needed to ensure patient safety, regulatory compliance, and effective care.

Organizations may audit whether patients are provided a choice of delivery models and the frequency of telerehabilitation and in-person visits for examinations.

Interested parties (e.g., clinicians, managers, organizations, agencies) may audit documentation to assess examinations completed via telerehabilitation.
Future Research

Studies are needed with broader patient and client representation to evaluate the effectiveness of telerehabilitation examination processes (diagnosis and or screening) in real-life clinical practice to improve generalizability.
Recommendation 6. Physical therapists should use telerehabilitation to achieve outcomes similar to in-person care for certain health conditions.

Evidence Quality:
Low

Strength of Recommendation:
Weak upgraded to moderate due to consistent results and inability to blind patients for clinicians.

Action Statement Profile
Aggregate evidence quality: 2 moderate-quality SRs,29,55 1 low-quality SR,14 and 3 moderate-quality RCTs.25,56,57

Rationale
The majority of the included studies comparing telerehabilitation with in-person physical therapy is rated fair for certain patient conditions and diagnoses. The methodological quality of the RCTs included in 2 SRs29,55 are rated fair and in 1 SR14 was rated poor. Similarly, the methodological quality of the 3 individual RCTs56,57 are rated fair. Poor to fair ratings were primarily due to sample size, lack of blinding, attrition, and some concerns around allocation procedures or data handling. Evidence was available for the following health conditions.

Chronic Heart Failure
Critical Outcomes: Evidence from 1 (n=53) RCT25 suggests that there are no differences between telerehabilitation and in-person care for improving exercise capacity in patients with chronic heart failure. The data met criteria for noninferiority at the end of treatment but did not meet criteria at 12 weeks of follow-up.

Chronic Respiratory Disease
Critical Outcomes: Evidence from 1 SR14 suggests that there are no differences between telerehabilitation and in-person care for improving exercise capacity, physical activity, or breathlessness in patients with chronic respiratory disease.

Parkinson Disease
Critical Outcomes: Evidence from 1 small but adequately powered (n=76) RCT57 suggests that balance at the end of treatment was improved for patients with PD who were given access to telerehabilitation using the TeleWii-lab platform relative to patients receiving in-person Sensory Integration Balance Training; this difference is no longer evident at 1 month after treatment has concluded.

Stroke
Critical Outcomes: Evidence from one SR\textsuperscript{55} shows no difference between treatment groups for improving balance.

Evidence from 1 SR\textsuperscript{55} and 1 small but adequately powered (n=52) RCT\textsuperscript{56} is inconsistent with respect to function. While there was no difference between treatment conditions for upper limb function\textsuperscript{55}, Fugl-Meyer scores were improved in the telerehabilitation condition.\textsuperscript{55}

\textit{Total Knee or Total Hip Arthroplasty}

Critical Outcomes: Evidence from one RCT reported in one SR\textsuperscript{20} shows improvements in stiffness scores on the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)\textsuperscript{58} following telerehabilitation relative to in-person care. Other WOMAC dimensions did not vary between treatment groups.

Evidence from one RCT\textsuperscript{22} reported in the SR\textsuperscript{29} shows improvements in distance covered in the 6-Minute-Walk Test following telerehabilitation relative to in-person care. Other WOMAC dimensions did not vary between treatment groups.

\textbf{Potential Benefits, Risks, Harms, and Costs to Implementing This Recommendation}

\textbf{Benefits:}

- Improved access to care when in-person services are unavailable (e.g., geographic distance, cost, social distancing specific to pandemic).
- Improved continuity of care (e.g., consistent patient-provider relationship).
- Greater flexibility in care models (e.g., increased patient and clinician choice of delivery method such as videoconferencing, store-and-forward, hybrid).
- No significant difference in incidence of safety-related adverse events for certain health conditions.
- Ability to monitor patients remotely (e.g., physiological data, therapeutic activities, movement, sleep) when health condition precludes contact.

\textbf{Risks, harms, and/or costs:}

- Increased burden on caregivers to support telerehabilitation consultations for individuals living with disability.
- Potential need for additional training and technology requiring time and resources.

\textit{Benefit-harm assessment: The benefits outweigh the risks, harms, and cost of providing telerehabilitation for patients in need of physical therapist rehabilitation services for certain health conditions.}
Role of Patient and Client Preferences

Telerehabilitation in physical therapy may require caregiver assistance to ensure participant safety or to access technology. The patient’s active role in telerehabilitation has demonstrated higher satisfaction.

Value Judgments

None

Intentional Vagueness

Evidence to date was insufficiently precise to judge the findings equivalent. Most studies had small sample sizes in certain health conditions, and limited health conditions were studied.

Exclusions

None.

Future Research

Studies are needed with standardized documentation of telerehabilitation interventions that specify session frequency, length, type of platforms, and deliverables that can be replicated in real-life clinical practice, taking into consideration social determinants of health.
**Recommendation 7.** Physical therapists should anticipate, prevent, manage, and document occurrences of adverse events specific to telerehabilitation as the mode of delivery.

**Evidence Quality:**

Low

**Strength of Recommendation:**

Weak upgraded to strong, to be consistent with professional codes of ethics to ensure patient safety by being accountable for making sound professional judgements (Principles 3, 6B APTA Code of Ethics). Competencies and standards of safe practice while providing telerehabilitation services should be considered.

**Action Statement Profile:** 2 moderate quality SRs and 2 moderate-quality RCTs with consistent results.

**Rationale**

Patients seeking physical therapy can use telerehabilitation without concern for increased frequency of adverse events related to telerehabilitation compared with in-person care. Adverse or negative events, when reported, were related to consequences of the physical therapists’ interventions, such as post session fatigue or pain. No reported events were related to the mode of delivery. The incidence of reported adverse events specific to physical therapist interventions, as indicated in the different studies, ranged from 8 out of 53 to 11 out of 1937 to 0 out of 1266, with an overall incidence of 19/3256, or .58%.

The body of evidence addressing adverse/negative events in patients undergoing physical therapy via telerehabilitation versus in-person therapy was small yet consistent despite the mixed health conditions in the included studies (e.g., stroke, chronic heart failure, total hip or knee arthroplasty, congestive obstructive pulmonary disease). In studies that reported adverse or negative events, it was suggested that there were no differences between the modes of delivery. It should be noted that these were all low-quality RCTs, that had limited evidence strength due to small sample sizes with many outcome measures, even in SRs that only report on one or two small studies.

In highly supervised experimental settings, rates and types of adverse or negative events in both the in-person and telerehabilitation treatment groups were low. Combined with the findings from the recommendation on patient outcomes, the evidence suggests that, overall, there are low adverse or negative event rates associated with providing physical therapy whether in-person or via telerehabilitation.

**Potential Benefits, Risks, Harms, and Costs**

Benefits:
Support of patient safety and quality improvement.

Ability for documentation to clarify incidence and types of events related specifically to telerehabilitation as the mode of delivery.

Demonstration of adherence to professional codes of ethics.

Risks, harms, and/or costs:

- None identified for prevention, management, or documentation.

Benefit-harm assessment: The benefits outweigh the risks, harms, and cost of providing telerehabilitation for patients in need of physical therapist rehabilitation services for certain health conditions.

Value Judgments

Professional codes of ethics and commitment to “do no harm” are strongly valued in physical therapist practice. The value placed on patient choice of service delivery modes may vary among individuals, organizations, or countries.

Intentional Vagueness

Study descriptions of adverse events lacked differentiation between the types of outcomes that are typically expected due to the health condition and interventions versus telerehabilitation as the mode of delivery.

Role of Patient Preferences

Despite no reported adverse events related to telerehabilitation, clinicians should ensure that patients are aware of their potential to occur. Clinicians and patients should engage in shared decision making to determine if telerehabilitation is an acceptable mode and to obtain patients’ informed consents.

Exclusions

None.

Quality Improvement

Organizations can monitor occurrences and severity of adverse events within each mode of delivery to develop service improvement strategies.

Implementation and Audit

Clinicians may need training on strategies for preventing potential adverse events.

Clinicians may need training to accurately document and review adverse events that contribute to the evidence associated with digital healthcare, versus the consequences of healing and exercise.
Electronic health records, where used, may need to be adapted to record adverse event types and severity.

Future research

Studies of adverse event occurrence, severity, and type specific to the mode of physical therapy delivery versus events associated with diagnosis-specific treatments are needed.

CONCLUSION

Seven recommendations address the efficacy, delivery, facilitators, barriers, and potential for adverse events when preparing and implementing telerehabilitation as a mode of delivery in physical therapy care. The overall body of evidence ranged from strong to weak, generating future research recommendations to move the evidence forward. It is strongly recommended that clinicians self-assess their knowledge, skills, and local regulations for delivering physical therapy care through telerehabilitation and obtain further training and technical support to enhance digital health care in physical therapy. Overall, this clinical practice guideline supports the digitally enabled physical therapist and physical therapist assistant to offer telerehabilitation as a mode of delivering physical therapy services to patients who would benefit from services and whose barriers can be accommodated.
Supplementary Material:

Additional Evidence Tables

Recommendation 1: Physical therapists should recommend telerehabilitation or hybrid care, as they are at least equivalent to in-person physical therapy with respect to patient acceptability and satisfaction and are superior to in-person physical therapy with respect to adherence and attendance for certain health conditions.

<table>
<thead>
<tr>
<th>Study</th>
<th>Appraisal Tool</th>
<th>Evidence Quality Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russell TG, Buttrum P, Wootton R, Jull GA. Internet-based outpatient telerehabilitation for patients following total knee arthroplasty: a randomized controlled trial. <em>JBJS.</em> 2011;93(2):113-120.</td>
<td>GRADE</td>
<td>Moderate RCT</td>
</tr>
<tr>
<td>Nelson M, Bourke M, Crossley K, Russell T. Telerehabilitation is non-inferior to usual care following total hip replacement—a</td>
<td>GRADE</td>
<td>Low RCT</td>
</tr>
</tbody>
</table>

<table>
<thead>
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<tbody>
<tr>
<td>GRADE: Low RCT</td>
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<tr>
<td>GRADE: Low RCT</td>
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<td>GRADE: Low RCT</td>
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<td>GRADE: Low RCT</td>
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<tr>
<td>GRADE: Very Low RCT</td>
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</thead>
<tbody>
<tr>
<td>GRADE: Very Low RCT</td>
<td></td>
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</tbody>
</table>

| Doiron-Cadrin P, Kairy D, Vendittoli P-A, Lowry V, Poitras S, Desmeules F. Feasibility and preliminary effects of a tele- |
|---|---|
| GRADE: Very Low RCT |


Recommendation 4: Physical therapists should identify and work to reduce clinician and organizational barriers and promote facilitators to support the delivery of telerehabilitation services.

<table>
<thead>
<tr>
<th>Study</th>
<th>Appraisal Tool</th>
<th>Evidence Quality Rating</th>
</tr>
</thead>
</table>
Recommendation 7: Physical therapists should anticipate, prevent, manage, and document occurrences of adverse events specific to telerehabilitation as the mode of delivery.
<table>
<thead>
<tr>
<th>Study</th>
<th>Appraisal Tool</th>
<th>Evidence Quality Rating</th>
</tr>
</thead>
</table>
References


1163 https://uspreventiveservicestaskforce.org/uspstf/about-USPSTF/methods-and-
processes/procedure-manual


“I was really sceptical... But it worked really well”: a qualitative study of patient perceptions of telephone-delivered exercise therapy by physiotherapists for people with knee osteoarthritis. *Osteoarthritis and cartilage*. 2018;26(6):741-750.


Knowledge, attitude, and barriers to telerehabilitation-based physical therapy practice in Saudi Arabia. MDPI; 2020:460.


1. **KEY QUESTIONS**

**Scope:**
- Patients of all ages, including caregivers, enrolled or enrolling in physical therapy
- Include different care settings: Outpatient, assisted living, home health setting, school settings, location (low, middle, high income countries)

**KQ 1:** For patients seeking physical therapy, what is the efficacy of providing telerehab compared to traditional in-person care for patient clinical and functional outcomes and diagnostic accuracy?

**KQ 2:** In patients seeking physical therapy, what is the accuracy of telerehab compared to traditional in-person care for diagnosing conditions requiring physical therapy?

**KQ 3:** For patients enrolled in physical therapy, what is the efficacy of providing 100% telerehab or hybrid care compared to traditional in-person care for patient clinical and functional outcomes?

**KQ 4:** For patients enrolled in physical therapy, what is the efficacy of providing 100% telerehab or hybrid care compared to traditional in-person care for occurrence of adverse/negative events?

**KQ 5:** For patients enrolled in physical therapy, what is the result of providing 100% telerehab or hybrid care compared to traditional in-person care on user acceptability/usability?

**KQ 6:** For patients enrolled in physical therapy, what is the cost-effectiveness of providing telerehab compared to traditional in-person care?

**KQ 7:** What are the facilitators and barriers to telehealth implementation for patients and providers? Access, human factors, culture, technology.

**KQ 8:** What are the facilitators and barriers to telehealth implementation for providers?

**Key questions to be included in Evidence Review**

<table>
<thead>
<tr>
<th>KQ</th>
<th>Population</th>
<th>Intervention</th>
<th>Comparator</th>
<th>Outcomes</th>
<th>Timing</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Patients seeking physical therapy</td>
<td>Telerehabilitation/remote initial evaluation</td>
<td>Traditional in person care: Face to face</td>
<td>Patient clinical/functional outcomes</td>
<td>Any</td>
<td>Any</td>
</tr>
<tr>
<td>KQ</td>
<td>Population</td>
<td>Intervention</td>
<td>Comparator</td>
<td>Outcomes</td>
<td>Timing</td>
<td>Setting</td>
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<tr>
<td>2</td>
<td>Patients seeking physical therapy</td>
<td>Telerehabilitation /remote initial evaluation</td>
<td>Traditional in person care: Face to face</td>
<td>Diagnostic accuracy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Patients enrolled in physical therapy</td>
<td>100% Telerehabilitation /remote physical therapy provision Hybrid in person and remote physical therapy provision</td>
<td>100% Traditional in person care: Face to face</td>
<td>Patient clinical/functional outcomes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Patients enrolled in physical therapy</td>
<td>100% Telerehabilitation /remote physical therapy provision Hybrid in person and remote physical therapy provision</td>
<td>100% Traditional in person care: Face to face</td>
<td>Occurrence of adverse/negative events</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Patients enrolled in physical therapy</td>
<td>Telerehabilitation /remote physical therapy provision Hybrid in person and remote physical therapy provision</td>
<td>100% Traditional in person care: Face to face</td>
<td>User acceptability/usability: patients, caregivers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Patients enrolled in physical therapy</td>
<td>Telerehabilitation /remote physical therapy provision Hybrid in person and remote physical therapy provision</td>
<td>Traditional in person care: Face to face</td>
<td>Cost effectiveness (access/quality)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Patients seeking and enrolled physical therapy</td>
<td>Telerehabilitation /remote physical therapy provision/remote monitoring</td>
<td></td>
<td>Barriers to accessing or using care</td>
<td>Barriers to accessing or using care</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td>Facilitators to accessing or using care</td>
<td>Examples: access, human factors, culture, technology, lack of insurance coverage/potential out-of-pocket costs</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>PTs providing PT via telehealth</td>
<td>Telerehabilitation /remote physical therapy provision/remote monitoring</td>
<td></td>
<td>Barriers to administering or providing care</td>
<td></td>
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</tbody>
</table>
2. PROTOCOL:

Systematic Review Protocol

American Physical Therapy Association: Clinical Practice Guideline for the use of Telerehabilitation in Physical Therapy

Objectives for the Systematic Review

ECRI will be conducting a systematic review in support of the American Physical Therapy Association (APTA) clinical practice guideline (CPG) for the use of telerehabilitation in physical therapy practice. This review will cover clinical, diagnostic, and cost-effectiveness outcomes when providing physical therapy treatments or assessment via two-way patient-provider telehealth modalities in comparison to traditional in-person care. Additionally, this review will examine barriers and facilitators for patient access to telehealth care, as well as barriers and facilitators for providers to deliver patient care.

The Key Questions

This systematic review will focus on reviewing the published evidence for the following 8 key questions (KQ):
KQ 1: For patients seeking physical therapy, what is the efficacy of providing telerehab compared to traditional in-person care for patient clinical and functional outcomes?

KQ 2: In patients seeking physical therapy, what is the accuracy of telerehab compared to traditional in-person care for diagnosing conditions requiring physical therapy?

KQ 3: For patients enrolled in physical therapy, what is the efficacy of providing 100% telerehab or hybrid care compared to traditional in-person care for patient clinical and functional outcomes?

KQ 4: For patients enrolled in physical therapy, what is the efficacy of providing 100% telerehab or hybrid care compared to traditional in-person care for occurrence of adverse/negative events?

KQ 5: For patients enrolled in physical therapy, what is the result of providing 100% telerehab or hybrid care compared to traditional in-person care on user acceptability/usability?

KQ 6: For patients enrolled in physical therapy, what is the cost-effectiveness of providing telerehab compared to traditional in-person care?

KQ 7: What are the facilitators and barriers to telehealth implementation for patients?

KQ 8: What are the facilitators and barriers to telehealth implementation for providers?

Population, Interventions, Comparators, Outcomes, Timing and Setting

Population(s): The population of interest for Key Questions 1-7 will include patients of all ages enrolled or enrolling in physical therapy, and caregivers. For Key Question 8, the population of interest will include providers.

The table below describes the interventions and comparators that will be covered in this systematic review. The interventions and comparators are listed according to the key questions they address.

Table 1. Interventions and Comparators

<table>
<thead>
<tr>
<th>KQ</th>
<th>Intervention</th>
<th>Comparator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2</td>
<td>Telerehabilitation/remote initial evaluation</td>
<td>Traditional in person care: Face to face</td>
</tr>
<tr>
<td>3-6</td>
<td>100% Telerehabilitation /remote physical therapy provision</td>
<td>100% Traditional in person care: Face to face</td>
</tr>
<tr>
<td>KQ</td>
<td>Intervention</td>
<td>Comparator</td>
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<td>----------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>7</td>
<td>Telerehabilitation /remote physical therapy provision/remote monitoring</td>
<td>(no comparator)</td>
</tr>
<tr>
<td>8</td>
<td>Telerehabilitation /remote physical therapy provision/remote monitoring</td>
<td>(no comparator)</td>
</tr>
</tbody>
</table>

Table 2 describes the outcomes of interest for all KQs in this systematic review, and indicates the prioritization the Work Group assigned to each outcome.

### Table 2. Outcomes

<table>
<thead>
<tr>
<th>KQ</th>
<th>Outcomes</th>
<th>Defined outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 3</td>
<td>Patient clinical/functional outcomes</td>
<td>Improvement in pain</td>
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<tr>
<td></td>
<td></td>
<td>Improvement in range of motion</td>
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<td></td>
<td></td>
<td>Improvement in ADL/IADL</td>
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<td></td>
<td></td>
<td>Improvement in QoL</td>
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<tr>
<td></td>
<td></td>
<td>Return to work/leisure activity</td>
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<tr>
<td></td>
<td></td>
<td>Therapy/body region specific improvement (e.g., KOOS-Knee Injury Osteoarthritis Outcome Score, Oxford Knee Score)</td>
</tr>
<tr>
<td>2</td>
<td>Diagnostic accuracy</td>
<td>% correct [what other measures would ECRI look for?]</td>
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<tr>
<td>4</td>
<td>Occurrence of adverse/negative events</td>
<td>Adverse events</td>
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<tr>
<td></td>
<td></td>
<td>Treatment-related pain</td>
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<tr>
<td>5</td>
<td>User acceptability/usability</td>
<td>Perceived usefulness or efficacy of treatment</td>
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<tr>
<td></td>
<td></td>
<td>Patient/caregiver satisfaction</td>
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<tr>
<td></td>
<td></td>
<td>Adherence to treatment</td>
</tr>
<tr>
<td>6</td>
<td>Cost effectiveness</td>
<td>Cost effectiveness ratio</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cost comparison</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quality-adjusted life-year</td>
</tr>
<tr>
<td>7</td>
<td>Barriers to accessing or using care</td>
<td>Examples: access, human factors, culture, technology, lack of insurance coverage/potential out-of-pocket costs, scheduling</td>
</tr>
<tr>
<td></td>
<td>Facilitators to accessing or using care</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Barriers to administering or providing care</td>
<td>Examples: Access, human factors, culture, technology, cost to implement clinically, managing patient privacy, scheduling</td>
</tr>
<tr>
<td></td>
<td>Facilitators to administering or providing care</td>
<td></td>
</tr>
</tbody>
</table>
Methods

The methods guiding this systematic review are described below. In part, these methods follow the guidelines for conducting a systematic review set forth by the Agency for Healthcare Research and Quality (AHRQ) in the ‘Methods Guide for Effectiveness and Comparative Effectiveness Reviews.’

Study Selection Criteria

General Inclusion Criteria

- Systematic reviews or clinical studies published on or after January 1, 2010, to March 22, 2021. If multiple systematic reviews address a key question, we will select the most recent and/or comprehensive review. Systematic reviews serve as the first line of evidence for all key questions. In the absence of a systematic review for an intervention, individual studies will be considered for inclusion.
- Studies must be published in English.
- Publication must be a full clinical study or systematic review; abstracts alone will not be included. Similarly, letters, editorials, and other publications that are not full-length clinical studies will not be accepted as evidence.
- Systematic reviews must have searched MEDLINE or EMBASE for eligible publications, performed a risk of bias assessment of included studies, and assessed the quality of evidence using a recognizable rating system, such as GRADE or something compatible (e.g., the Strength of Evidence grading used by the Evidence-based Practice Centers of the Agency for Healthcare Research and Quality). If an existing review did not assess the overall quality of the evidence, evidence from the review must be reported in a manner that allows us to judge the overall risk of bias, consistency, directness, and precision of evidence. We will not use an existing review as evidence if we are not able to assess the overall quality of the evidence in the review.
- Systematic reviews should include a majority of papers using an acceptable study design, or report findings in a manner that allows us to abstract data for acceptable study designs (e.g., a review reporting on RCTs and retrospective cohort studies should report data in a manner that allows us to isolate the RCT data)
- Intervention trials must be must be prospective, randomized controlled trials with an independent control group, and be primary analysis papers, except as noted below.
- For KQs 1, 3, 4, and 5, studies must be randomized controlled trials (RCTs) or systematic reviews of RCTs.
For KQ 2, studies must be RCTs or prospective diagnostic cohort studies, or systematic reviews of these study designs.

For KQ 6, study should be an RCT or analysis of an RCT describing cost-effectiveness data, or systematic reviews of these study designs.

For KQs 7 and 8, any study design, including systematic review, that reports on original data describing barriers and facilitators to care are acceptable.

Study must have enrolled at least 20 patients (10 per study group); Small sample size is associated with increased risk of bias and we downgrade small studies in the GRADE domain of precision: one downgrade for imprecision of a single study with <200 patients per study arm and 2 downgrades for imprecision for <50 total patients.

Study must have reported on at least one outcome of interest.

**Searching for the Evidence:**

**Literature Search Strategies for Identification of Relevant Studies to Answer the Key Questions:** Information professionals performing literature searches within the ECRI Health Technology Assessment/EPC Information Center will follow established guidelines and procedures as identified by the Director of the Information Center. Consistent with our evidence-based searching protocol, for all key questions, we will search the following external databases: MEDLINE and EMBASE (via EMBASE.com), and In Process Medline and PubMed-unique content (via PubMed.gov), and Cumulative Index to Nursing and Allied Health Literature (CINAHL). Our searches of the bibliographic databases will cover the time-period of January 1, 2010, through March 22, 2021. Further details of the bibliographic search strategy used in EMBASE.com and PsycINFO are provided in Appendix A.

We will identify search terms by: (1) reviewing relevant systematic reviews on similar topics identified by members of the research staff; (2) reviewing how other relevant studies are indexed, their subject heading terms, and their keywords; (3) reviewing MeSH, EMTREE, and the PsycINFO thesaurus for relevant and appropriate terms; (4) reviewing the search strategies for previously published relevant guidelines and publications; and (5) discussions with the guideline panel. After reviewing these, we will identify a combination of subject headings and keywords. Team members and the medical librarian will review the search strategies developed using these terms. We will apply a study-design filter to retrieve systematic reviews, comparative studies, and other study designs addressing the key questions of this review.

ECRI staff members will review all articles at the abstract level. We will obtain for full review any articles possibly meeting the inclusion criteria for at least one of the key questions. Individual team members will review all retrieved articles for inclusion; uncertainty about full-length article inclusion will be resolved by discussion and consensus between two team members.
Data Management

Data Abstraction and Data Management: For each study included in this review, we will abstract the following study level details: country, purpose, and quality rating. For previous systematic reviews, we will report the search strategy used, study selection criteria, and overall information about the evidence base, including number of included studies and overall patients enrolled. For intervention studies and previous systematic reviews, we will also abstract data about characteristics of the included patients and treatments being assessed. Finally, for all studies, we will abstract data on the findings for the outcomes of interest for this review.

Rating the Evidence

Assessment of Individual Study Quality (Methodological Risk of Bias of Individual Studies): Risk-of-bias (or study quality) of individual diagnostic, observational, and interventional studies will be assessed using the U.S. Preventive Services Task Force (USPSTF) method. Each study is assigned a rating of Good, Fair, or Poor based on sets of criteria that vary depending on study design. Detailed lists of criteria and definitions of Good, Fair, or Poor ratings for different study designs appear in Appendix VI of the USPSTF procedure manual.

Data Synthesis: We will use a narrative approach to synthesize the evidence for all the Key Questions. Where possible, systematic reviews with quantitative synthesis will be the first line of evidence. For questions in which a previous review was available, individual studies that met this review’s inclusion criteria will be used to supplement or update the previous review. For questions where multiple systematic reviews with similar arrays of included individual studies are available, we will choose the most comprehensive (in terms of the number of high-quality cited studies) and/or recent systematic review for our evidence synthesis to avoid multiple ratings of a similar evidence base. Additional systematic reviews not contributing to the overall grading of evidence may be included in narrative summaries of our findings, particularly if they contain a small number of unique, but high quality, individual studies. For questions for which no previous review was available, we will summarize the overall findings for the outcomes of interest of the individual studies that addressed a key question.

Assessing the Overall Quality of the Body of Evidence for an Outcome: The overall quality of the body of evidence supporting the findings for the outcomes of interest in this report will be assessed using the GRADE system. The GRADE system primarily involves consideration of the following factors: overall study quality (or overall risk of bias or study limitations), consistency of evidence, directness of evidence, and precision of evidence. Given time and resources, other factors such as publication bias may also be considered. The definitions of the factors listed above are provided in Table 3. For more information on the GRADE system go to the GRADE working group website: http://www.gradeworkinggroup.org/
The GRADE system rates the overall quality of the evidence as high, moderate, low, and very low. For instance, a body of evidence that consists of RCTs automatically starts with a rating of high quality. This rating can be downgraded if some of the RCTs have serious flaws such as lack of blinding of outcome assessors, not reporting concealment of allocation, or high dropout rate. Similarly, the quality can be downgraded or further downgraded if inconsistencies of findings are present or if there is a lack of precision surrounding an outcome’s effect size.

Table 3. GRADE Factors Used to Assess the Quality of a Body of Evidence

<table>
<thead>
<tr>
<th>Evidence Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study Quality (Internal Validity or Risk of Bias)</td>
<td>Study quality takes into account the overall risk of bias rating of all the studies included in the evidence base. For the purpose of this review, the overall risk of bias would be the average or median USPSTF rating for studies comprising an evidence base for a key outcome.</td>
</tr>
<tr>
<td>Consistency of Evidence</td>
<td>Consistency of evidence refers to the degree of similarity in the direction of effects or the degree of similarity in the effect sizes (magnitude of effect) across individual studies within an evidence base.</td>
</tr>
<tr>
<td>Directness of Evidence</td>
<td>Direct evidence directly compares interventions of interest in populations of interest and measures patient-oriented outcomes. Evidence can be indirect if the tested intervention differs from the intervention of interest, the study population differs from the population of interest, the outcomes differ from those of primary interest, or treatment comparisons have not been tested in head-to-head comparisons.</td>
</tr>
<tr>
<td>Precision of Evidence</td>
<td>Precision is the degree of certainty surrounding an estimate of effect with respect to an outcome. Precision is primarily assessed by examining the 95% confidence intervals around the summary effect size. CIs within the following ranges indicate non-statistical significance, but are considered precise and should not be downgraded for precision. Further, if a KQ is focused on comparative effectiveness of two interventions estimates within these bounds support findings of equivalence or no difference.</td>
</tr>
</tbody>
</table>

- Summary estimates using ratio statistics: Lower CI: 0.80 to Upper CI: 1.25
- Summary estimates using standardized mean difference: Lower CI: -0.2 to Upper CI: 0.2
- Summary estimates using raw mean difference: Depends on measure or instrument; default is 20% difference on each side

Estimates outside of these bounds would be considered imprecise and downgraded for imprecision.

Assessing Applicability: When describing the evidence base addressing a Key Question, we will discuss aspects of the included studies, such as inclusion/exclusion criteria, characteristics of
included patients, and characteristics of the treatments being assessed, that may make the overall findings of the studies more or less applicable to the population, treatments, or outcomes of interest to this review.
### Appendix A.

## Literature Search Strategy

<table>
<thead>
<tr>
<th>Name</th>
<th>Date Limits</th>
<th>Platform/Provider</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bibliographic Databases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cumulative Index to Nursing and Allied Health Literature (CINAHL)</td>
<td>January 1, 2010 through March 16, 2021</td>
<td>EBSCO</td>
</tr>
<tr>
<td>EMBASE (Excerpta Medica) and MEDLINE</td>
<td>January 1, 2010 through March 22, 2021</td>
<td>Elsevier</td>
</tr>
<tr>
<td>PubMed (In-process and Publisher records)</td>
<td>January 1, 2010 through March 16, 2021</td>
<td>NLM</td>
</tr>
</tbody>
</table>

## EMBASE and MEDLINE with EMBASE.com syntax

<table>
<thead>
<tr>
<th>Set #</th>
<th>Concept</th>
<th>Strategy</th>
</tr>
</thead>
</table>
| #1    | Population: Patients (or caregivers) seeking or enrolled in physical therapy | `('athletic rehabilitation'/de OR 'functional training'/de OR 'geriatric rehabilitation'/de OR physical medicine/exp/mj OR 'physiotherapy'/exp/mj OR 'pulmonary rehabilitation'/de OR 'rehabilitation care'/de

| #2    |                                                                        | ((physical therap*/ OR thera* OR physiotherapy*/ OR exercise*) AND rehabilitation):ti,ab,kw OR 'exercise rehabilitation':ti,ab,kw OR exercise-training:ti,ab,kw OR (physical NEXT/2 therap*):ti,ab,kw

| #3    |                                                                        | ((rehabilitation OR rehabilitate OR physiotherapy OR 'physlogical therapy’ OR (phys* NEXT/2 therapy)):	i

| #4    |                                                                        | #3 AND ((replace*:ti OR arthroplasty*:ti) AND (knee* OR hip OR joint)):ti,ab,kw

| #5    |                                                                        | #3 AND ((back NEXT/3 pain*) OR 'cerebrovascular accident’ OR 'chronic obstructive pulmonary disease’ OR COPD OR CHF OR disability OR disabilities OR injur* OR 'low back pain’ OR 'motor performance’ OR post-surg* OR recover* OR spine OR spinal OR stroke):ti,ab

| #6    |                                                                        | #1 OR #2 OR #4 OR #5

| #7    | Interventions:                              | 'teleconference'/de OR 'teleconsultation'/de OR ‘telediagnosis’/de OR 'telehealth'/exp/mj OR 'telemedicine'/exp/mj OR 'telerehabilitation'/de OR 'teletherapy'/de OR 'videoconferencing'/de OR ‘virtual rehabilitation system’/de OR ('health care delivery'/exp/mj AND (teleconsul* OR telerehab* OR televideo* OR videoconference* OR virtual OR remote OR synchronous):ti)

| #8    |                                                                        | ("e health*" OR "e care" OR "e consult*" OR "e medicine" OR "e therap*" OR ((distant* OR electronic OR remote* OR video* OR virtual OR real-time OR 'real time' OR realtime OR synchronous) NEAR/2 (care OR communicat* OR conferenc* OR consult* OR monitor* OR health* OR rehab* OR therap* OR treatment*)):ti,ab

| #9    |                                                                        | (tele NEXT/1 (car* OR conferenc* OR consult* OR counsel* OR health OR homecare* OR intervention* OR manag* OR medicine OR refer* OR support* OR therap* OR treat* OR visit*)):ti,ab
<table>
<thead>
<tr>
<th>Set #</th>
<th>Concept</th>
<th>Strategy</th>
</tr>
</thead>
</table>
| #10   | (ecare OR econsult* OR ehealth* OR emedicine* OR etherap* OR ‘interactive virtual rehabilitation’ OR internet-based OR mhealth* OR ‘remote rehab*’ OR ‘remote technolog*’ OR telear* OR teleconferenc* OR teleconsult* OR telecounsel* OR telehealth OR telehomecare* OR teleintervention* OR telecomanag* OR telemed* OR telerefer* OR telerehab* OR tele-rehab* OR telesupport* OR teletherap* OR telerehab* OR tele* OR telerehab* OR telesupport* OR teletherap* OR telerehab*):ti,ab,kw
<p>| #11   | Home based care | (‘home based’ OR ‘in home’ OR ‘at home’ OR telerehab*):ti,ab AND (synchronous OR ‘real time’ OR virtual* OR video*):ti |
| #12   | Computer/Electronic applications | ‘android’/de OR ‘iphone’/de OR ‘mobile health application’/de OR ‘mobile phone’/exp OR ‘rehabilitation software’/exp OR ‘self-care software’/exp OR ‘smartphone’/de OR ‘web-based intervention’/de |
| #13   | Remote monitoring | (Android* OR app OR apps OR cellphone* OR cell-phone* OR computer OR ‘computer based’ OR digital OR email OR ‘e mail’ OR facetime OR ‘face time’ OR internet OR mhealth* OR ‘m health*’ OR ‘internet based’ OR ipad* OR iphone* OR online OR ‘on line’ OR ‘mobile health’ OR (mobile NEXT/3 health) OR smartphone* OR ‘smart phone*’ OR tablet* OR ‘technology supported management’ OR ‘technology based intervention*’ OR text OR texting OR texts OR ‘web based’):ti,ab |
| #14   | Remote coaching | (((‘home based’ OR remote OR telerehab*) AND coach*) OR ‘remote coaching’ OR telecoach* OR ‘tele coach*’):ti,ab,kw |
| #15   | Combine interventions | #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 |
| #16   | Combine Population and interventions (KQ1 through KQ5) | #6 AND #16 |
| #17   | Population KQ7, KQ8 Patient seeking and enrolled in PT | ‘athletic rehabilitation’/de OR ‘functional training’/de OR ‘geriatric rehabilitation’/de OR ‘physical medicine’/exp/mj OR ‘physiotherapy’/exp/mj OR ‘pulmonary rehabilitation’/de OR ‘rehabilitation care’/de |
| #18   | ((‘physical therap*’ OR therapeutic* OR physiotherapy* OR exercise*) AND rehabilitation):ti,ab,kw OR ‘exercise rehabilitation’:ti,ab,kw OR exercise-training:ti,ab,kw OR (physical NEXT/2 therap*):ti,ab,kw |
| #19   | PTs providing PT via telehealth | ‘physiotherapist’/de OR ‘physiotherapy practice’/de OR ‘physical therap*:ti,ab OR ((‘health care professional’/exp OR ‘outpatient department’/de OR ‘professional practice’/exp) AND (‘physical therap*:ti OR physiotherapy*:ti)) |
| #20   | Combine Population (KQ7, KQ8) | #18 OR #19 OR #21 OR #22 OR #23 |</p>
<table>
<thead>
<tr>
<th>Set #</th>
<th>Concept</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>#25</td>
<td>Barriers - providers</td>
<td>'health personnel attitude'/exp OR 'barrier' OR (accept OR acceptance OR adapt* OR attitude* OR perception* OR prefer* OR dissatisfied OR dis-satisfied OR barrier* OR challenge* OR concern* OR difficult* OR disadvantage* OR hurdle* OR issue* OR obstacle*):ti</td>
</tr>
<tr>
<td>#26</td>
<td></td>
<td>'clinical competence'/exp OR 'competence'/exp OR 'competency'/de OR 'logistics'/de OR (competen* OR logistic* OR prepar* OR security OR set up OR setup OR training OR toolkit OR tools OR resources OR platform OR software OR equipment OR laptop* OR computer OR broadband OR broadwith):ti</td>
</tr>
<tr>
<td>#27</td>
<td></td>
<td>'confidentiality'/exp OR 'informed consent'/exp OR 'medical liability'/exp OR 'insurance'/exp OR 'legal liability'/exp OR 'malpractice'/exp OR 'medicare'/exp OR 'medicaid'/exp OR 'health insurance'/exp OR 'reimbursement'/exp OR (comply OR compliance OR confidential* OR ethic* OR 'informed consent' OR govern* OR manage* OR protocol* OR “HIPAA” OR laws OR legal* OR legislat* OR liability OR liabilities OR regulate* OR regulation* OR privacy OR protect* OR consent* OR malpractice OR cost OR costs OR economic* OR expenditure* OR insurance* OR Medicaid OR medicare OR payor* OR payer* OR payment OR reimburs* OR financ*):ti</td>
</tr>
<tr>
<td>#28</td>
<td>Barriers – patients</td>
<td>'patient attitude'/mj OR ((client* OR patient* OR caregiver*):ti AND (attitude* OR difficult* OR accessib* OR accept* OR engage* OR obstacle* OR barrier* OR participat* OR satisf* OR dissatisf* OR hesitan* OR prefer* OR cost* OR knowledge)):ti,ab</td>
</tr>
<tr>
<td>#29</td>
<td>Combine barriers – providers or patients</td>
<td>#25 OR #26 OR #27 OR #28</td>
</tr>
<tr>
<td>#30</td>
<td>Combine Population (KQ7, KQ8) and Barriers</td>
<td>#24 AND #29</td>
</tr>
<tr>
<td>#31</td>
<td>Final sets</td>
<td>#17 OR #30</td>
</tr>
</tbody>
</table>

Apply limits

| #32 |  | #31 AND [2010-2021]/py AND [English]/lim AND [humans]/lim |
| #33 |  | #32 NOT ([animals]/lim NOT [humans]/lim) OR (animal* OR experimental OR (vitro NOT vivo) OR canine OR dog OR dogs OR mouse OR mice OR murine:ti OR pig OR pigs OR piglet* OR porcine OR rabbit* OR rat OR rats OR rodent* OR sheep OR swine):ti |
| #34 |  | #33 NOT ('conference paper'/exp OR [conference abstract]/lim OR [conference paper]/lim OR [conference review]/lim OR ('case report' OR book OR editorial OR erratum OR letter OR note OR 'short survey')/de OR (book OR conference OR editorial OR erratum OR letter OR note OR 'short survey'):it OR ('a case' OR 'year old'):ti:ab OR (book OR 'conference proceeding'):pt OR ('case report' OR comment OR ((rationale OR study) NEAR/3 protocol) OR 'protocol for'):ti |
| #35 |  | #34 AND ('meta analysis'/exp OR 'systematic review'/de OR [cochrane review]/lim OR systematic*:ti OR (cochrane OR metaanaly* OR "meta analy*" OR (search* AND (databases OR electronic OR methodolog* OR embase* OR ebsco* OR medline* OR ovid* OR sciencedirect* OR scopus* OR systematic OR web)) OR (systematic* NEAR/2 review*)):ti,ab) |
| #36 |  | #34 AND ('random sample'/de OR 'randomized controlled trial'/de OR randomization/de OR (random* OR RCT)):ti,ab |
### 3. Evidence Synthesis Results:

**Use of Telerehabilitation in Physical Therapy**

**Evidence Synthesis Report**

**Clinical Practice Guideline**

*Prepared for:*

The American Physical Therapy Association
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Objectives for the Systematic Review

ECRI will be conducting a systematic review in support of the American Physical Therapy Association (APTA) clinical practice guideline (CPG) for the use of telerehabilitation in physical therapy practice. This review will cover clinical, diagnostic, and cost-effectiveness outcomes when providing physical therapy treatments or assessment via two-way patient-provider telehealth modalities in comparison to traditional in-person care. Additionally, this review will examine barriers and facilitators for patient access to telehealth care, as well as barriers and facilitators for providers to deliver patient care.

The Key Questions and Scope

This systematic review will focus on reviewing the published evidence for the following 8 key questions (KQ)

KQ 1: For patients seeking physical therapy, what is the efficacy of providing telerehab compared to traditional in-person care for patient clinical and functional outcomes?
KQ 2: In patients seeking physical therapy, what is the accuracy of telerehab compared to traditional in-person care for diagnosing conditions requiring physical therapy?
KQ 3: For patients enrolled in physical therapy, what is the efficacy of providing 100% telerehab or hybrid care compared to traditional in-person care for patient clinical and functional outcomes?
KQ 4: For patients enrolled in physical therapy, what is the efficacy of providing 100% telerehab or hybrid care compared to traditional in-person care for occurrence of adverse/negative events?
KQ 5: For patients enrolled in physical therapy, what is the result of providing 100% telerehab or hybrid care compared to traditional in-person care on user acceptability/usability?
KQ 6: For patients enrolled in physical therapy, what is the cost-effectiveness of providing telerehab compared to traditional in-person care?
KQ 7: What are the facilitators and barriers to telehealth implementation for patients?
KQ 8: What are the facilitators and barriers to telehealth implementation for providers?
Population, Interventions, Comparators, Outcomes, Timing and Setting

Population(s): The population of interest for Key Questions 1-7 will include patients of all ages enrolled or enrolling in physical therapy, and caregivers. For Key Question 8, the population of interest will include providers.

The table below describes the interventions and comparators that will be covered in this systematic review. The interventions and comparators are listed according to the key questions they address.
Table 1. Interventions and Comparators

<table>
<thead>
<tr>
<th>Key Question</th>
<th>Interventions</th>
<th>Comparators</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 2</td>
<td>Telerehabilitation/remote initial evaluation</td>
<td>Traditional in person care: Face to face</td>
</tr>
<tr>
<td>3-6</td>
<td>100% Telerehabilitation/remote physical therapy provision</td>
<td>100% Traditional in person care: Face to face</td>
</tr>
<tr>
<td></td>
<td>Hybrid in person and remote physical therapy provision</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Telerehabilitation/remote physical therapy provision/remote monitoring</td>
<td>(no comparator)</td>
</tr>
<tr>
<td>8</td>
<td>Telerehabilitation/remote physical therapy provision/remote monitoring</td>
<td>(no comparator)</td>
</tr>
</tbody>
</table>

Outcomes(s): Table 2 describes the outcomes of interest for all KQs in this systematic review, and indicates the prioritization the Work Group assigned to each outcome. It should be noted that most studies did not report on many of the pre-defined outcomes. ECRI reports on the best approximation of the critical outcomes, where no critical outcomes were reported for a paper, if an important outcome was reported, we elevated it to critical.

Table 2. Outcomes

<table>
<thead>
<tr>
<th>Key Question</th>
<th>Critical Outcomes(s)</th>
<th>Important Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 3</td>
<td>Patient clinical/functional outcomes</td>
<td>Improvement in range of motion</td>
</tr>
<tr>
<td></td>
<td>Improvement in pain</td>
<td>Improvement in ADL/IADL</td>
</tr>
<tr>
<td></td>
<td>Improvement in QoL</td>
<td>arda in range of motion</td>
</tr>
<tr>
<td></td>
<td>Return to work/leisure activity</td>
<td>Adherence to treatment</td>
</tr>
<tr>
<td></td>
<td>Therapy/body region specific improvement (e.g., KOOS-Knee Injury</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Osteoarthritis Outcome Score, Oxford Knee Score)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Diagnostic accuracy</td>
<td>Adverse events</td>
</tr>
<tr>
<td></td>
<td>Impact on management decisions</td>
<td>Treatment-related pain</td>
</tr>
<tr>
<td>4</td>
<td>Occurrence of adverse/negative events</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Perceived usefulness or efficacy of treatment</td>
<td>Examples: Access, human factors, culture,</td>
</tr>
<tr>
<td></td>
<td>Patient/caregiver satisfaction</td>
<td>technology, lack of insurance coverage/potential out-of-pocket costs, scheduling</td>
</tr>
<tr>
<td></td>
<td>Adherence to treatment</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Cost effectiveness ratio</td>
<td>Examples: Access, human factors, culture,</td>
</tr>
<tr>
<td></td>
<td>Cost comparison</td>
<td>technology, cost to implement clinically,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>managing patient privacy, scheduling</td>
</tr>
<tr>
<td>7</td>
<td>Barriers to accessing or using care</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Facilitators to accessing or using care</td>
<td>Examples: Access, human factors, culture,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>technology, lack of insurance coverage/potential out-of-pocket costs, scheduling</td>
</tr>
<tr>
<td>8</td>
<td>Barriers to administering or providing care</td>
<td>Examples: Access, human factors, culture,</td>
</tr>
<tr>
<td></td>
<td>Facilitators to administering or providing care</td>
<td>technology, cost to implement clinically,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>managing patient privacy, scheduling</td>
</tr>
</tbody>
</table>

Timing: Any
Settings: Any
Methods

The methods guiding this systematic review are described below. In part, these methods follow the guidelines for conducting a systematic review set forth by the Agency for Healthcare Research and Quality (AHRQ) in the ‘Methods Guide for Effectiveness and Comparative Effectiveness Reviews.’

Study Selection Criteria

General Inclusion Criteria

- Systematic reviews or clinical studies published on or after January 1, 2010, to July 26, 2021. If multiple systematic reviews address a key question, we will select the most recent and/or comprehensive review. Systematic reviews serve as the first line of evidence for all key questions. In the absence of a systematic review for an intervention, individual studies will be considered for inclusion.
- Studies must be published in English.
- Publication must be a full clinical study or systematic review; abstracts alone will not be included. Similarly, letters, editorials, and other publications that are not full-length clinical studies will not be accepted as evidence.
- Systematic reviews must have searched MEDLINE or EMBASE for eligible publications, performed a risk of bias assessment of included studies, and assessed the quality of evidence using a recognizable rating system, such as GRADE or something compatible (e.g., the Strength of Evidence grading used by the Evidence-based Practice Centers of the Agency for Healthcare Research and Quality). If an existing review did not assess the overall quality of the evidence, evidence from the review must be reported in a manner that allows us to judge the overall risk of bias, consistency, directness, and precision of evidence. We will not use an existing review as evidence if we are not able to assess the overall quality of the evidence in the review.
- Systematic reviews should include a majority of papers using an acceptable study design, or report findings in a manner that allows us to abstract data for acceptable study designs (e.g., a review reporting on RCTs and retrospective cohort studies should report data in a manner that allows us to isolate the RCT data).
- Intervention trials must be prospective, randomized controlled trials with an independent control group, and be primary analysis papers, except as noted below.
- For KQs 1, 3, 4, and 5, studies must be randomized controlled trials (RCTs) or systematic reviews of RCTs.
- For KQ 2, studies must RCTs or prospective diagnostic cohort studies, or systematic reviews of these study designs.
- For KQ 6, study should be an RCT or analysis of an RCT describing cost-effectiveness data, or systematic reviews of these study designs.
For KQs 7 and 8, any study design, including systematic review, that reports on original data describing barriers and facilitators to care are acceptable.

Study must have enrolled at least 20 patients (10 per study group); Small sample size is associated with increased risk of bias and we downgrade small studies in the GRADE domain of precision: one downgrade for imprecision of a single study with <200 patients per study arm and 2 downgrades for imprecision for <50 total patients.

Study must have reported on at least one outcome of interest.

Searching for the Evidence

Literature Search Strategies for Identification of Relevant Studies to Answer the Key Questions: Information professionals performing literature searches within the ECRI Health Technology Assessment/EPC Information Center will follow established guidelines and procedures as identified by the Director of the Information Center. Consistent with our evidence-based searching protocol, for all key questions, we will search the following external databases: MEDLINE and EMBASE (via EMBASE.com), and In Process Medline and PubMed-unique content (via PubMed.gov), and Cumulative Index to Nursing and Allied Health Literature (CINAHL). Our searches of the bibliographic databases will cover the time-period of January 1, 2010, through July 26, 2021. Further details of the bibliographic search strategy used in EMBASE.com and PsycINFO are provided in Appendix A.

We will identify search terms by: (1) reviewing relevant systematic reviews on similar topics identified by members of the research staff; (2) reviewing how other relevant studies are indexed, their subject heading terms, and their keywords; (3) reviewing MeSH, EMTREE, and the PsycINFO thesaurus for relevant and appropriate terms; (4) reviewing the search strategies for previously published relevant guidelines and publications; and (5) discussions with the guideline panel. After reviewing these, we will identify a combination of subject headings and keywords. Team members and the medical librarian will review the search strategies developed using these terms. We will apply a study-design filter to retrieve systematic reviews, comparative studies, and other study designs addressing the key questions of this review.

ECRI staff members will review all articles at the abstract level. We will obtain for full review any articles possibly meeting the inclusion criteria for at least one of the key questions. Individual team members will review all retrieved articles for inclusion; uncertainty about full-length article inclusion will be resolved by discussion and consensus between two team members.

Data Management

Data Abstraction and Data Management: For each study included in this review, we will abstract the following study level details: country, purpose, and quality rating. For previous systematic reviews, we will report the search strategy used, study selection criteria, and overall
information about the evidence base, including number of included studies and overall patients enrolled. For intervention studies and previous systematic reviews, we will also abstract data about characteristics of the included patients and treatments being assessed. Finally, for all studies, we will abstract data on the findings for the outcomes of interest for this review.
Rating the Evidence

Assessment of Individual Study Quality (Methodological Risk of Bias of Individual Studies):
Risk-of-bias (or study quality) of individual diagnostic, observational, and interventional studies will be assessed using the U.S. Preventive Services Task Force (USPSTF) method. Each study is assigned a rating of Good, Fair, or Poor based on sets of criteria that vary depending on study design. Detailed lists of criteria and definitions of Good, Fair, or Poor ratings for different study designs appear in Appendix VI of the USPSTF procedure manual.

Data Synthesis: We will use a narrative approach to synthesize the evidence for all the Key Questions. Where possible, systematic reviews with quantitative synthesis will be the first line of evidence. For questions in which a previous review was available, individual studies that met this review’s inclusion criteria will be used to supplement or update the previous review. For questions where multiple systematic reviews with similar arrays of included individual studies are available, we will choose the most comprehensive (in terms of the number of high-quality cited studies) and/or recent systematic review for our evidence synthesis to avoid multiple ratings of a similar evidence base. Additional systematic reviews not contributing to the overall grading of evidence may be included in narrative summaries of our findings, particularly if they contain a small number of unique, but high quality, individual studies. For questions for which no previous review was available, we will summarize the overall findings for the outcomes of interest of the individual studies that addressed a key question.

Assessing the Overall Quality of the Body of Evidence for an Outcome: The overall quality of the body of evidence supporting the findings for the outcomes of interest in this report will be assessed using the GRADE system. The GRADE system primarily involves consideration of the following factors: overall study quality (or overall risk of bias or study limitations), consistency of evidence, directness of evidence, and precision of evidence. Given time and resources, other factors such as publication bias may also be considered. The definitions of the factors listed above are provided in Table 3. For more information on the GRADE system go to the GRADE working group website: http://www.gradeworkinggroup.org/

The GRADE system rates the overall quality of the evidence as high, moderate, low, and very low. For instance, a body of evidence that consists of RCTs automatically starts with a rating of high quality. This rating can be downgraded if some of the RCTs have serious flaws such as lack of blinding of outcome assessors, not reporting concealment of allocation, or high dropout rate. Similarly, the quality can be downgraded or further downgraded if inconsistencies of findings are present or if there is a lack of precision surrounding an outcome’s effect size.
Table 3. GRADE Factors Used to Assess the Quality of a Body of Evidence

<table>
<thead>
<tr>
<th>Evidence Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study Quality (Internal Validity or Risk of Bias)</td>
<td>Study quality takes into account the overall risk of bias rating of all the studies included in the evidence base. For the purpose of this review, the overall risk of bias would be the average or median USPSTF rating for studies comprising an evidence base for a key outcome.</td>
</tr>
<tr>
<td>Consistency of Evidence</td>
<td>Consistency of evidence refers to the degree of similarity in the direction of effects or the degree of similarity in the effect sizes (magnitude of effect) across individual studies within an evidence base.</td>
</tr>
<tr>
<td>Directness of Evidence</td>
<td>Direct evidence directly compares interventions of interest in populations of interest and measures patient-oriented outcomes. Evidence can be indirect if the tested intervention differs from the intervention of interest, the study population differs from the population of interest, the outcomes differ from those of primary interest, or treatment comparisons have not been tested in head-to-head comparisons.</td>
</tr>
</tbody>
</table>
| Precision of Evidence                     | Precision is the degree of certainty surrounding an estimate of effect with respect to an outcome. Precision is primarily assessed by examining the 95% confidence intervals around the summary effect size. CIs within the following ranges indicate non-statistical significance, but are considered precise and should not be downgraded for precision. Further, if a KQ is focused on comparative effectiveness of two interventions estimates within these bounds support findings of equivalence or no difference.  
  • Summary estimates using ratio statistics: Lower CI: 0.80 to Upper CI: 1.25  
  • Summary estimates using standardized mean difference: Lower CI: -0.2 to Upper CI: 0.2  
  • Summary estimates using raw mean difference: Depends on measure or instrument; default is 20% difference on each side  
  Estimates outside of these bounds would be considered imprecise and downgraded for imprecision. |

Assessing Applicability: When describing the evidence base addressing a Key Question, we will discuss aspects of the included studies, such as inclusion/exclusion criteria, characteristics of included patients, and characteristics of the treatments being assessed, that may make the overall findings of the studies more or less applicable to the population, treatments, or outcomes of interest to this review.

Results of Literature Searches

Extensive literature searches identified 5,085 citations potentially addressing the key questions of interest to this evidence review. Of those, 4,235 were excluded upon title review for clearly not meeting inclusion criteria (e.g., not pertinent to the topic, not published in English, published prior to study inclusion publication date, or not a full-length article). Overall, 850 abstracts were reviewed with 363 of those being excluded for the following reasons: not a systematic review or clinical study, did not address a key question of interest to this review, did not enroll a population of interest, or published prior to January 1, 2010. A total of 487 full-length articles were reviewed. Of those, 347 were excluded at a first pass review for the following: not addressing a key question of interest, not enrolling the population of interest, not meeting inclusion criteria for clinical study or systematic review, not meeting inclusion criteria for any key question, or being a duplicate. A total of 140 full-length articles were thought to address one
or more key questions and were further reviewed. Of these, 111 were ultimately excluded and reasons for their exclusion are presented in Figure 1 below. Tables listing all studies excluded at both the full-article and key question level are included in each key question chapter.

Overall, 29 studies addressed one or more of the key questions and were considered as evidence in this review. Table 4 indicates the number of studies that addressed each of the questions. A list of all studies included in this systematic review listed by key question is provided in Appendix B.

Figure 1. Study Flow Diagram
Table 4. Evidence Base for Key Questions

<table>
<thead>
<tr>
<th>Key Question</th>
<th>Question</th>
<th>Number of Studies and Type of Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 3*</td>
<td>For patients seeking physical therapy, what is the efficacy of providing telerehab compared to traditional in-person care for patient clinical and functional outcomes?</td>
<td>3 SRs, 4 RCTs</td>
</tr>
<tr>
<td>2</td>
<td>In patients seeking physical therapy, what is the accuracy of telerehab compared to traditional in-person care for diagnosing conditions requiring physical therapy?</td>
<td>8 RSs</td>
</tr>
<tr>
<td>4</td>
<td>For patients enrolled in physical therapy, what is the efficacy of providing 100% telerehab or hybrid care compared to traditional in-person care for occurrence of adverse/negative events?</td>
<td>2 SRs, 2 RCTs</td>
</tr>
<tr>
<td>5</td>
<td>For patients enrolled in physical therapy, what is the result of providing 100% telerehab or hybrid care compared to traditional in-person care on user acceptability/usability?</td>
<td>1 SR</td>
</tr>
<tr>
<td>6</td>
<td>For patients enrolled in physical therapy, what is the cost-effectiveness of providing telerehab compared to traditional in-person care?</td>
<td>1 SR, 1 RCT</td>
</tr>
<tr>
<td>7</td>
<td>What are the facilitators and barriers to telehealth implementation for patients?</td>
<td>5 qualitative studies</td>
</tr>
<tr>
<td>8</td>
<td>What are the facilitators and barriers to telehealth implementation for providers?</td>
<td>8 qualitative studies</td>
</tr>
</tbody>
</table>

**Total Evidence Base: Several studies addressed more than one KQ** 29 studies

* The literature did not cleanly distinguish patients seeking care from patients enrolled in care, therefore ECRI combined the literature for KQ 1 and 3.

PT: physical therapy; OT: occupational therapy; RCT: randomized controlled trial; SR: systematic review

**Overview of Report**

The remainder of the evidence report is divided into chapters, with each chapter addressing a key question. Each chapter describes the overall evidence base that addresses the question and provides details about the methodological quality of the included studies. Each chapter also describes the patients and treatments considered in the studies and includes a table summarizing the overall quality of the evidence (study profile tables). Finally, the chapters have their own appendices that include more detailed evidence tables, an excluded studies table, and reference list.
Key Question 1/3: For patients seeking or enrolled in physical therapy, what is the efficacy of providing 100% telerehab or hybrid care compared to traditional in-person care for patient clinical and functional outcomes?
Contents

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Table 2. Individual Studies .................................................................................................................................... 132
Table 3. Excluded Studies .................................................................................................................................... 166451
Key Question 1/3: For patients seeking or enrolled in physical therapy, what is the efficacy of providing 100% telerehab or hybrid care compared to traditional in-person care for patient clinical and functional outcomes?

Summary of Evidence Base
The literature did not cleanly distinguish patients seeking care from patients enrolled in care, therefore ECRI combined the literature for KQ 1 and 3.

Our searches identified 3 systematic reviews (SRs) and 3 randomized controlled trials (RCTs) that compared 100% telerehabilitation with various forms of conventional in-person rehabilitation. All included papers presented widely different forms of telerehabilitation and conventional rehabilitation programs. The interventions varied in number of sessions, length of sessions, platform used, and materials delivered. Studies also differed in the type of condition the rehabilitation addressed. We identified 3 SRs that covered a range of conditions such as chronic respiratory conditions, stroke, and total knee or hip arthroscopy (TKA or THA).

We identified one RCT that addressed telerehabilitation in patients with chronic heart failure and one in patients with Parkinson’s disease. We also identified an additional RCT addressing stroke, which was not covered in the existing SRs.

Table 1 lists the included studies along with information about the comparisons covered in the review, and the primary study design and methodological quality of the included studies.

We only considered evidence from SRs or RCTs published on or after January 1, 2010, to July 26, 2021. Additionally, RCTs that were included in the SRs were not considered independently as evidence. See Tables 3 and 4 for detailed information on the characteristics of the studies and patients included in the reviews. Studies excluded as evidence for this key question are presented in Table 5 of Appendices.
### Table 1. Overview of Evidence Addressing Key Question 1/3

<table>
<thead>
<tr>
<th>Review</th>
<th>Intervention(s)</th>
<th>Evidence Base/Study Design</th>
<th>Overall Quality of Included Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cox et al. 2021⁶⁰</td>
<td>Telerehabilitation vs. in-person rehabilitation* in chronic respiratory disease</td>
<td>15 studies (including 9 RCTs) in 1 SR</td>
<td>Poor</td>
</tr>
<tr>
<td>Laver et al. 2020⁶²</td>
<td>Telerehabilitation vs. in-person rehabilitation* in stroke</td>
<td>416 studies (14 studies included in quantitative meta-analysis) in 1 SR</td>
<td>Fair</td>
</tr>
<tr>
<td>Jansson et al. 2020⁶¹</td>
<td>Telerehabilitation vs. in-person rehabilitation* in stroke</td>
<td>9 RCTs in 1 SR</td>
<td>Fair</td>
</tr>
<tr>
<td>Hwang et al. 2017⁶³</td>
<td>Telerehabilitation vs. in-person rehabilitation in chronic heart failure</td>
<td>1 RCT</td>
<td>Fair</td>
</tr>
<tr>
<td>Gandolfi et al. 2017⁶⁴</td>
<td>Telerehabilitation vs. in-person rehabilitation in Parkinson’s disease</td>
<td>1 RCT</td>
<td>Fair</td>
</tr>
<tr>
<td>Chen et al. 2020⁶⁵</td>
<td>Telerehabilitation vs. in-person rehabilitation in stroke</td>
<td>1 RCT</td>
<td>Fair</td>
</tr>
</tbody>
</table>

RCT: randomized controlled trial; SR: systematic review; THA: total hip arthroplasty; TKA: total knee arthroplasty

### Study Quality Rating

The methodological quality of the RCTs included in 3 SRs was rated by the authors of the review as Poor to Fair. Many of the RCTs in the SRs rated as low quality had concerns around outcome reporting, low sample size, attrition, and lack of blinding. There was limited information from the studies in the reviews about other sources of bias like variations between intervention and control conditions between sites or across time and other study details.

The methodological quality of the 3 individual RCTs was rated Fair using U.S. Preventative Services Task Force (USPSTF) criteria for RCTs. Fair ratings are primarily due to small lack of blinding, attrition, and come concerns around allocation procedures or data handling. See Tables 3 and 4 for study quality ratings for each paper.

### Key Findings

Below, we describe the critical outcomes from the included studies with the GRADE strength of the evidence (SOE) rating. Note that a statement of “no difference” between treatments for outcomes does not imply equivalence. Where we judge the findings to be equivalent, it is explicitly stated in the key findings. See Table 2 for factors that influenced the SOE ratings for critical outcomes and for complete details of important outcomes, and Tables 3 and 4 for more information about the characteristics of the included studies.
Chronic Heart Failure

Critical Outcomes

- Evidence from 1 small (n=53) RCT\(^63\) suggests that there are no differences between telerehabilitation and in-person care for improving exercise capacity in patients with chronic heart failure. The data met criteria for noninferiority at the end of treatment, but did not meet criteria at 12 weeks of follow-up. (SOE: Very low)

Chronic Respiratory Disease

Critical Outcomes

- Evidence from 1 SR\(^60\) suggests that there are no differences between telerehabilitation and in-person care for improving exercise capacity, physical activity, or breathlessness in patients with chronic respiratory disease. (SOE across all outcomes: Very low)

Parkinson’s Disease

Critical Outcomes

- Evidence from 1 small (n=76) RCT\(^64\) suggests that balance was improved for patients given access to telehealth using TeleWii-lab platform relative to patients receiving in-person Sensory Integration Balance Training at the end of treatment. (SOE: Low)
  - Evidence from this same RCT shows that this difference is no longer evidence at 1 month after treatment has concluded. (SOE: Very low)

Stroke

Critical Outcomes

- Evidence from 1 SR\(^62\) shows no difference between treatment groups for improvement of balance. (SOE: Low)
- Evidence from 1 SR\(^62\) and 1 small (n=52) RCT\(^65\) is inconsistent with respect to function. While there was no difference between treatment conditions for upper limb function SR\(^62\) Fugl-Meyer scores were improved in the telerehabilitation condition.\(^65\) (SOE: Very low)

Total Knee or Total Hip Arthroplasty

Critical Outcomes

- Evidence from 1 RCT reported in 1 SR\(^61\) shows improvements in stiffness scores on the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) following telerehabilitation relative to in-person care. Other dimensions of the WOMAC did not vary between treatment conditions. (SOE: Very low)
Evidence from 1 RCT reported in 1 SR\textsuperscript{61} shows improvements in distance covered in the 6MWD test following telerehabilitation relative to in-person care. Other dimensions of the WOMAC did not vary between treatment conditions. (SOE: Low)

**Discussion**

Overall, the evidence comparing telerehabilitation versus conventional in-person therapy is modest yet consistent despite the mixed patient diagnoses of the included studies. For most outcomes across studies, Low to Very low quality evidence shows no differences between telerehabilitation and in-person care. Generally speaking, the evidence was insufficiently precise to judge the findings equivalent. The strength of the evidence was limited in most cases by small sample size, with many outcomes even within SRs being represented by one or two small studies.

Low to Very low evidence shows that telerehabilitation was favored in patients with TKA/THA for measures of stiffness and for the 6MWD test,\textsuperscript{61} in patients with Parkinson’s Disease for improvements in balance,\textsuperscript{64} and in patients with stroke for physical function assessed by Fugl-Meyer.\textsuperscript{65} The apparent benefit of telerehabilitation over in-person care in these cases is modest, and likely would not influence a recommendation to choose telerehabilitation over in-person care for these specific outcomes, as other outcomes within these studies did not vary as a function of treatment condition.

Adverse events (covered in Key Question 4) were overall infrequent and suggest that telerehabilitation is a safe and useful means of providing therapy to patients in need of physical therapy. These findings should be taken in context with the findings from KQs 7 and 8, where it is clear that local factors, such as access to technology, patient, caregiver, and provider willingness and training, and other barriers and facilitators to care play a large role in the success or failure of implementing telerehabilitation in physical therapy practice.
Overall Quality of Evidence Rating

Table 2. Overall Assessment of Quality of Evidence Base

<table>
<thead>
<tr>
<th>Outcome (Rating)</th>
<th>Quantity and Type of Evidence</th>
<th>Intervention (Number of Patients) Follow-up</th>
<th>Findings</th>
<th>Study Limitations (Study Quality, Risk-of-Bias)*</th>
<th>Inconsistencyb</th>
<th>Indirectnessc</th>
<th>Imprecisiond</th>
<th>GRADE of Evidence for Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic Heart Failure</td>
<td></td>
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</tbody>
</table>
| Exercise Capacity (Critical) | 1 RCT Hwang et al. 201763 | Telerehabilitation vs. Center-based n=53 Follow-up: 12 weeks | **End of treatment** 6MWT: MD: 15m; 95% CI: -28 to 59  
No difference. Meets predefined criteria for noninferiority.  
12-week follow-up 6MWT: Mean difference between group (n=49): MD: 2; 95% CI: -36 to 41  
No difference. | Serious limitations (-1) | No serious inconsistency | No serious indirectness | Very serious imprecision (-2) (Single small study and wide CIs) | Very low |
| Chronic Respiratory Disease |                                |                                             |          |                                                 |                |              |             |                                |
| Exercise Capacity (Critical) | 1 SR of 15 RCTs (n=1,904) Cox et al. 202160 | Telerehabilitation vs. Center-based 4 RCTs; n=556 Follow-up: End of rehabilitation (range 6 weeks to 12 weeks) | **6MWT**: MD: 0.06 m; 95% CI: -10.82 m to 10.94 m; i²=22%  
No difference. | Very serious limitations (-2) | No serious inconsistency | No serious indirectness | Serious imprecision (-1) | Very low |
<table>
<thead>
<tr>
<th>Outcome (Rating)</th>
<th>Quantity and Type of Evidence</th>
<th>Intervention (Number of Patients) Follow-up</th>
<th>Findings</th>
<th>Study Limitations (Study Quality, Risk-of-Bias)</th>
<th>Inconsistency</th>
<th>Indirectness</th>
<th>Imprecision</th>
<th>GRADE of Evidence for Outcome</th>
</tr>
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<tr>
<td><strong>Physical Activity (Critical)</strong></td>
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<tr>
<td>1 SR of 15 RCTs (n=1,904) Cox et al. 2021&lt;sup&gt;60&lt;/sup&gt;</td>
<td>Telerehabilitation vs. Center-based 2 RCTs; n=192 Follow-up: End of intervention</td>
<td>Time spent in sedentary behaviors: MD: -8.57 minutes; 95% CI: -66.69 to 49.54 Change in steps/day: MD: 387.09 steps; 95% CI: -84.64 to 858.81; I²=NR No difference.</td>
<td>Very serious limitations (-2) No serious inconsistency</td>
<td>Serious indirectness</td>
<td>Serious imprecision (-1)</td>
<td>Very low</td>
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<tr>
<td><strong>Breathlessness (Critical)</strong></td>
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<tr>
<td>1 SR of 15 RCTs (n=1,904) Cox et al. 2021&lt;sup&gt;60&lt;/sup&gt;</td>
<td>Telerehabilitation vs. Center-based 3 RCTs; n=394 Follow-up: End of intervention</td>
<td>Breathlessness (CRO dyspnea domain): MD: 0.13; 95% CI: -0.13 to 0.40 No difference.</td>
<td>Very serious limitations (-2) No serious inconsistency</td>
<td>No serious indirectness</td>
<td>Serious imprecision (-1)</td>
<td>Very low</td>
<td></td>
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<tr>
<td><strong>Quality of Life (Important)</strong></td>
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<tr>
<td>1 SR of 15 RCTs (n=1,904) Cox et al. 2021&lt;sup&gt;60&lt;/sup&gt;</td>
<td>Telerehabilitation vs. Center-based Follow-up: End of intervention</td>
<td>SGRQ (2 studies, n=274): MD: -1.26; 95% CI: -3.97 to 1.45 CAT (2 studies, n=224): MD: 1.37; 95% CI: -3.1 to 0.36 No difference.</td>
<td>Very serious limitations (-2) No serious inconsistency</td>
<td>No serious indirectness</td>
<td>Serious imprecision (-1)</td>
<td>Very low</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Parkinson's Disease**

| Balance (Critical) | | | | | | | | |
| 1 RCT Gandolfi et al. 2017<sup>64</sup> | Telehealth using TeleWii-lab platform vs. in-person Sensory Integration Balance Training n=76 Follow-up: post intervention | The Berg Balance Scale: MD: 2.54; 95% CI: 0.41 to 4.67; p=0.02 Favors telerehabilitation. | Serious limitations (-1) No serious inconsistency | No serious indirectness | Serious imprecision (-1) (Single small study) | Low |
| Balance (Critical) | | | | | | | | |
| 1 RCT Gandolfi et al. 2017<sup>64</sup> | Telehealth using TeleWii-lab platform vs. in-person Sensory Integration Balance Training n=76 Follow-up: 1 month | The Berg Balance Scale: MD: 2.18; 95% CI: -0.40 to 4.77; p=not significant No difference. | Serious limitations (-1) No serious inconsistency | No serious indirectness | Very serious imprecision (-2) (Single small study, wide CIs) | Very low |
## Outcome (Rating) | Quantity and Type of Evidence | Intervention (Number of Patients) Follow-up | Findings | Study Limitations (Study Quality, Risk-of-Bias) | Inconsistency | Indirectness | Imprecision | GRADE of Evidence for Outcome
---|---|---|---|---|---|---|---|---
### Stroke
#### Balance (Critical)
- 1 SR of 9 RCTs Laver et al. 2020
- 3 RCTs; n=106 Follow-up: Range: 1 month to 12 months.
  - Telerehabilitation vs. in-person therapy
  - Findings: Balance: MD: 0.48; 95% CI: -1.36 to 2.32; \( I^2 = 0\% \)
  - Study Limitations: No serious inconsistency
  - GRADE of Evidence: Low

#### Function (Critical)
- 1 SR of 9 RCTs Laver et al. 2020
- 1 RCT Chen et al. 2020 Follow-up: Range: 1 month to 12 months.
  - Telerehabilitation vs. in-person therapy
  - Findings: Upper limb function (3 studies, n=170): MD: 1.23; 95% CI: -2.17 to 4.64; \( I^2 = 42\% \)
  - Study Limitations: Serious limitations (-1)
  - GRADE of Evidence: Very low

#### Activities of Daily Living (Important)
- 1 SR of 9 RCTs Laver et al. 2020
- 1 RCT Chen et al. 2020 Follow-up: Range: 1 month to 12 months.
  - Telerehabilitation vs. in-person therapy
  - Findings: Activities of daily living (3 studies but only 2 pooled, n=75): MD: 0.59; 95% CI: -5.5 to 6.68; \( I^2 = 0\% \)
  - Study Limitations: No serious inconsistency
  - GRADE of Evidence: Low

### Total Knee or Total Hip Arthroplasty
#### WOMAC (Critical)
- 1 SR of 9 RCTs Jansson et al. 2020
- Total n: 1,266 Follow-up: Range: 2 to 8 weeks
  - Telerehabilitation vs. traditional in-person care
  - Findings: Change in stiffness score (1 study, n=NR): SMD: -0.61; 95% CI: -1.11 to -0.12; p=NR
    - Favoring telerehabilitation.
  - Total WOMAC score (1 study):
    - SMD: -0.69; 95% CI: -0.98 to 0.41
    - No difference.
  - Study Limitations: No serious inconsistency
  - GRADE of Evidence: Very low
<table>
<thead>
<tr>
<th>Outcome (Rating)</th>
<th>Quantity and Type of Evidence</th>
<th>Intervention (Number of Patients) Follow-up</th>
<th>Findings</th>
<th>Study Limitations (Study Quality, Risk-of-Bias)a</th>
<th>Inconsistencyb</th>
<th>Indirectnessc</th>
<th>Imprecisiond</th>
<th>GRADE of Evidence for Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>6MWD (Critical)</td>
<td>1 SR of 9 RCTs Jansson et al. 2020</td>
<td>Telerehabilitation vs. traditional in-person care Total n: 1,266 Follow-up: Range: 2 to 8 weeks</td>
<td>Difference between groups (one study): SMD: -2.34; 95% CI: -2.70 to -1.97 <strong>Favors telerehabilitation</strong> (per figure 3; text states no difference but based on the data this appears to be an error).</td>
<td>Serious limitations (-1)</td>
<td>No serious inconsistency</td>
<td>No serious indirectness</td>
<td>Serious imprecision (-1) (Findings from one study)</td>
<td>Low</td>
</tr>
<tr>
<td>KOOS (Critical)</td>
<td>1 SR of 9 RCTs Jansson et al. 2020</td>
<td>Telerehabilitation vs. traditional in-person care Total n: 1,266 Follow-up: Range: 2 to 8 weeks</td>
<td>No difference between telerehabilitation and conventional care (pooled data not reported).</td>
<td>Serious limitations (-1)</td>
<td>No serious inconsistency</td>
<td>No serious indirectness</td>
<td>Very serious imprecision (-2) (Data not reported)</td>
<td>Very low</td>
</tr>
<tr>
<td>Pain (Important)</td>
<td>1 SR of 9 RCTs Jansson et al. 2020</td>
<td>Telerehabilitation vs. traditional in-person care Total n: 1,266 Follow-up: Range: 2 to 8 weeks</td>
<td>Change in VAS pain (five studies, n=NR): SMD: NR; 95% CI: NR; p=NR No difference.</td>
<td>Serious limitations (-1)</td>
<td>No serious inconsistency</td>
<td>No serious indirectness</td>
<td>Very serious imprecision (-2) (Data not reported)</td>
<td>Very low</td>
</tr>
<tr>
<td>Range of Motion (Important)</td>
<td>1 SR of 9 RCTs Jansson et al. 2020</td>
<td>Telerehabilitation vs. traditional in-person care Total n: 1,266 Follow-up: Range: 2 to 8 weeks</td>
<td>Knee motion Change in active flexion (three studies, n=NR) No difference. Change in active and passive extension (four studies, n=NR): SMD: -0.06; 95% CI: -0.55 to 0.43; p=NR No difference.</td>
<td>Serious limitations (-1)</td>
<td>No serious inconsistency</td>
<td>No serious indirectness</td>
<td>Very serious imprecision (-2) (Data not reported; wide CIs)</td>
<td>Very low</td>
</tr>
</tbody>
</table>

a Methodological Quality considers the overall risk of bias rating of all the studies included in the evidence base;
b Inconsistency of results considers if the studies demonstrated similar positive or negative results (an inconsistent rating would indicate that the findings across studies were mixed);
c Indirectness of evidence considers the link between the interventions and patient outcomes (head-to-head comparisons provide the most direct evidence) as well as the applicability of the study population;
d Imprecision estimates the degree of uncertainty (based on variance or sample size) around an outcome’s effect size.

6MWD: 6-minute walk distance; CAT: COPD Assessment Test; CI: confidence interval; COPD: chronic obstructive pulmonary disease; KOOS: Knee Injury and Osteoarthritis Outcome Score; MD: mean difference; NR: not reported; RCT: randomized controlled trial; ROB: risk of bias; SD: standard deviations; SGRQ: St George's Respiratory Questionnaire; SMD: standardized mean difference; THA: total hip arthroscopy; TKA: total knee arthroscopy; VAS: visual analog scale; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index
Appendix A. Evidence Tables

Table 3. Systematic Review/Meta-analysis

<table>
<thead>
<tr>
<th>Study Details</th>
<th>Search Strategy/Evidence Base</th>
<th>Patients/Interventions</th>
<th>Outcomes/Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference: Cox et al. 2021&lt;sup&gt;60&lt;/sup&gt;</td>
<td>Cochrane Airways Trials Register, Cochrane Central Register of Controlled Trials, MEDLINE, Embase, plus four other databases and three trial registries were searched through November 2020. The evidence base consisted of 15 RCTs comparing telerehabilitation to in-person rehabilitation, or no rehabilitation. We report the data for telerehabilitation versus in-person care.</td>
<td>Number of Patients: 1,904</td>
<td><strong>Exercise Capacity</strong>&lt;br&gt;Primary rehabilitation&lt;br&gt;6MWD: End of rehabilitation (range 6 weeks to 12 weeks)&lt;br&gt;Telerehabilitation vs. center-based (4 RCTs, n=556)&lt;br&gt;MD: 0.06 m; 95% CI: -10.82 m to 10.94 m; I²=22%&lt;br&gt;No difference.&lt;br&gt;6MWD long term f/u: ~12 months post-intervention&lt;br&gt;Telerehabilitation vs. center-based (2 studies, n=308)&lt;br&gt;MD: 1.40 m; 95% CI: -12.62 to 15.43&lt;br&gt;No difference.&lt;br&gt;Physical Activity&lt;br&gt;Primary rehabilitation&lt;br&gt;Time spent in sedentary behaviors:&lt;br&gt;Telerehabilitation vs. other intervention (2 studies, n=192)&lt;br&gt;MD: -8.57 minutes; 95% CI: -66.69 to 49.54&lt;br&gt;No difference.&lt;br&gt;Change in steps/day:&lt;br&gt;Telerehabilitation vs. other intervention&lt;br&gt;MD: 387.09 steps; 95% CI: -84.64 to 858.81; I²=NR&lt;br&gt;No difference.&lt;br&gt;Quality of Life (SGRQ)&lt;br&gt;Telerehabilitation vs. other intervention (2 studies, n=274)&lt;br&gt;MD: -1.26; 95% CI: -3.97 to 1.45</td>
</tr>
<tr>
<td>Country: Australia</td>
<td></td>
<td>Diagnosis: Chronic respiratory disease of any severity and in a stable state&lt;br&gt;Age: Mean age between 62 to 75 years old&lt;br&gt;Gender: NR&lt;br&gt;Race: NR</td>
<td><strong>Physical Activity</strong>&lt;br&gt;Primary rehabilitation&lt;br&gt;Time spent in sedentary behaviors:&lt;br&gt;Telerehabilitation vs. other intervention (2 studies, n=192)&lt;br&gt;MD: -8.57 minutes; 95% CI: -66.69 to 49.54&lt;br&gt;No difference.&lt;br&gt;Change in steps/day:&lt;br&gt;Telerehabilitation vs. other intervention&lt;br&gt;MD: 387.09 steps; 95% CI: -84.64 to 858.81; I²=NR&lt;br&gt;No difference.&lt;br&gt;Quality of Life (SGRQ)&lt;br&gt;Telerehabilitation vs. other intervention (2 studies, n=274)&lt;br&gt;MD: -1.26; 95% CI: -3.97 to 1.45</td>
</tr>
<tr>
<td>Purpose: To determine the effectiveness and safety of telerehabilitation for people with chronic respiratory disease.</td>
<td></td>
<td><strong>Physical Activity</strong>&lt;br&gt;Primary rehabilitation&lt;br&gt;Time spent in sedentary behaviors:&lt;br&gt;Telerehabilitation vs. other intervention (2 studies, n=192)&lt;br&gt;MD: -8.57 minutes; 95% CI: -66.69 to 49.54&lt;br&gt;No difference.&lt;br&gt;Change in steps/day:&lt;br&gt;Telerehabilitation vs. other intervention&lt;br&gt;MD: 387.09 steps; 95% CI: -84.64 to 858.81; I²=NR&lt;br&gt;No difference.&lt;br&gt;Quality of Life (SGRQ)&lt;br&gt;Telerehabilitation vs. other intervention (2 studies, n=274)&lt;br&gt;MD: -1.26; 95% CI: -3.97 to 1.45</td>
<td></td>
</tr>
<tr>
<td>Quality Rating: Poor</td>
<td>All studies were at high risk of bias due to lack of blinding of patients and all study personnel. Additionally, there were concerns around selective reporting, attrition, and incomplete outcome data.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Publication Bias: NR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funding Source: National Institute of Health Research</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study Details</td>
<td>Search Strategy/Evidence Base</td>
<td>Patients/Interventions</td>
<td>Outcomes/Results</td>
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<tr>
<td>---------------</td>
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</tr>
<tr>
<td><strong>No difference.</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Quality of Life (CAT)</strong></td>
<td></td>
<td></td>
<td>Telerehabilitation vs. other intervention (2 studies, n=224) MD: 1.37; 95% CI: -3.1 to 0.36 No difference.</td>
</tr>
<tr>
<td><strong>Breathlessness (CRQ dyspnea domain)</strong></td>
<td></td>
<td></td>
<td>Telerehabilitation vs. other intervention (3 studies, n=394) MD: 0.13; 95% CI: -0.13 to 0.40 No difference.</td>
</tr>
</tbody>
</table>

**Stroke**

**Reference:** Laver et al. 2020

**Country:** Australia

**Purpose:** To determine whether telerehabilitation leads to improved ability to perform activities of daily living amongst stroke survivors when compared with in-person rehabilitation or no rehabilitation.

**Quality Rating:** Fair

Some concerns around lack of clarity regarding randomization, allocation concealment, blinding, and selective reporting. Studies have small number of participants and poor reporting of trial details.

**Publication Bias:** Overall publication bias not reported.

**Funding Source:** NR

CoCranne Stroke Group Trials Register, Cochrane Central Register of Controlled Trials, MEDLINE, Embase, and eight additional databases searched up to June 4, 2019.

The evidence base consisted of 9 studies comparing telerehabilitation to in-person in patients who had experienced stroke.

**Inclusion/Exclusion Criteria:** Studies were included if they were RCTs that compared either: i) telerehabilitation with in-person rehabilitation, ii) with no rehabilitation, iii) two different types of rehabilitation, iv) hybrid telerehabilitation with another intervention. Telerehabilitation was defined as “the delivery of rehabilitation services via information and communication technologies”. Asynchronous telerehabilitation interventions were included as well. Patients with mixed etiology were excluded unless more detailed data were available. No age limit was set. Twenty-two RCTs were included in this systematic review.

**Number of Patients:** 1,937

**Diagnosis:** Stroke as defined by the WHO, all types, levels, and stages, as well as subarachnoid hemorrhage

**Age:** NR

**Gender:** NR

**Race:** NR

**Intervention/Comparators:** Except for 1 study, all interventions were delivered in the patient’s home. 8 studies focused on enhancing care and well-being while 14 studies focused on improving functions like limb mobility, mobility, balance, and speech and language abilities.

9 studies reported on telerehabilitation versus in-person rehabilitation.

10 studies reported on telerehabilitation versus no rehabilitation or usual care (out of scope).

1 3-armed study compared telerehabilitation with in-person rehabilitation and no intervention.

**Primary Outcomes:** Independence in activity of daily living post-intervention

**Follow-up:** Range: 1 month to 12 months

**Telerehabilitation versus in-person therapy**

**Balance (3 studies, n=106):** MD: 0.48; 95% CI: -1.36 to 2.32; I²=0%

**No difference.**

**Upper limb function (3 studies, n=170):** MD: 1.23; 95% CI: -2.17 to 4.64; I²=42%

**No difference.**

**Activities of daily living (3 studies but only 2 pooled, n=75):** MD: 0.59; 95% CI: -5.5 to 6.68; I²=0%

**No difference.**
## Study Details

<table>
<thead>
<tr>
<th>Reference: Jansson et al. 2020&lt;sup&gt;61&lt;/sup&gt;</th>
<th>Country: Finland</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Purpose:</strong> To investigate the effects and safety of telerehabilitation in patients with lower-limb joint replacement.</td>
<td><strong>Quality Rating:</strong> Fair</td>
</tr>
<tr>
<td>Main concerns were lack of clarity blinding of patients and clinical staff, including outcome assessors. Additional concerns were related to lack of clarity around identical treatment of groups, data analysis, and reliability of outcome measures.</td>
<td><strong>Main concerns were lack of clarity blinding of patients and clinical staff, including outcome assessors. Additional concerns were related to lack of clarity around identical treatment of groups, data analysis, and reliability of outcome measures.</strong></td>
</tr>
<tr>
<td><strong>Publication Bias:</strong> NR</td>
<td><strong>Funding Source:</strong> Business Finland, as a part of the &quot;Intelligent Customer-driven Solution for Orthopedic and Pediatric Surgery Care&quot;.</td>
</tr>
</tbody>
</table>

## Search Strategy/Evidence Base

- Melinda and Medline Ovid, Scopus, Ebsco Databases, and Web of Science were searched to February 2020.
- The evidence base consisted of 9 RCTs comparing telerehabilitation to traditional in-person care in patients with THA or TKA.

## Inclusion/Exclusion Criteria: RCTs comparing telerehabilitation and in-person outpatient physical therapy. Only adults (>18 years) were included. Studies of assessment tools, conference abstracts, preliminary results, unpublished studies were excluded.

## Patients/Interventions

- **Number of Patients:** 1,266
- **Diagnosis:** Patients following discharge from hospital after TKA and THA were included. Patients must be discharged with an active range of motion and the ability to walk using a walking aid. Patients must also be able to access and use a smartphone, and live in an area served by high-speed Internet within a one hour drive from the treating hospital.
- **Age:** Mean age 54.5 to 73.3 years old
- **Gender:** NR
- **Race:** NR
- **Intervention/Comparators:** Telerehabilitation, defined as an internet-based real-time two-way videoconferencing system, interactive virtual telerehabilitation software-hardware platform, asynchronous video-based software platform, internet based orthopedic care platform, or an app-based active muscle training system. Conventional in-person outpatient physical therapy.

## Outcomes/Results

| **Primary Outcomes:** Physical functioning, adverse events, resource utilization |
| **Follow-up:** Range 2 to 8 weeks |
| **WOMAC** Change in stiffness score (1 study, n=NR) |
| SMD: -0.61; 95% CI: -1.11 to -0.12; p=NR |
| **Favors telerehabilitation.** |
| Total WOMAC score (1 study) |
| SMD: -0.69; 95% CI: -0.98 to 0.41 |
| **No difference.** |
| **6MWD** Difference between groups (one study) |
| SMD: -2.34; 95% CI: -2.70 to -1.97 |
| **Favors telerehabilitation** (per figure 3; text states no difference but based on the data this appears to be an error). |
| **KOOS** No difference between telerehabilitation and conventional care (pooled data not reported). |
| **VAS pain** Change in VAS pain (five studies, n=NR) |
| SMD: NR; 95% CI: NR; p=NR |
| **No significant difference.** |
| **Knee motion** Change in active flexion (three studies, n=NR) |
| SMD: -0.06; 95% CI: -0.55 to 0.43; p=NR |
| **No difference.** |

**6MWD:** 6-minute walk distance; **CAT:** COPD Assessment Test; **CI:** confidence interval; **COPD:** chronic obstructive pulmonary disease; **KOOS:** Knee Injury and Osteoarthritis Outcome Score; **MD:** mean difference; **NR:** not reported; **RCT:** randomized controlled trial; **ROB:** risk of bias; **SD:** standard deviations; **SGRQ:** St George's Respiratory Questionnaire; **SMD:** standardized mean difference; **THA:** total hip arthroscopy; **TKA:** total knee arthroscopy; **VAS:** visual analog scale; **WOMAC:** Western Ontario and McMaster Universities Osteoarthritis Index
### Table 4. Individual Studies

<table>
<thead>
<tr>
<th>Study Details</th>
<th>Patients/Interventions</th>
<th>Intervention/Outcomes</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chronic Heart Failure</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Reference:</strong> Hwang et al. 2017&lt;sup&gt;63&lt;/sup&gt;</td>
<td><strong>Number of Patients:</strong> 53</td>
<td><strong>Intervention:</strong> Telerehabilitation was delivered by a synchronous videoconferencing platform via the internet to groups of up to four participants at home.</td>
<td><strong>12 weeks of intervention 6MWD</strong></td>
</tr>
<tr>
<td><strong>Country:</strong> Australia</td>
<td><strong>Diagnosis:</strong> Chronic heart failure confirmed by an echocardiogram, including heart failure with reduced or preserved ejection fraction.</td>
<td>Intervention group mean (SD) (n=24): 364 (96)</td>
<td>Intervention group mean (SD) (n=23): 374 (89)</td>
</tr>
<tr>
<td><strong>Study Design:</strong> RCT</td>
<td><strong>Mean Age Years (SD):</strong> 67 years</td>
<td>Control group mean (SD) (n=26): 394 (119)</td>
<td>Control group mean (SD) (n=26): 410 (103)</td>
</tr>
<tr>
<td><strong>Purpose:</strong> To determine non-inferiority of telerehabilitation versus traditional center-based program for patients with chronic heart failure in terms of 6-minute walk distance.</td>
<td><strong>Gender (% male):</strong> 75%</td>
<td>Mean difference between group (n=50): MD: 15; 95% CI: -28 to 59; p=NR</td>
<td>Mean difference between group (n=49): MD: 2; 95% CI: -36 to 41; p=NR</td>
</tr>
<tr>
<td><strong>Quality Rating:</strong> Fair</td>
<td><strong>Race:</strong> 49 (92%) Caucasian</td>
<td><strong>No difference.</strong></td>
<td><strong>No difference.</strong></td>
</tr>
<tr>
<td>Potential recruitment bias and uneven allocation. Single blind (outcome assessors). Low attrition, ITT used.</td>
<td><strong>Mean Baseline:</strong></td>
<td><strong>12 weeks f/u (24 weeks total) 6MWD</strong></td>
<td><strong>12 weeks f/u (24 weeks total) 6MWD</strong></td>
</tr>
<tr>
<td><strong>Funding Rating:</strong> Heart Foundation Health Professional Scholarship, Princess Alexandra Hospital Research Support Scheme Small Grant 2013, The Prince Charles Hospital Foundation Novice Researcher Grant 2012, Queensland Health: Health Practitioner Research Scheme 2012.</td>
<td>Intervention group 6MWD: 346 (104)</td>
<td><strong>Primary Outcomes:</strong> 6-minute walk test</td>
<td><strong>Primary Outcomes:</strong> 6-minute walk test</td>
</tr>
<tr>
<td><strong>Inclusion Criteria:</strong> Patients with a recent hospital admission for heart failure and were referred to the heart failure services. Only adults (&gt;18 years old) were included.</td>
<td>Control group 6MWD: 382 (106)</td>
<td><strong>Follow-up:</strong> 12 weeks after intervention ends</td>
<td><strong>Follow-up:</strong> 12 weeks after intervention ends</td>
</tr>
<tr>
<td><strong>Exclusion Criteria:</strong> Patients who did not meet safety screening criteria per Australian exercise guidelines for patients with chronic heart failure were excluded. Patients who lived more than an hour driving distance from the treating hospital or had no support person at home were also excluded.</td>
<td><strong>Note:</strong> Control group also had additional home exercises three times a week, unsupervised.</td>
<td><strong>Note:</strong> No difference was found between the groups for number of adverse events.</td>
<td><strong>Note:</strong> No difference was found between the groups for number of adverse events.</td>
</tr>
<tr>
<td>Telerehabilitation group had higher attendance than control group.</td>
<td><strong>12 weeks of intervention 6MWD</strong></td>
<td>Telerehabilitation group had higher attendance than control group.</td>
<td>Telerehabilitation group had higher attendance than control group.</td>
</tr>
<tr>
<td>Study Details</td>
<td>Patients/Interventions</td>
<td>Intervention/Outcomes</td>
<td>Results</td>
</tr>
<tr>
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</tr>
<tr>
<td>Reference: Gandolfi et al. 2017&lt;sup&gt;64&lt;/sup&gt;</td>
<td>Parkinson’s Disease</td>
<td>Intervention: Each session began with upper and lower extremities self-applied joint mobilization while supine, followed by an exercise game as selected by the physiotherapist. The physiotherapists have live video monitoring throughout, but supervises two patients at a time. Control: The Sensory Integration Balance Training (SIBT) starts with stretching exercises followed by dynamic balancing exercises under various sensory conditions. All sessions performed in the clinic. Intervention group used the TeleWii-lab platform. <strong>Note:</strong> Both groups received 21 individualized treatment sessions of 50 minutes each, 3 days/week for 7 consecutive weeks. <strong>Primary Outcomes:</strong> The Berg Balance Scale (BBS)</td>
<td><strong>After intervention</strong>&lt;br&gt;BBS&lt;br&gt;TeleWii group: 52.37 (3.29)&lt;br&gt;SIBT group: 49.82 (5.70)&lt;br&gt;Between group difference: MD: 2.54; 95% CI: 0.41 to 4.67; p=0.02&lt;br&gt;<strong>Favors telerehabilitation.</strong> <strong>1 month follow-up</strong>&lt;br&gt;BBS&lt;br&gt;TeleWii group: 51.84 (4.53)&lt;br&gt;SIBT group: 49.66 (6.59)&lt;br&gt;Between group difference: MD: 2.18; 95% CI: -0.40 to 4.77; p=not significant&lt;br&gt;<strong>No difference.</strong> <strong>Note:</strong> No adverse events were reported during the study period.</td>
</tr>
<tr>
<td>Country: Italy</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Study Design: RCT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purpose: To compare remote home-based balance training and in-person balance training for improvements in postural stability.</td>
<td></td>
<td></td>
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<tr>
<td>Quality Rating: Fair</td>
<td></td>
<td></td>
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<tr>
<td>Single-blind study (outcome assessor), low attrition, some lack of clarity around ITT and per protocol data handling.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funding Rating: Grant of Ricerca Sanitaria Finalizzata Regionale 2010.</td>
<td></td>
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</tbody>
</table>

**Number of Patients:** 76  
**Diagnosis:** Parkinson’s disease  
**Mean Age Years (SD):** 67.45 (7.18) and 69.84 (9.41) for the intervention group and in-clinic group, respectively.  
**Gender (% male):** 60.5% and 73.7% for intervention and in-clinic group respectively.  
**Race:** NR  
**Inclusion Criteria:** Patients older than 18 years, modified Hoehn and Yahr stages 2.5 to 3, stable medication usage in the previous month, ability to maintain standing for 10 minutes, and presence of caregiver.  
**Exclusion Criteria:** Patients with cardiovascular, orthopedic, and otovestibular disorders were excluded. Patients with visual or other neurological conditions, severe dyskinesia or fluctuations, MMSE score of <24/30, and severe depression were also excluded.
**Study Details**

**Patients/Interventions**

**Intervention/Outcomes**

**Results**

### Stroke

**Reference:** Chen et al. 2020

**Country:** China

**Study Design:** RCT

**Purpose:** To determine the effects of a 12-week-home-based telerehabilitation program for subcortical stroke patients versus conventional rehabilitation.

**Quality Rating:** Fair

- Single-blind study (outcome assessor) ~25% attrition, ITT used.

**Funding Rating:**

- Shanghai Strategic Emerging Industries Project Plan and the National Natural Science Foundation of China.

**Number of Patients:** 52

**Diagnosis:** Stroke patient with first-onset stroke with a single subcortical lesion involving the motor pathway and hemiplegia.

**Mean Age Years (SD):** 64.19 (9.42) and 59.42 (10.00) for telerehabilitation group and conventional care group, respectively.

**Gender (% male):** 53.8% and 46.2% for telerehabilitation group and conventional care group respectively.

**Race:** NR

**Mean (SD) Baseline:**

- Telerehabilitation: FMA: 71.88 (10.76)
- Conventional care: FMA: 71.65 (10.25)

**Median (IQR) Baseline:**

- Telerehabilitation: MBI: 70.0 (58.75, 76.25)
- Conventional care: MBI: 77.5 (60.0, 85.0)

**Inclusion Criteria:**

- a) Between 30-85 years, b) right-handed before stroke, c) screening within 1-3 weeks after stroke symptoms onset and in a stable condition, d) first-onset stroke with a single subcortical lesion involving the motor pathway, e) clinical evidence of hemiplegia based on neurologic examination and the corresponding responsible lesions evident on CT or MRI, f) NIH Stroke Scale score 2-20, and g) not receiving regular rehabilitation training but who have a strong need for rehabilitation and good family support.

**Exclusion Criteria:**

- a) Unconsciousness, cognitive impairment, or cooperation difficulties, b) cerebellar or pontine lesion, c) other brain abnormalities or psychiatric disorder, or clinically significant or unstable medical disease, d) use of medication that may affect motor examination, e) contraindication for MRI scanning, and f) claustrophobia.

**Intervention:** Patients used the TRS platform under the therapist’s OT/PT and ENTS by live video conferencing.

**Control:** Patients completed their rehabilitation training face-to-face with a therapist in the outpatient rehabilitation department.

**Primary Outcomes:**

- **Fugl-Meyer assessment for motor function for upper and lower extremities,** activities of daily living as measured by the modified Barthel Index (MBI).

**Follow-up:** 12 weeks and 24 weeks

**After 12 weeks of rehabilitation**

**Noninferiority 1-tailed test:** Mean difference between group

- FMA (n=52): MD: 5.807; 95% CI: 0.560 to 6.972; p=0.003
- MBI (n=52): MD: 5.576; 95% CI: 0.504 to 10.349; p=0.019

**Telerehabilitation significantly better than control for FMA, but only non-inferior to control for MBI.**

**Superiority 1-tailed test:** Mean difference between group

- FMA (n=52): MD: 5.807; 95% CI: 0.076 to 7.456; p=0.011
- MBI (n=52): MD: 5.576; 95% CI: -0.085 to 11.098; p=0.097

**Telerehabilitation superior to control in FMA, but not for MBI.**

**12-week f/u**

**No significant differences were found for primary outcomes between baseline and week 24.**

**Note:** No adverse events observed.
Appendix B. References


## Appendix C. Excluded Studies

### Table 5. Excluded Studies

<table>
<thead>
<tr>
<th>Reference</th>
<th>Reason for Exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bonnevie et al. 2021</td>
<td>Intervention not of interest.</td>
</tr>
<tr>
<td>Chaudhry et al. 2021</td>
<td>Intervention not of interest.</td>
</tr>
<tr>
<td>Dias et al. 2021</td>
<td>Mixed comparators, most do not meet inclusion criteria. Telerehabilitation compared to face-to-face rehabilitation not reported separately.</td>
</tr>
<tr>
<td>Keteyian et al. 2021</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Shaw et al. 2021</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Taito et al. 2021</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Turcinovic et al. 2021</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Barbosa et al. 2020</td>
<td>No risk of bias assessment.</td>
</tr>
<tr>
<td>Camden et al. 2020</td>
<td>No risk of bias and included trials do not meet inclusion criteria.</td>
</tr>
<tr>
<td>De Mata et al. 2020</td>
<td>Included trials do not meet inclusion criteria.</td>
</tr>
<tr>
<td>Horsley et al. 2020</td>
<td>Relevant review with no data to extract.</td>
</tr>
<tr>
<td>Lai et al. 2020</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Lawford et al. 2020</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Nelson et al. 2020</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Prvu Bettger et al. 2020</td>
<td>Comparator not of interest, dissimilar to nature of telehealth intervention.</td>
</tr>
<tr>
<td>Velayati et al. 2020</td>
<td>No risk of bias analysis and included trials do not meet inclusion criteria.</td>
</tr>
<tr>
<td>Watts et al. 2020</td>
<td>Does not meet inclusion criteria for KQ3, and no data to extract.</td>
</tr>
<tr>
<td>Wong et al. 2020</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Wu et al. 2020</td>
<td>Does not meet inclusion criteria for KQ3, and comparator not of interest.</td>
</tr>
<tr>
<td>Bernocchi et al. 2019</td>
<td>Intervention not of interest.</td>
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<tr>
<td>Kamalnathan et al. 2019</td>
<td>Intervention not of interest.</td>
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<tr>
<td>Rintala et al. 2019</td>
<td>Included trials do not meet inclusion criteria.</td>
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<tr>
<td>Adamse et al. 2018</td>
<td>Included trials do not meet inclusion criteria.</td>
</tr>
<tr>
<td>Azma et al. 2018</td>
<td>Intervention not of interest.</td>
</tr>
<tr>
<td>Bennell et al. 2018</td>
<td>Intervention not of interest, and comparator not of interest.</td>
</tr>
<tr>
<td>Bernocchi et al. 2018</td>
<td>Intervention not of interest.</td>
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<tr>
<td>Carr et al. 2018</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Grona et al. 2018</td>
<td>Relevant review with no data to extract.</td>
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<tr>
<td>Hong et al. 2018</td>
<td>Does not meet inclusion criteria for KQ3.</td>
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<tr>
<td>Jiang et al. 2018</td>
<td>All studies included in Jansson et al. 2020.</td>
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<tr>
<td>Kalron et al. 2018</td>
<td>Intervention not of interest.</td>
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<tr>
<td>Van Egmond et al. 2018</td>
<td>Included trials do not meet inclusion criteria for KQ 3: Interventions not of interest.</td>
</tr>
<tr>
<td>Reference</td>
<td>Reason for Exclusion</td>
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<tr>
<td>Wu et al. 2018</td>
<td>No risk of bias analysis and most included trials do not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Bennell et al. 2017</td>
<td>Intervention not of interest.</td>
</tr>
<tr>
<td>Hinman et al. 2017</td>
<td>Does not meet inclusion criteria for KQ3 and no data to extract.</td>
</tr>
<tr>
<td>Veras et al. 2017</td>
<td>No risk of bias analysis, most included trials do not meet inclusion criteria, and intervention not of interest.</td>
</tr>
<tr>
<td>Boissy et al. 2016</td>
<td>Does not meet inclusion criteria for KQ3.</td>
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<td>Bring et al. 2016</td>
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<tr>
<td>Chan et al. 2016</td>
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<tr>
<td>Kim et al. 2016</td>
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<tr>
<td>Jansen-Kosterink et al. 2015</td>
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<tr>
<td>Lloréns et al. 2015</td>
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<tr>
<td>Moffet et al. 2015</td>
<td>Included in Jansson et al. 2020.</td>
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<tr>
<td>Lear et al. 2014</td>
<td>Intervention not of interest.</td>
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<tr>
<td>Odole et al. 2014</td>
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<tr>
<td>Varnfield et al. 2014</td>
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<tr>
<td>Kraal et al. 2013</td>
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<tr>
<td>Ortiz-Gutierrez et al. 2013</td>
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<td>Scalvini et al. 2013</td>
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<td>Chumbler et al. 2012</td>
<td>Intervention not of interest.</td>
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<tr>
<td>Bowles et al. 2011</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Johansson et al. 2011</td>
<td>Included trials do not meet inclusion criteria.</td>
</tr>
<tr>
<td>Steel et al. 2011</td>
<td>Included trials do not meet inclusion criteria.</td>
</tr>
<tr>
<td>Kosterink et al. 2010</td>
<td>Intervention not of interest.</td>
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</tbody>
</table>

CPG: clinical practice guideline; KQ: key question; SR: systematic review; TAU: treatment as usual
Key Question 2: In patients seeking physical therapy, what is the accuracy of telerehab compared to traditional in-person care for diagnosing conditions requiring physical therapy?
Contents

Key Question 2: In patients seeking physical therapy, what is the accuracy of telerehab compared to traditional in-person care for diagnosing conditions requiring physical therapy? .......................... 32

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Key Question 2: In patients seeking physical therapy, what is the accuracy of telerehab compared to traditional in-person care for diagnosing conditions requiring physical therapy?

Summary of Evidence Base

Our searches identified 8 within-groups rater reliability studies (RS)\textsuperscript{49,52,127-132} that compared examinations via telerehab (TR; including audio and video) to traditional face-to-face examinations. These studies were not diagnostic accuracy studies, but considered the agreement between assessments given by a TR physical therapist (PT) to assessments by an in-person PT. The studies considered patients with low back pain (LBP)\textsuperscript{49,127} other musculoskeletal conditions (e.g., ankle, shoulder, elbow),\textsuperscript{52,128,129,131,132} and Parkinson’s disease.\textsuperscript{130} Seven of the studies were carried out by a number of the same investigators in Australia and used the eHAB® TR system,\textsuperscript{52,127-132} and the other study was carried out in the US using Zoom videoconferencing.\textsuperscript{49} Most of the studies using the eHAB® TR system noted that one or more authors had a financial interest in the system, but that the potentially conflicted authors were not directly involved in the collection or analysis of study data. All eight studies employed a repeated-measures design with patients undergoing both face-to-face and TR assessment in the same examination room. Raters were randomly assigned to give assessments via TR or face-to-face and patients were randomized to the order of examination type. As all assessments were undertaken in the clinic in rapid succession, the quality of the TR assessments may not be reflective of real-world TR assessments (i.e., those given over videoconference in the patient’s home). We did not identify any other study types or health conditions that addressed this key question that met inclusion criteria.

We originally only considered evidence from systematic reviews, randomized controlled trials or prospective diagnostic cohort studies. We did not identify any papers meeting inclusion criteria. Therefore, we employed a best evidence approach to include rater reliability studies. Our searches were limited to papers published on or after January 1, 2010, to July 26, 2021. See Table 2 for detailed information on the characteristics of the studies and patients included in the reviews. Studies excluded as evidence for this key question are presented in Table 3 of Appendices.
Study Quality Rating

The methodological quality of the eight individual RSs was rated Fair to Poor using U.S. Preventative Services Task Force (USPSTF) criteria. This is primarily due to lack of clarity around patient selection and demographics and lack of clarity around representativeness of the patient population. In addition, Poor ratings for one study was related to use of inappropriate randomization techniques (coin toss). See Table 2 for study quality ratings for each paper.

Key Findings

Below, we describe the critical outcomes from the included studies with the GRADE strength of the evidence (SOE) rating. Note that a statement of “no difference” between treatments for outcomes does not imply equivalence. Where we judge the findings to be equivalent, it is explicitly stated in the key findings. See Table 1 for factors that influenced the SOE ratings for critical outcomes, and Table 2 for more information about the characteristics of the included studies.

Use of Telerehabilitation in Assessing Low Back Pain

Critical Outcomes

- Evidence from 1 small RS (n=47)\(^9\) suggests that there is moderate interrater agreement between TR and face-to-face PT overall assessments in patients with LBP. (SOE: Very low)
- Evidence from 1 small RS (n=26)\(^{127}\) indicates that there is poor interrater agreement between TR and face-to-face PTs for assessment of posture in patients with LBP. (SOE: Very low)
- Evidence from 1 small RS (n=26)\(^{127}\) indicates that there is moderate to strong interrater agreement between TR and face-to-face PTs for assessment of range of motion, symptoms, and pain with movement in patients with LBP. (SOE: Very low)

Use of Telerehabilitation in Assessing Mixed Musculoskeletal Injury

Critical Outcomes

- Evidence from 5 small RSs (n range from 10 to 42)\(^{52,128,129,131,132}\) suggests that there is moderate to strong interrater agreement between TR and face-to-face PT in diagnosing issues in patients with musculoskeletal injury. (SOE: Very low)
- Evidence from 5 small RSs (n range from 10 to 42)\(^{52,128,129,131,132}\) suggests that there is substantial interrater agreement between TR and face-to-face PT in determining physical examination findings in patients with musculoskeletal injury. (SOE: Very low)
Use of Telerehabilitation in Assessing Parkinson’s Disease

Critical Outcomes

- Evidence from 1 small RSs (n=12)\textsuperscript{130} suggests that there is strong interrater agreement between TR and face-to-face PT in assessing function in patients with Parkinson’s disease. (SOE: Very low)

Discussion

Overall, the evidence assessing the diagnostic accuracy of TR in patients entering into physical therapy is consistent but limited. Eight small RSs reported interrater reliability between TR and face-to-face assessments of patients with LBP,\textsuperscript{49,127} other musculoskeletal conditions (e.g., ankle, shoulder, elbow),\textsuperscript{52,128,129,131,132} and Parkinson’s disease.\textsuperscript{130} The studies were all very small, with sample sizes <50 patients total, and there was a lack of information regarding the representativeness of the samples. Moreover, as the studies focused on the ratings of the PTs, there is limited evidence on clinical outcomes in the patients.

Very low quality evidence supports the use of TR in assessing the domains of range of motion, symptoms as measured by the straight leg raise (SLR) test, and pain with motion in patients with LBP.\textsuperscript{127} Very low quality evidence suggests that assessment of posture in patients with LBP is less likely to be accurate with TR compared to face-to-face assessments.\textsuperscript{127} Very low quality evidence suggests that overall assessments of patients with LBP may have some agreement between TR and face-to-face PT, but these assessments are highly variable.

Very low quality evidence supports the use of TR in diagnosing patients with musculoskeletal conditions.\textsuperscript{52,128,129,131,132} There was very low quality evidence showing substantial to almost perfect agreement between TR and face-to-face physical examination findings, suggesting reasonable utility of TR across a range of populations. Lending strength to these findings is the consistent methodology across studies. However, the papers all share common investigators, and were carried out in laboratory/clinical settings rather than in real-world settings. It is unclear how the high level of agreement seen in experimental settings would translate to real-world settings.

Finally, Very low quality evidence supports the use of assessing patients with Parkinson’s disease.\textsuperscript{130} Agreement was high for all ordinal assessment items (step test, steps in 360° turn, total Berg Balance Scale score), with the exception of the total Berg Balance Scale score. Further analysis showed that the individual item “Standing on one leg” scored the lowest (50.0 %). The limits of agreement for all continuous data variables (functional and lateral reach, timed “up and go” test, timed stance test) fell within the clinically acceptable criteria for adequate agreement. This study employed similar methodology and technology as the studies assessing musculoskeletal injury and one study assessing low back pain. In this study, however, face-to-face investigators were present at all times to ensure the safety of the participants.
The overall strength of the evidence for most of the outcomes assessed was rated as very low. These ratings are primarily due to limitations in the methodological quality of the included studies—non-RCTs begin with a GRADE rating of Low independent of any study limitations. Further contributing to very low ratings, there were concerns around representativeness of the included patients in all studies. Study size was a major contributor to assessing precision of the findings, resulting in downgrades for imprecision. Finally, the study settings may not be representative of real-world TR settings and we downgraded these studies for indirectness.
# Overall Quality of Evidence Rating

## Table 1. Overall Assessment of Quality of Evidence Base

<table>
<thead>
<tr>
<th>Outcome (Rating)</th>
<th>Quantity and Type of Evidence</th>
<th>Intervention (Number of Patients) Follow-up</th>
<th>Findings</th>
<th>Study Limitations (Study Quality, Risk-of-Bias)(^a)</th>
<th>Inconsistency(^b)</th>
<th>Indirectness(^c)</th>
<th>Imprecision(^d)</th>
<th>GRADE of Evidence for Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low Back Pain</strong></td>
<td></td>
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</tbody>
</table>
| Agreement: Overall (Critical) | 1 within-subjects RS Peterson et al. 2019\(^{19}\) | n=47 Follow-up: End of study | Interrater Agreement  
κ: 0.52; 95% CI: 0.32 to 0.72; moderate agreement  
Percent agreement between face-to-face and TR assessments: 68.1%  
Assignment to subsequent treatment groups did not vary by assessment type.  
\(\chi^2\): 2.14; p=0.54 | Very serious limitations (-2) | No serious inconsistency | Serious indirectness (-1) | TR intervention may not accurately reflect in-home TR | Very serious imprecision (-2) | Single small study and wide CIs | Very low |
| Agreement: Posture (Critical) | 1 within-subjects RS Truter et al. 2014\(^{127}\) | n=26 Follow-up: End of study | Interrater Agreement  
Assessment of Posture  
Percent agreement between face-to-face and TR ranged from 25% to 75%.  
κ values poor to slight; \(\chi^2\): NS | Serious limitations (-1) | No serious inconsistency | Serious indirectness (-1) | TR intervention may not accurately reflect in-home TR | Very serious imprecision (-2) | Single very small study; poor agreement | Very low |
| Agreement: Range of Motion (Critical) | 1 within-subjects RS Truter et al. 2014\(^{127}\) | n=26 Follow-up: End of study | Active Range of Motion  
Pearson’s r between face-to-face and TR ranged from moderate: 0.67 (Lateral flexion) to strong: 0.83 (extension) and 0.89 (flexion). | Serious limitations (-1) | No serious inconsistency | Serious indirectness (-1) | TR intervention may not accurately reflect in-home TR | Very serious imprecision (-2) | Single very small study | Very low |
| Agreement: Identifying Pain with Movement (Critical) | 1 within-subjects RS Truter et al. 2014\(^{127}\) | n=26 Follow-up: End of study | Agreement That a Movement Was Painful  
There was high agreement between face-to-face and TR in identifying if a movement was painful (all movements >81% agreement; all \(\chi^2\): p ≤0.001). | Serious limitations (-1) | No serious inconsistency | Serious indirectness (-1) | TR intervention may not accurately reflect in-home TR | Very serious imprecision (-2) | Single very small study | Very low |
<table>
<thead>
<tr>
<th>Outcome (Rating)</th>
<th>Quantity and Type of Evidence</th>
<th>Intervention (Number of Patients) Follow-up</th>
<th>Findings</th>
<th>Study Limitations (Study Quality, Risk-of-Bias)</th>
<th>Inconsistencya</th>
<th>Indirectnessc</th>
<th>Imprecisiond</th>
<th>GRADE of Evidence for Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agreement: SLR Test (Critical)</td>
<td>1 within-subjects RS Truter et al. 2014127</td>
<td>n=26 Follow-up: End of study</td>
<td>Agreement for Symptoms: SLR Test There was high agreement between face-to-face and TR in categorical rating of symptoms (painful: 90% agreement; χ²: p &lt;0.01; symptoms: 84% agreement; κ value: 0.62 [moderate]).</td>
<td>Serious limitations (-1)</td>
<td>No serious inconsistency</td>
<td>Serious indirectness (-1) TR intervention may not accurately reflect in-home TR</td>
<td>Very serious imprecision (-2) Single very small study</td>
<td>Very low</td>
</tr>
<tr>
<td>Lower Limb Injury</td>
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<tr>
<td>Agreement: Diagnosis (Critical)</td>
<td>1 within-subjects RS Russell et al. 2010128</td>
<td>n=19 Follow-up: End of study</td>
<td>Validity (agreement between face-to-face and TR): 79%; χ²: 5.26; p=0.022</td>
<td>Serious limitations (-1)</td>
<td>No serious inconsistency</td>
<td>Serious indirectness (-1) TR intervention may not accurately reflect in-home TR</td>
<td>Very serious imprecision (-2) Single very small study</td>
<td>Very low</td>
</tr>
<tr>
<td>Agreement: Physical Examination Findings (Critical)</td>
<td>1 within-subjects RS Russell et al. 2010128</td>
<td>n=19 Follow-up: End of study</td>
<td>Categorical Physical Examination Findings Validity (agreement between face-to-face and TR): weighted κ: 0.76; substantial Binary Scale-rated Physical Examination Findings Validity (agreement between face-to-face and TR): 82.9%; χ²: 227.69; p &lt;0.001</td>
<td>Serious limitations (-1)</td>
<td>No serious inconsistency</td>
<td>Serious indirectness (-1) TR intervention may not accurately reflect in-home TR</td>
<td>Very serious imprecision (-2) Single very small study</td>
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<tr>
<td>Ankle Pain</td>
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<tr>
<td>Agreement: Diagnosis (Critical)</td>
<td>1 within-subjects RS Russell et al. 201052</td>
<td>n=15 Follow-up: End of study</td>
<td>Validity (agreement between face-to-face and TR): 80%; χ²: 4.267; p &lt;0.04</td>
<td>Serious limitations (-1)</td>
<td>No serious inconsistency</td>
<td>Serious indirectness (-1) TR intervention may not accurately reflect in-home TR</td>
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<td>Very low</td>
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<tr>
<td>Outcome (Rating)</td>
<td>Quantity and Type of Evidence</td>
<td>Intervention (Number of Patients) Follow-up</td>
<td>Findings</td>
<td>Study Limitations (Study Quality, Risk-of-Bias)</td>
<td>Inconsistency</td>
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<td>GRADE of Evidence for Outcome</td>
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<tr>
<td><strong>Upper Limb Injury</strong></td>
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<tr>
<td>Agreement: Physical Examination Findings (Critical)</td>
<td>1 within-subjects RS Russell et al. 2010&lt;sup&gt;12&lt;/sup&gt;</td>
<td>n=15 Follow-up: End of study</td>
<td>Categorical Physical Examination Findings Validity (agreement between face-to-face and TR): weighted κ: 0.92; almost perfect</td>
<td>Serious limitations (-1)</td>
<td>No serious inconsistency</td>
<td>Serious indirectness (-1) TR intervention may not accurately reflect in-home TR</td>
<td>Very serious imprecision (-2) Single very small study</td>
<td>Very low</td>
</tr>
<tr>
<td>Agreement: Diagnosis (Critical)</td>
<td>1 within-subjects RS Lade et al. 2012&lt;sup&gt;129&lt;/sup&gt;</td>
<td>n=10 Follow-up: End of study</td>
<td>System Diagnosis Validity (agreement between face-to-face and TR): 73%; p=0.013</td>
<td>Serious limitations (-1)</td>
<td>No serious inconsistency</td>
<td>Serious indirectness (-1) TR intervention may not accurately reflect in-home TR</td>
<td>Very serious imprecision (-2) Single very small study</td>
<td>Very low</td>
</tr>
<tr>
<td>Agreement: Physical Examination Findings (Critical)</td>
<td>1 within-subjects RS Lade et al. 2012&lt;sup&gt;129&lt;/sup&gt;</td>
<td>n=10 Follow-up: End of study</td>
<td>Categorical Data Tests Validity and reliability (agreement between face-to-face and TR): &gt;71% exact agreement; &gt;77% similar agreement; κ: 0.45 Binary Scale-rated Physical Examination Findings Validity and reliability (agreement between face-to-face and TR): all &gt;68%; all p &lt;0.006</td>
<td>Serious limitations (-1)</td>
<td>No serious inconsistency</td>
<td>Serious indirectness (-1) TR intervention may not accurately reflect in-home TR</td>
<td>Very serious imprecision (-2) Single very small study</td>
<td>Very low</td>
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<tr>
<td><strong>Shoulder Pain</strong></td>
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<tr>
<td>Agreement: Diagnosis (Critical)</td>
<td>1 within-subjects RS Steele et al. 2012&lt;sup&gt;131&lt;/sup&gt;</td>
<td>n=28 Follow-up: End of study</td>
<td>System Diagnosis Validity (agreement between face-to-face and TR): 78.6%; p &lt;0.001</td>
<td>Serious limitations (-1)</td>
<td>No serious inconsistency</td>
<td>Serious indirectness (-1) TR intervention may not accurately reflect in-home TR</td>
<td>Very serious imprecision (-2) Single very small study</td>
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</table>
### Agreement: Physical Examination Findings (Critical)

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<tr>
<th>Outcome (Rating)</th>
<th>Quantity and Type of Evidence</th>
<th>Intervention (Number of Patients) Follow-up</th>
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<th>GRADE of Evidence for Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agreement: Physical Examination Findings (Critical)</td>
<td>1 within-subject RS Steele et al. 2012(^{131})</td>
<td>n=28 Follow-up: End of study</td>
<td><strong>Categorical Data Tests</strong>&lt;br&gt;Validity and reliability (agreement between face-to-face and TR): &gt;76.8% exact and close agreement; χ²: 0.50 and above <strong>Binary Scale-rated Physical Examination Findings</strong>&lt;br&gt;Validity: strong agreement across most outcomes (Highest for ROM: 87.4% agreement; χ²: 30.782; p &lt;0.001; Lowest for nerve testing: 56.1% agreement; χ²: 6.291; p=0.012)&lt;br&gt;Joint assessment had poor agreement (64.4%; p=0.383)</td>
<td>Serious limitations (-1)</td>
<td>No serious inconsistency</td>
<td>Serious indirectness (-1)</td>
<td>No serious inconsistency</td>
<td>Very serious imprecision (-2)</td>
</tr>
</tbody>
</table>

### Musculoskeletal (Mixed Population Upper and Lower)

<table>
<thead>
<tr>
<th>Outcome (Rating)</th>
<th>Quantity and Type of Evidence</th>
<th>Intervention (Number of Patients) Follow-up</th>
<th>Findings</th>
<th>Study Limitations (Study Quality, Risk-of-Bias)(^a)</th>
<th>Inconsistency(^b)</th>
<th>Indirectness(^c)</th>
<th>Imprecision(^d)</th>
<th>GRADE of Evidence for Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agreement: Diagnosis and Management (Critical)</td>
<td>1 within-subjects RS Cottrell et al. 2018(^{132})</td>
<td>n=42 Follow-up: End of study</td>
<td><strong>Management Pathway</strong>&lt;br&gt;Level of agreement between TR and in-person assessment for clinical management decisions&lt;br&gt;Exact agreement: 83/3%&lt;br&gt;AC1: 0.83; 95% CI: 0.70 to 0.95; near perfect&lt;br&gt;<strong>Referral to Specific Allied Health Professions</strong>&lt;br&gt;<strong>Physiotherapy</strong>&lt;br&gt;Exact agreement: 90.5%&lt;br&gt;AC1: 0.90; 95% CI: 0.785 to 1.0; near perfect&lt;br&gt;<strong>Psychology</strong>&lt;br&gt;Exact agreement: 85.7%&lt;br&gt;AC1: 0.78; 95% CI: 0.6 to 0.97; substantial agreement</td>
<td>Serious limitations (-1)</td>
<td>No serious inconsistency</td>
<td>Serious indirectness (-1)</td>
<td>No serious inconsistency</td>
<td>Very serious imprecision (-2)</td>
</tr>
</tbody>
</table>
# Evidence Synthesis Report

## Outcome (Rating)  
Quantity and Type of Evidence  
Intervention (Number of Patients)  
Follow-up  
Findings  
Study Limitations (Study Quality, Risk-of-Bias)  
Inconsistency\(^b\)  
Indirectness\(^c\)  
Imprecision\(^d\)  
GRADE of Evidence for Outcome

### Parkinson’s Disease

| Agreement: Physical Examination Findings (Critical) | 1 within-subjects RS Russell et al. 2013\(^{130}\) | n=12 Follow-up: End of study | Weighted kappa scores for all ordinal scale assessment items: \(\geq 0.90\); high agreement  
The limits of agreement for all continuous data variables fell within the clinically acceptable criteria for adequate agreement.  
Functional reach: -2.71 to 0.69 cm;  
Lateral reach: -2.09 to 0.51 cm; clinically acceptable level: 4.74 cm  
Timed “up and go” test: -1.25 to 1.24 s; clinically acceptable level: 5 s  
Timed stance test: -4.17 to 5.06 s; clinically acceptable level: 8 s | Serious limitations (-1) | No serious inconsistency | Serious indirectness (-1) TR intervention may not accurately reflect in-home TR | Very serious imprecision (-2) Single very small study | Very low |

\(^a\) Methodological Quality considers the overall risk of bias rating of all the studies included in the evidence base;  
\(^b\) Inconsistency of results considers if the studies demonstrated similar positive or negative results (an inconsistent rating would indicate that the findings across studies were mixed);  
\(^c\) Indirectness of evidence considers the link between the interventions and patient outcomes (head-to-head comparisons provide the most direct evidence) as well as the applicability of the study population;  
\(^d\) Imprecision estimates the degree of uncertainty (based on variance or sample size) around an outcome’s effect size.  

AC1: Gwet's agreement coefficient; CI: confidence interval; \(\kappa\): kappa; NR: not reported; NS: not significant; RS: reliability study; SLR: straight leg raise test; TR: telerehabilitation
## Appendix A. Evidence Tables

### Table 2. Individual Studies

<table>
<thead>
<tr>
<th>Study Details</th>
<th>Patients/Interventions</th>
<th>Intervention/Outcomes</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low Back Pain</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| **Reference:** Peterson et al. 2019⁴⁹ | **Number of Patients:** 47 | **Intervention:** TR assessment given over Zoom. | **Interrater Agreement**  
\( \kappa: 0.52; 95\% CI: 0.32 \text{ to } 0.72; \) moderate agreement |
<p>| <strong>Country:</strong> U.S. | <strong>Diagnosis:</strong> Low back pain; median symptom duration of 28 days | <strong>Control:</strong> Face-to-face assessment | Percent agreement between face-to-face and TR assessments: 68.1% |
| <strong>Study Design:</strong> RS (within-subjects) | <strong>Mean Age Years (SD):</strong> 48.6 (15.0) | Assessments were given in same private treatment room in the clinic, one followed by the other. Order of face-to-face and TR assessments and the clinician giving the assessments were randomized using a coin toss. | Assignment to subsequent treatment groups did not vary by assessment type. |
| <strong>Purpose:</strong> To examine the agreement between TR and face-to-face assessments of patients with acute and subacute LBP using a modified TBC system. | <strong>Gender (% male): 30%</strong> | The testing and interviewing procedures followed previous research on the TBC system and used a hierarchical algorithm to assign treatments. SLR, prone instability test, and spring testing could not be assessed using telehealth in the same manner as face-to-face. See page 1081 in the full paper for description of adaptations to accommodate a TR setting. | ( \chi^2: 2.14; p=0.54 ) |
| <strong>Quality Rating:</strong> Poor | <strong>Race:</strong> NR | <strong>TR Set-up:</strong> The patient side of the intervention included both a computer with a camera and an iPad mounted on a tripod with a wide-angle lens. The clinician side of the intervention included a computer. Patients had a single view of the clinician and the clinician had two views of the patient for assessment. |         |
| Clinicians blinded to each other’s assessments, no other blinding. Random assignment of assessment order determined by coin toss (non-valid method) and order of assessments were not equal. Assessments given in same session with at most a 10-minute break for the patient. | <strong>Inclusion Criteria:</strong> Surgical history in the lumbosacral spine; visible lateral lumbar shift or acute kyphotic deformity; no reproduction of symptoms with the active range of motion or palpation; a SLR &lt;30°; lower limb reflex or strength deficits deemed abnormal; or pregnancy. | <strong>Primary Outcomes:</strong> Agreement (( \kappa ) coefficient⁴) between face-to-face and TR assessments |         |
| <strong>Funding Source:</strong> NR | <strong>Exclusion Criteria:</strong> Adults (18-65 years) with LBP &lt;90 days duration and ODI score ≥25%. | After assessments, patients were assigned to intervention groups: mobilization/manipulation, specific exercise, or stabilization. |         |
|                       |                       | <strong>Follow-up:</strong> End of visit |         |</p>
<table>
<thead>
<tr>
<th>Study Details</th>
<th>Patients/Interventions</th>
<th>Intervention/Outcomes</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference: Truter et al. 2014[127]</td>
<td>Number of Patients: 26</td>
<td>Intervention: TR assessment given with the eHAB® TR system.</td>
<td>Assessment of Posture</td>
</tr>
<tr>
<td>Country: Australia</td>
<td>Diagnosis: LBP</td>
<td>Control: Face-to-face assessment</td>
<td>Percent agreement between face-to-face and TR ranged from 25% to 75%. k values poor to slight; χ²: NS</td>
</tr>
<tr>
<td>Study Design: RS (within-subjects)</td>
<td>Mean Age Years (SD): 38.1 (NR)</td>
<td>Assessments were given in same private treatment room in the clinic, one followed by the other. Order of face-to-face and TR assessments and the clinician giving the assessments were randomized using computer-generated code. Patients experiencing increased LBP after the initial assessment were given the option to discontinue participation.</td>
<td><strong>Active Range of Motion (SLR)</strong></td>
</tr>
<tr>
<td>Purpose: To evaluate the validity of performing an effective physical examination of the lumbar spine via TR in a clinical setting.</td>
<td>Gender (% male): 42%</td>
<td>Patients were asked to bring a friend with them to assist in the examination. In the event the patient was unaccompanied, untrained, non-clinical staff assistant the patient.</td>
<td>Pearson’s r between face-to-face and TR ranged from moderate: 0.67 (Lateral flexion) to strong: 0.83 (extension) and 0.89 (flexion).</td>
</tr>
<tr>
<td>Quality Rating: Fair</td>
<td>Race: NR</td>
<td><strong>Agreement That a Movement Was Painful</strong></td>
<td>There was high agreement between face-to-face and TR in identifying if a movement was painful (all movements &gt;81% agreement; all χ²: p ≤0.001).</td>
</tr>
<tr>
<td>Clinicians blinded to each other’s assessments, no other blinding. Random assignment of assessment adequate. Inadequate demographic information on participants. Assessments given in same session with at most a 10-minute break for the patient.</td>
<td>Inclusion Criteria: Current or recent LBP (w/in past 2 years).</td>
<td><strong>Agreement for Symptoms and Sensitization of the SLR Test</strong></td>
<td>There was high agreement between face-to-face and TR in categorical rating of symptoms (painful: 90% agreement; χ²: p &lt;0.01; symptoms: 84% agreement; k value: 0.62 [moderate]).</td>
</tr>
<tr>
<td>Funding Source: NR</td>
<td>Exclusion Criteria: &lt;18 years old; medical conditions precluding a safe physical examination; inadequate cognition or communication to allow the use of the TR system; unable to mobilize independently; or current severe irritable LBP and/or severe neurological symptoms.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Study Details

<table>
<thead>
<tr>
<th>Reference: Russell et al. 2010¹²</th>
<th>Country: Australia</th>
<th>Study Design: RS (within-subjects)</th>
<th>Purpose: To determine the validity and reliability of remote physical assessment and diagnosis of nonarticular lower limb musculoskeletal conditions via TR.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of Patients:</strong> 19</td>
<td><strong>Diagnosis:</strong> Lower limb injury</td>
<td><strong>Mean Age Years (SD):</strong> 26 (13)</td>
<td><strong>Gender (% male):</strong> 26%</td>
</tr>
<tr>
<td><strong>Race:</strong> NR</td>
<td><strong>Inclusion Criteria:</strong> Non-joint-related lower limb pain.</td>
<td><strong>Exclusion Criteria:</strong> &lt;18 years old; medical conditions precluding a safe physical examination; inadequate cognition or communication to allow the use of the TR system; unable to mobilize independently.</td>
<td><strong>Control:</strong> Face-to-face assessment. Assessments were given in the same private treatment room in the clinic, one followed by the other. Order of face-to-face and TR assessments and the clinician giving the assessments were determined using block randomization. In addition to a face-to-face and real-time TR assessment (measuring validity), recordings were viewed by a third PT and by the same TR PT to determine interrater and intrarater reliability, respectively. Re-review by the same TR PT was separated by one month. <strong>TR Set-up:</strong> The TR assessment was conducted using the same eHAB® TR system as described in Truter et al. 2014.¹²⁷ <strong>Primary Outcomes:</strong> Agreement (κ coefficient) between face-to-face and TR assessments. Values of κ over 0.40 were considered to be clinically acceptable. After assessments, patients were assigned to intervention groups: mobilization/manipulation, specific exercise, or stabilization. <strong>Follow-up:</strong> End of visit.</td>
</tr>
</tbody>
</table>

### Musculoskeletal Conditions

<table>
<thead>
<tr>
<th>Number of Patients: 15</th>
<th>Diagnosis: Ankle pain</th>
<th>Mean Age Years (SD): 24.5 (10.8)</th>
<th>Gender (% male): 33%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Race:</strong> NR</td>
<td><strong>Inclusion Criteria:</strong> Current ankle pain and dysfunction.</td>
<td><strong>Intervention:</strong> TR assessment given with the eHAB® TR system.</td>
<td><strong>Control:</strong> Face-to-face assessment. Assessments were given in the same private treatment room in the clinic, one followed by the other. Order of face-to-face and TR assessments and the clinician giving the assessments were determined using block randomization. In addition to a face-to-face and real-time TR assessment (measuring validity), recordings were viewed by a third PT and by the same TR PT to determine interrater and intrarater reliability, respectively. Re-review by the same TR PT was separated by one month. <strong>TR Set-up:</strong> The TR assessment was conducted using the same eHAB® TR system as described in Truter et al. 2014.¹²⁷ <strong>Primary Outcomes:</strong> Agreement (κ coefficient) between face-to-face and TR assessments. Values of κ over 0.40 were considered to be clinically acceptable. After assessments, patients were assigned to intervention groups: mobilization/manipulation, specific exercise, or stabilization. <strong>Follow-up:</strong> End of visit.</td>
</tr>
</tbody>
</table>

### System Diagnosis

- **Validity** (agreement between face-to-face and TR): 79%; χ²: 5.26; p = 0.022
- Intra-rater reliability: 100%; χ²: 13.46; p < 0.001
- Intrarater reliability: 89%; χ²: 3.91; p = 0.048

### Categorical Physical Examination Findings

- **Validity** (agreement between face-to-face and TR): weighted κ: 0.76; substantial
- Intrarater reliability: weighted κ: 0.99; almost perfect
- Intrarater reliability: weighted κ: 0.98; almost perfect

### Binary Scale-rated Physical Examination Findings

- **Validity** (agreement between face-to-face and TR): 82.9%; χ²: 227.69; p < 0.001
- Intrarater reliability: 97.4%; χ²: 969.81; p < 0.001
- Intrarater reliability: 95.1%; χ²: 827.23; p < 0.001

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¹² Russell et al. 2010
¹²² Truter et al. 2014
<table>
<thead>
<tr>
<th>Study Details</th>
<th>Patients/Interventions</th>
<th>Intervention/Outcomes</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quality Rating: Fair</strong>&lt;br&gt;Clinicians blinded to each other’s assessments, no other blinding.&lt;br&gt;Outcome assessor blinded to examination type. Random assignment of assessment adequate. Inadequate demographic information on participants. Assessments given in same session.&lt;br&gt;Funding Source: NR</td>
<td>Exclusion Criteria: &lt;18 years old; medical conditions precluding a safe physical examination; inadequate cognition or communication to allow the use of the TR system; unable to mobilize independently.&lt;br&gt;Follow-up: End of visit</td>
<td><strong>Binary Scale-rated Physical Examination Findings</strong>&lt;br&gt;Validity (agreement between face-to-face and TR): 99.3%; $\chi^2$: 234.41; p &lt; 0.001&lt;br&gt;Intrarater reliability: 99.2%; $\chi^2$: 694.45; p &lt; 0.001&lt;br&gt;Interrater reliability: 99.9%; $\chi^2$: 579.68; p &lt; 0.001</td>
<td><strong>Pathoanatomical Diagnoses</strong>&lt;br&gt;Validity: agreement between face-to-face and TR: 36% exact agreement; 73% similar agreement&lt;br&gt;Intrarater reliability: 73% exact agreement; 82% similar agreement&lt;br&gt;Interrater reliability: 18% exact agreement; 73% similar agreement</td>
</tr>
</tbody>
</table>

### Reference: Lade et al. 2012<sup>129</sup>

**Country:** Australia  
**Study Design:** RS (within-subjects)  
**Purpose:** To determine whether a TR system could enable an examiner to make the same pathoanatomical and systems diagnosis, and obtain the same physical examination findings as a face-to-face examination.  
**Quality Rating:** Fair  
Each examiner was blinded to the findings of the other examiners. The repeated measures design enabled participants to learn from the first examination, which could have influenced the way in which they conducted and reported the second examination. The lack of experience of the examiners (honor students) and the clinical reasoning process each employed may have affected the validity and reliability of the TR examinations.  
**Funding Source:** NR  

| Number of Patients: 10<br>Diagnosis: Upper limb (elbow) injury<br>Mean Age Years (SD): 38 (13)<br>Gender (% male): 90%<br>Race: NR<br>Inclusion Criteria: Patients with current elbow pain or dysfunction; >18 years; English-speaking; sufficient cognitive and communication levels to complete the examination.<br>Exclusion Criteria: <18 years old; poor vision or hearing (corrected or uncorrected) that would prevent successful completion of the examination. | Intervention: TR assessment via TR system (eHAB, NeoRehab, Brisbane).<br>Control: Face-to-face physical examination<br>Assessments were given in a single session; one included an interview and face-to-face examination; the other was a remote physical examination guided by a remote examiner at a differed location. The order of the assessments was randomized using a balanced block design of size four. The 3 examiners involved in the study were randomized to act as either the face-to-face examiner, the first TR examiner or the second TR examiner, for each participant.<br>The comparison of the diagnoses obtained in each assessment was performed by an independent and blinded physiotherapist. To evaluate the intra-rater reliability of the telerehabilitation examination, the video-recordings produced on the eHAB system by the first TR examiner were reassessed by the same examiner. 6 weeks after the initial assessment, to produce another set of diagnoses. To evaluate the inter-rater reliability of the TR examination, a second examiner viewed the video-recordings produced on the eHAB system by the first TR examiner, for each participant.  
**TR Set-up:** The TR assessment was conducted using the same eHAB® TR system as described in Truter et al. 2014.<sup>127</sup> | **Validity:**<br>Spinal and cranial diagnoses, and reliability (agreement between face-to-face and TR): >71% exact agreement; >77% similar agreement<br>Intrarater reliability: 99.2%; $\chi^2$: 694.45; p < 0.001<br>Interrater reliability: 99.9%; $\chi^2$: 579.68; p < 0.001 | **Pathoanatomical Diagnoses**<br>Validity: agreement between face-to-face and TR: 36% exact agreement; 73% similar agreement<br>Intrarater reliability: 73% exact agreement; 82% similar agreement<br>Interrater reliability: 18% exact agreement; 73% similar agreement | **System Diagnosis**<br>Validity: agreement between face-to-face and TR: 73%; p=0.013<br>Intrarater reliability: 90%; p < 0.001<br>Interrater reliability: 64%; p=0.11 | **Categorical Data Tests**<br>Validity and reliability (agreement between face-to-face and TR): >71% exact agreement; >77% similar agreement; k: 0.45 | **Binary Scale-rated Physical Examination Findings**<br>Validity and reliability (agreement between face-to-face and TR): all >68%; all p < 0.006 |
The equipment enables videoconferencing (320x240 pixels) using a wireless 3G Internet connection.

**Primary Outcomes:** Agreement (κ coefficient and Chi-square) between face-to-face and TR assessments. Values of κ over 0.40 were considered to be clinically acceptable.

**Follow-up:** End of visit

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**Reference:** Steele et al. 2012

**Country:** Australia

**Study Design:** RS (within-subjects)

**Purpose:** To evaluate the validity and reliability of using a TR system to identify disorders of the shoulder.

**Quality Rating:** Fair

Clinicians blinded to each other’s assessments, no other blinding. Outcome assessor blinded to examination type. Random assignment of assessment adequate. Inadequate demographic information on participants.

**Funding Source:** One author (T. G. Russell) has a material role in the commercialization of the eHAB system. In order to maintain independence, this author was not involved in the collection of the data in this study. No competing financial interests exist for the remaining authors.

**Number of Patients:** 28

**Diagnosis:** Shoulder pain

**Mean Age Years (SD):** 30.7 (14.2)

**Gender (% male):** 72.7%

**Race:** NR

**Inclusion Criteria:** Patients with current shoulder pain or dysfunction; >18 years; English-speaking; sufficient cognitive and communication levels to complete the examination.

**Exclusion Criteria:** <18 years old; poor vision or hearing (corrected or uncorrected) that would prevent successful completion of the examination.

**Intervention:** TR assessment via TR system (eHAB, NeoRehab, Brisbane).

**Control:** Face-to-face physical examination

Assessments were given in a similar manner to the other eHAB® TR system papers, reported above.127-129

**TR Set-up:** The TR assessment was conducted using the same eHAB® TR system as described in Truter et al. 2014.127

**Primary Outcomes:** Agreement (κ coefficient and Chi-square) between face-to-face and TR assessments. Values of κ over 0.40 were considered to be clinically acceptable.

**Follow-up:** End of visit

**Pathoanatomical Diagnoses**

Validity (agreement between face-to-face and TR): 18.52% same agreement; 40.74% similar agreement; 40.74% different

Intrarater reliability: 23.08% same agreement; 50% similar agreement; 26.92% different

 Interrater reliability: 40.74% same agreement; 59.26% similar agreement; 0% different

**System Diagnosis**

Validity (agreement between face-to-face and TR): 78.6%; p <0.001

Intrarater reliability: 82.1%; p <0.001

Interrater reliability: 82.1%; p <0.001

**Categorical Data Tests**

Validity and reliability (agreement between face-to-face and TR): >76.8% exact and close agreement; κ: 0.50 and above

**Binary Scale-rated Physical Examination Findings**

Validity: strong agreement across most outcomes (Highest for ROM: 87.4% agreement; $\chi^2$: 30.782; p <0.001; Lowest for nerve testing: 56.1% agreement; $\chi^2$: 6.291; p=0.012); joint assessment had poor agreement (64.4%; p=0.383)

Reliability: very high across all binary measures, ranging from 66.9% to 98.3% agreement (all ps <0.05).
### Study Details

- **Reference:** Cottrell et al. 2018
- **Country:** Australia
- **Study Design:** RS (within-subjects)
- **Purpose:** To determine level of agreement between TR and in-person assessment of patients with chronic musculoskeletal conditions referred to advanced-practice physiotherapy screening clinics.
- **Quality Rating:** Fair

Paired assessors were blinded to each other’s findings until all data collection forms had been returned. Study design may have enabled a ‘learned effect’ in participants, subsequently influencing the responses provided in the second assessment. Interrater agreement for each specific delivery medium was not evaluated.

- **Funding Source:** Two authors have a material interest in the eHAB® telerehabilitation system. They have not been directly involved in the collection or analysis of data in this study.

### Patients/Interventions

- **Number of Patients:** 42
- **Diagnosis:** Chronic lumbar spine (n=14); knee (n=14); or shoulder (n=14)
- **Mean Age Years (SD):** 52.7 (14.5)
  - Lumbar spine: 51.6 (13.5)
  - Knee: 48.9 (14.2)
  - Shoulder: 57.7 (15.5)
- **Gender (% female):** 57.1%
- **Race:** NR

**Inclusion Criteria:** >18 years; triaged by their referring physician for a non-urgent or semi-urgent assessment; available radiological investigations (tests) performed within the previous 12 months.

**Exclusion Criteria:** Medical conditions precluding a safe examination (e.g., cardiac or neurological disease), hearing or visual impairment precluding adequate participation in TR, inability to mobilize independently, or required use of an interpreter.

### Intervention/Outcomes

- **Intervention:** TR assessment via eHAB TR videoconferencing platform (NeoRehab Pty Ltd. Brisbane, QLD).
- **Control:** In-person physical examination

Assessments were given in a similar manner to the other eHAB® TR system papers, reported above.\(^{127-129}\)

**TR Set-up:** The TR assessment was conducted using the same eHAB® TR system as described in Truter et al. 2014.\(^{127}\) Participants were provided with an iPad on a portable stand connected wirelessly to the Internet within a hospital department.

**Primary Outcomes:** Agreement (Gwet’s AC1)\(^3\)

**Follow-up:** End of visit

### Results

**Management Pathway**

- Level of agreement between TR and in-person assessment for clinical management decisions
- Exact agreement: 83.3%
- AC1: 0.83; 95% CI: 0.70 to 0.95; near perfect

**Referral to Specific Allied Health Professions**

- **Physiotherapy**
  - Exact agreement: 90.5%
  - AC1: 0.90; 95% CI: 0.785 to 1.0; near perfect
- **Psychology**
  - Exact agreement: 85.7%
  - AC1: 0.78; 95% CI: 0.6 to 0.97; substantial agreement
- **Dietetics**
  - Exact agreement: 85.7%
  - AC1: 0.74; 95% CI: 0.53 to 0.957; substantial agreement

**Analysis of Clinical Diagnoses**

- Overall: 83.3% agreement
- Level of agreement between TR and in-person assessment for individual clinical diagnosis

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Same</th>
<th>Similar</th>
<th>Different</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumbar Spine</td>
<td>6/14 (42.9%)</td>
<td>7/14 (50%)</td>
<td>1/14 (7.1%)</td>
</tr>
<tr>
<td>Knee</td>
<td>6/14 (42.9%)</td>
<td>5/14 (35.7%)</td>
<td>3/14 (21.4%)</td>
</tr>
<tr>
<td>Shoulder</td>
<td>4/14 (28.6%)</td>
<td>7/14 (50%)</td>
<td>3/14 (21.4%)</td>
</tr>
<tr>
<td>Study Details</td>
<td>Patients/Interventions</td>
<td>Intervention/Outcomes</td>
<td>Results</td>
</tr>
<tr>
<td>---------------</td>
<td>------------------------</td>
<td>-----------------------</td>
<td>---------</td>
</tr>
</tbody>
</table>
| **Reference**: Russell et al. 2013<sup>130</sup>  
**Country**: Australia  
**Study Design**: RS (within-subjects)  
**Purpose**: To determine the validity and reliability of remote physical assessment of patients with Parkinson's disease via TR.  
**Quality Rating**: Fair  
Clinicians blinded to each other's assessments, no other blinding. Outcome assessor blinded to examination type. Random assignment of assessment adequate. Inadequate demographic information on participants. Assessments given in same session.  
**Funding Source**: The primary author has a material role in the commercialization of the eHAB system. To maintain independence, this author was not directly involved in the collection or analysis of the data in this study. No competing financial interests exist for the remaining authors.  
**Number of Patients**: 12  
**Diagnosis**: Parkinson's disease  
**Mean Age Years (SD)**: 66.1 (8.5)  
**Gender (% male)**: 50%  
**Race**: NR  
**Mean Years Since Diagnosis (SD)**: 6.8 yrs (4.4); range 2 to 15 yrs  
**Inclusion Criteria**: Parkinson's disease severity rating between stages I and IV on the Hoehn and Yahr Score; independently mobile; communication and cognitive status adequate to complete assessment tasks.  
**Exclusion Criteria**: Any comorbid conditions, such as a chronic orthopedic complaint that would prevent them from safely completing assessment tasks.  
**Intervention**: TR assessment via eHAB TR videoconferencing platform (NeoRehab Pty Ltd. Brisbane, QLD).  
Face-to-face investigators were present at all times to ensure the safety of the participants while performing balance assessment items and transfers.  
**Control**: In-person physical examination  
Assessments were given in a similar manner to the other eHAB® TR system papers, reported above.<sup>127-129</sup>  
**TR Set-up**: The TR assessment was conducted using the same eHAB® TR system as described in Truter et al. 2014.<sup>127</sup> Participants were provided with an iPad on a portable stand connected wirelessly to the Internet within a hospital department.  
**Primary Outcomes**: Agreement (κ coefficient<sup>1</sup> and Chi-square) between face-to-face and TR assessments. Values of κ over 0.40 were considered to be clinically acceptable.  
**Follow-up**: End of visit  
**Results**: Weighted kappa scores for all ordinal scale assessment items*: ≥0.90; high agreement  
Percent exact agreement was ≥66.7% for all assessment items except for the total Berg Balance Scale score (16.7%). Further analysis showed that the individual item “Standing on one leg” scoring lowest (50.0%). The limits of agreement for all continuous data variables fell within the clinically acceptable criteria for adequate agreement.  
**Functional reach**: -2.71 to 0.69 cm; **Lateral reach**: -2.09 to 0.51 cm; **clinically acceptable level**: 4.74 cm  
**Timed “up and go” test**: -1.25 to 1.24 s; **clinically acceptable level**: 5 s  
**Timed stance test**: -4.17 to 5.06 s; **clinically acceptable level**: 8 s  
**Rater reliability was high across all assessments**:  
**Interrater ICC (2,1)**: >0.96  
**Intrarater ICC (2,1)**: >0.98  
**Excellent reliability**  
* Step test, Steps in 360° turn, Total Berg Balance Scale score

<sup>1</sup> κ coefficient was interpreted as follows: less than 0.00=poor; 0.00 to 0.20=slight; 0.21 to 0.40=fair; 0.41 to 0.60=moderate; 0.61 to 0.80=substantial; and 0.81 to 1.00=almost perfect

<sup>2</sup> Pearson’s r was interpreted as follows: 0.00 to 0.35=weak correlation; 0.36 to 0.67=moderate correlation; and 0.68 to 1.00=strong correlation

<sup>3</sup> Gwet’s AC1 was interpreted as follows: ≤0.2 poor, 0.21-0.4 fair, 0.41-0.6 moderate, 0.61-0.8 substantial, 0.81-1.0 near perfect agreement

AC1: Gwet's agreement coefficient; CI: confidence interval; cm: centimeters; ICC (2,1): intraclass correlation coefficients; κ: kappa; LBP: low back pain; NR: not reported; NS: not significant; ODI: Oswestry disability index; PT: physical therapist; ROM: range of motion; RS: reliability study; s: seconds; SLR: straight leg raise test; TBC: treatment-based classification; TR: telerehabilitation
Appendix B. References

## Appendix C. Excluded Studies

### Table 3. Excluded Studies

<table>
<thead>
<tr>
<th>Reference</th>
<th>Reason for Exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wong et al. 2020\textsuperscript{84}</td>
<td>Scoping review.</td>
</tr>
<tr>
<td>Richardson et al. 2017\textsuperscript{133}</td>
<td>Fewer than 10 patients per arm.</td>
</tr>
<tr>
<td>Mani et al. 2016\textsuperscript{134}</td>
<td>Insufficient information provided on included studies.</td>
</tr>
<tr>
<td>Cikajlo et al. 2014\textsuperscript{135}</td>
<td>Does not meet study design criteria.</td>
</tr>
</tbody>
</table>
Key Question 4: For patients enrolled in physical therapy, what is the efficacy of providing 100% telerehab or hybrid care compared to traditional in-person care for occurrence of adverse/negative events?
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Key Question 4: For patients enrolled in physical therapy, what is the efficacy of providing 100% telerehab or hybrid care compared to traditional in-person care for occurrence of adverse/negative events?

Summary of Evidence Base

Our searches identified 2 systematic reviews (SRs)\(^61,62\) and 2 randomized controlled trials (RCTs)\(^63,76\) that compared telerehabilitation to conventional, in-person therapy and reported on adverse events and negative outcomes. All included studies varied widely in patient diagnosis, telerehabilitation protocol, and duration of interventions. Both SRs\(^61,62\) and 1 RCT\(^63\) were covered in KQ 1/3 and the RCT by Hansen\(^76\) was included in one of the SRs\(^60\) addressing KQ 1/3.

No studies meeting the search criteria were identified that addressed hybrid telerehabilitation specifically. No studies of asynchronous telerehabilitation reported on adverse/negative events outcomes.

Table 1 lists the included studies along with information about the comparisons covered in the review, and the primary study design and methodological quality of the included studies.

We only considered evidence from SRs or RCTs published on or after January 1, 2010, to July 26, 2021. Additionally, RCTs included in the SRs were not considered independently as evidence. See Tables 3 and 4 for detailed information on the characteristics of the studies and patients included in the reviews. Studies excluded as evidence for this key question are presented in Table 5 of Appendices.

<table>
<thead>
<tr>
<th>Review</th>
<th>Intervention(s)</th>
<th>Evidence Base/Study Design</th>
<th>Overall Quality of Included Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laver et al. 2020(^62)</td>
<td>Telerehabilitation vs. in-person rehabilitation* in stroke</td>
<td>416 studies (14 studies included in quantitative meta-analysis) in 1 SR</td>
<td>Fair</td>
</tr>
<tr>
<td>Jansson et al. 2020(^61)</td>
<td>Telerehabilitation vs. in-person rehabilitation* in TKA and THA</td>
<td>9 RCTs in 1 SR</td>
<td>Fair</td>
</tr>
</tbody>
</table>
Review | Intervention(s) | Evidence Base/Study Design | Overall Quality of Included Studies
---|---|---|---
Hansen et al. 2020<sup>76</sup>  
In KQ 1/3, this paper was included in the systematic review by Cox et al. 2021<sup>60</sup> and was therefore not included in that KQ.  
Telerehabilitation vs. in-person rehabilitation in patients with COPD | 1 RCT | Fair
Hwang et al. 2017<sup>63</sup>  
Telerehabilitation vs. in-person rehabilitation in chronic heart failure | 1 RCT | Fair

COPD: chronic obstructive pulmonary disease; RCT: randomized controlled trial; SR: systematic review THA: total hip arthroplasty; TKA: total knee arthroplasty

**Study Quality Rating**

The methodological quality of the RCTs included in 2 SRs was rated by the authors of the review as Fair. Many of the RCTs in the SRs rated as fair quality had concerns around outcome reporting, low sample size, attrition, and lack of blinding. There was limited information from the studies in the reviews about other sources of bias like variations between intervention and control conditions between sites or across time and other study details.

The methodological quality of the 2 individual RCTs was rated Fair using U.S. Preventative Services Task Force (USPSTF) criteria for RCTs. Fair ratings are primarily due to small lack of blinding, attrition, and come concerns around allocation procedures or data handling. See Tables 3 and 4 for study quality ratings for each paper.

**Key Findings**

Below, we describe the critical outcomes from the included studies with the GRADE strength of the evidence (SOE) rating. Note that a statement of “no difference” between treatments for outcomes does not imply equivalence. Where we judge the findings to be equivalent, it is explicitly stated in the key findings. See Table 2 for factors that influenced the SOE ratings for critical outcomes and for complete details of important outcomes, and Tables 3 and 4 for more information about the characteristics of the included studies.

**Telerehabilitation vs. In-person Rehabilitation**

**Critical Outcomes**

- Across all studies, rates of adverse events were low and did not vary between telerehabilitation or in-person care. Adverse events, when reported, were related to the nature of the physical therapy intervention (e.g., fatigue or arm, shoulder, groin, or knee pain). (SOE: Low)
Discussion

Overall, the evidence addressing adverse events in patients undergoing telerehabilitation versus conventional in-person therapy is small yet consistent despite the mixed patient diagnosis of the included studies. For most outcomes across studies, Low quality evidence shows no differences between telerehabilitation and in-person care. Generally speaking, the evidence was insufficiently precise to judge the findings equivalent. The strength of the evidence was limited in most cases by small sample size, with many outcomes even within SRs being represented by one or two small studies. Most studies did not report any adverse events at all. A limitation of examining adverse events when rates are low is that there is insufficient information in most cases to inform a high level of confidence in the findings.

Taken together with the findings from KQ1/3, the evidence suggests that the use of telerehabilitation is similar, but not identical, to in-person care. In highly-supervised experimental settings, rates of adverse events in both treatment groups are low. These findings should be taken in context with the findings from KQs 7 and 8, where it is clear that local factors, such as access to technology, patient, caregiver, and provider willingness and training, and other barriers and facilitators to care play a large role in the success or failure of implementing telerehabilitation in physical therapy practice.
# Overall Quality of Evidence Rating

## Overall Assessment of Quality of Evidence Base

<table>
<thead>
<tr>
<th>Outcome (Rating)</th>
<th>Quantity and Type of Evidence</th>
<th>Intervention (Number of Patients) Follow-up</th>
<th>Findings</th>
<th>Study Limitations (Study Quality, Risk-of-Bias)(^a)</th>
<th>Inconsistency(^b)</th>
<th>Indirectness(^c)</th>
<th>Imprecision(^d)</th>
<th>GRADE of Evidence for Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adverse Events (Critical)</strong></td>
<td>3 RCTs in 2 SRs Laver et al. 2020(^52) Jansson et al. 2020(^61) And 2 RCTS Hwang et al. 2017(^53) Hansen et al. 2020(^76)</td>
<td>Telerehabilitation vs. In-person rehabilitation <strong>Follow-up:</strong> 2 weeks to 12 months</td>
<td><strong>Stroke</strong>&lt;br&gt;No events in 1 study, 11 events in the second study.&lt;br&gt;6 non-serious adverse events in telerehabilitation group (arm and shoulder pain).&lt;br&gt;5 non-serious adverse events in control group (fatigue and arm and shoulder pain).&lt;br&gt;<strong>No difference.</strong>&lt;br&gt;TKA/THA&lt;br&gt;<strong>No difference</strong> between telerehabilitation and conventional care as reported by one study.&lt;br&gt;Chronic Heart Failure&lt;br&gt;<strong>No difference</strong> between intervention and control group.&lt;br&gt;Intervention group (n=24): 6&lt;br&gt;Control group (n=26): 2&lt;br&gt;Between group difference: p=0.89</td>
<td><strong>Serious limitations (-1)</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>Low</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>COPD</strong>&lt;br&gt;2 patients from conventional care group dropped out due to adverse events. Both related to overload and pain in knee and groin.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) Methodological Quality considers the overall risk of bias rating of all the studies included in the evidence base;
\(^b\) Inconsistency of results considers if the studies demonstrated similar positive or negative results (an inconsistent rating would indicate that the findings across studies were mixed);
\(^c\) Indirectness of evidence considers the link between the interventions and patient outcomes (head-to-head comparisons provide the most direct evidence) as well as the applicability of the study population;
\(^d\) Imprecision estimates the degree of uncertainty (based on variance or sample size) around an outcome’s effect size.
# Appendix A. Evidence Tables

## Table 3. Systematic Review/Meta-analysis

<table>
<thead>
<tr>
<th>Study Details</th>
<th>Search Strategy/Evidence Base</th>
<th>Patients/Interventions</th>
<th>Outcomes/Results</th>
</tr>
</thead>
</table>
| **Reference:** Laver et al. 2020<sup>62</sup>  
**Country:** Australia  
**Purpose:** To determine whether telerehabilitation leads to improved ability to perform activities of daily living amongst stroke survivors when compared with in-person rehabilitation or no rehabilitation.  
**Quality Rating:** Fair  
Some concerns around lack of clarity regarding randomization, allocation concealment, blinding, and selective reporting. Studies have small number of participants and poor reporting of trial details.  
**Publication Bias:** 13 studies have unclear reporting bias, 3 studies have low risk, 3 studies have high risk. Overall publication bias not reported.  
**Funding Source:** NR | Cochrane Stroke Group Trials Register, Cochrane Central Register of Controlled Trials, MEDLINE, Embase, and eight additional databases searched up to June 4, 2019.  
The evidence base consisted of 9 studies comparing telerehabilitation to in-person in patients who had experienced stroke.  
**Inclusion/Exclusion Criteria:** Studies were included if they were RCTs that compared either: i) telerehabilitation with in-person rehabilitation, ii) with no rehabilitation, iii) two different types of rehabilitation, iv) hybrid telerehabilitation with another intervention. Telerehabilitation was defined as “the delivery of rehabilitation services via information and communication technologies”. Asynchronous telerehabilitation interventions were included as well. Patients with mixed etiology were excluded unless more detailed data were available. No age limit was set. Twenty-two RCTs were included in this systematic review. | **Number of Patients:** 1,937  
**Diagnosis:** Stroke as defined by the WHO, all types, levels, and stages, as well as subarachnoid hemorrhage.  
**Age:** NR  
**Gender:** NR  
**Race:** NR  
**Intervention/Comparators:** Except for 1 study, all interventions were delivered in the patient’s home. 8 studies focused on enhancing care and well-being while 14 studies focused on improving functions like limb mobility, mobility, balance, and speech and language abilities.  
9 studies reported on telerehabilitation versus in-person rehabilitation.  
10 studies reported on telerehabilitation versus no rehabilitation or usual care (out of scope).  
1 3-armed study compared telerehabilitation with in-person rehabilitation and no intervention.  
**Primary Outcomes:** Independence in activity of daily living post-intervention.  
**Follow-up:** Range: 1 month to 12 months | **Adverse events**  
2 papers included in the SR described adverse events:  
Chen 2017: No adverse events occurred.  
Cramer 2019  
6 non-serious adverse events in telerehabilitation group (arm and shoulder pain).  
5 non-serious adverse events in control group (fatigue and arm and shoulder pain).  
**No difference.** |
<table>
<thead>
<tr>
<th>Study Details</th>
<th>Search Strategy/Evidence Base</th>
<th>Patients/Interventions</th>
<th>Outcomes/Results</th>
</tr>
</thead>
</table>
| **Reference:** Jansson et al. 2020<sup>61</sup>  
**Country:** Finland  
**Purpose:** To investigate the effects and safety of telerehabilitation in patients with lower-limb joint replacement.  
**Quality Rating:** Fair  
Main concerns were lack of clarity blinding of patients and clinical staff, including outcome assessors. Additional concerns were related to lack of clarity around identical treatment of groups, data analysis, and reliability of outcome measures.  
**Publication Bias:** NR  
**Funding Source:** Business Finland, as a part of the “Intelligent Customer-driven Solution for Orthopedic and Pediatric Surgery Care”.  
Melinda and Medline Ovid, Scopus, Ebsco Databases, and Web of Science were searched to February 2020.  
The evidence base consisted of 9 RCTs comparing telerehabilitation to traditional in-person care in patients with THA or TKA.  
**Inclusion/Exclusion Criteria:** RCTs comparing telerehabilitation and in-person outpatient physical therapy. Only adults (>18 years) were included.  
Studies of assessment tools, conference abstracts, preliminary results, unpublished studies were excluded.  
**Number of Patients:** 1,266  
**Diagnosis:** Patients following discharge from hospital after TKA and THA were included.  
Patients must be discharged with an active range of motion and the ability to walk using a walking aid. Patients must also be able to access and use a smartphone, and live in an area served by high-speed Internet within a one hour drive from the treating hospital.  
**Age:** Mean age 54.5 to 73.3 years old  
**Gender:** NR  
**Race:** NR  
**Intervention/Comparators:** Telerehabilitation, defined as an internet-based real-time two-way videoconferencing system, interactive virtual telerehabilitation software-hardware platform, asynchronous video-based software platform, internet based orthopedic care platform, or an app-based active muscle training system.  
Conventional in-person outpatient physical therapy.  
**Primary Outcomes:** Physical functioning, adverse events, resource utilization  
**Follow-up:** Range 2 to 8 weeks  
**Adverse events**  
No difference between telerehabilitation and conventional care as reported by one study. |
### Table 4. Individual Studies

<table>
<thead>
<tr>
<th>Study Details</th>
<th>Patients/Interventions</th>
<th>Intervention/Outcomes</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chronic Heart Failure</strong></td>
<td></td>
<td></td>
<td><strong>Adverse events</strong></td>
</tr>
<tr>
<td><strong>Reference:</strong> Hwang et al. 2017</td>
<td><strong>Number of Patients:</strong> 53</td>
<td><strong>Intervention:</strong> Telerehabilitation was delivered by a synchronous videoconferencing platform via the internet to groups of up to four participants at home.</td>
<td><strong>No difference</strong> between intervention and control group.</td>
</tr>
<tr>
<td><strong>Country:</strong> Australia</td>
<td><strong>Diagnosis:</strong> Chronic heart failure confirmed by an echocardiogram, including heart failure with reduced or preserved ejection fraction.</td>
<td><strong>Control:</strong> Center based rehabilitation program. Over the span of 12 weeks, a physiotherapist conducts a 60-minute session twice a week at a treating hospital.</td>
<td>Intervention group (n=24): 6</td>
</tr>
<tr>
<td><strong>Study Design:</strong> RCT</td>
<td><strong>Mean Age Years (SD):</strong> 67 years</td>
<td><strong>Note:</strong> Control group also had additional home exercises three times a week, unsupervised.</td>
<td>Control group (n=26): 2</td>
</tr>
<tr>
<td><strong>Purpose:</strong> To determine non-inferiority of telerehabilitation versus traditional center-based program for patients with chronic heart failure in terms of 6-minute walk distance.</td>
<td><strong>Gender (% male):</strong> 75%</td>
<td></td>
<td>Between group difference: ( p=0.89 )</td>
</tr>
<tr>
<td><strong>Quality Rating:</strong> Fair</td>
<td><strong>Race:</strong> 49 (92%) Caucasian</td>
<td><strong>Angina</strong></td>
<td><strong>Cardiac arrest</strong></td>
</tr>
<tr>
<td>Potential recruitment bias and uneven allocation. Single blind (outcome assessors). Low attrition, ITT used.</td>
<td><strong>Mean Baseline:</strong> Intervention group 6MWD: 346 (104)</td>
<td>Tele: 3; Control: 0</td>
<td>Tele: 0; Control: 0</td>
</tr>
<tr>
<td><strong>Funding Rating:</strong> Heart Foundation Health Professional Scholarship, Princess Alexandra Hospital Research Support Scheme Small Grant 2013, The Prince Charles Hospital Foundation Novice Researcher Grant 2012, Queensland Health: Health Practitioner Research Scheme 2012.</td>
<td>Control group 6MWD: 382 (106)</td>
<td><strong>Death</strong></td>
<td><strong>Diaphoresis</strong></td>
</tr>
<tr>
<td><strong>Inclusion Criteria:</strong> Patients with a recent hospital admission for heart failure and were referred to the heart failure services. Only adults (( &gt;18 ) years old) were included.</td>
<td><strong>Inclusion Criteria:</strong> Patients who did not meet safety screening criteria per Australian exercise guidelines for patients with chronic heart failure were excluded. Patients who lived more than an hour driving distance from the treating hospital or had no support person at home were also excluded.</td>
<td>Tele: 0; Control: 0</td>
<td>Tele: 1; Control: 2</td>
</tr>
<tr>
<td><strong>Exclusion Criteria:</strong> Patients who who did not meet safety screening criteria per Australian exercise guidelines for patients with chronic heart failure were excluded. Patients who lived more than an hour driving distance from the treating hospital or had no support person at home were also excluded.</td>
<td><strong>Follow-up:</strong> 12 weeks after intervention ends</td>
<td><strong>Fall</strong></td>
<td><strong>Palpitations</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Tele: 0; Control: 0</strong></td>
<td><strong>Tele: 0; Control: 0</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Tele: 2; Control: 0</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Tele: 0; Control: 0</strong></td>
</tr>
</tbody>
</table>
### Study Details

<table>
<thead>
<tr>
<th>Chronic Respiratory Illness</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>References:</strong> Hansen et al. 2020&lt;sup&gt;76&lt;/sup&gt;</td>
</tr>
<tr>
<td>In KQ 1/3, this paper was included in the systematic review by Cox et al. 2021.&lt;sup&gt;60&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>Country:</strong> Denmark</td>
</tr>
<tr>
<td><strong>Study Design:</strong> RCT</td>
</tr>
<tr>
<td><strong>Purpose:</strong> To investigate whether pulmonary telerehabilitation is superior to conventional rehabilitation on 6MWD, quality of life, physical activity, lower limb function in patients with COPD.</td>
</tr>
<tr>
<td><strong>Quality Rating:</strong> Fair</td>
</tr>
<tr>
<td>Lack of blinding, some concerns around lack of clarity related to incomplete outcome reporting and selective reporting.</td>
</tr>
<tr>
<td><strong>Funding source:</strong> Danish Lung Foundation, Telemedical Center Regional Capital</td>
</tr>
</tbody>
</table>

| **Number of Patients:** 134 |
| **Diagnosis:** COPD as defined as FEV1/FVC <0.70, FEV1 <50% |
| **Mean Age Years (SD):** 68.4 (8.7) and 68.2 (9.4) for telerehabilitation and conventional care group respectively. |
| **Gender (% male):** 48% and 42% for telerehabilitation and conventional care group respective. |
| **Race:** NR |
| **Mean Baseline (SD):** |
| Highest 6MWD in meters: |
| Telerehabilitation: 322.3 (108.3) |
| Conventional care: 332.3 (97.5) |
| **Inclusion Criteria:** Inclusion criteria corresponds to the criteria for outpatient hospital-based routine pulmonary rehabilitation. Patients must be a) an adult, b) diagnosed with COPD, and c) medical research council ≥2. |
| **Exclusion Criteria:** Patients who participated in pulmonary rehabilitation within 6 months of the start of the intervention are excluded. |

| **Intervention:** The telerehabilitation group had a group-based, supervised program performed by the patients in the home setting via videoconference. Interventions were carried out three times a week or ten weeks, at 35 minutes of exercise and 20 minutes of education per session. |
| **Control:** A hospital based pulmonary rehabilitation program, group-based and supervised performed in-person twice a week for 10 weeks. Each session was 60 minutes long. Patient education sessions occurred once a week and lasted 60 to 90 minutes. |

| **Primary Outcomes:** 6 minutes walking distance |
| **Follow-up:** 22 weeks |

| **Adverse events** |
| 2 patients from conventional care group dropped out due to adverse events. Both related to overload and pain in knee and groin. |

COPD: chronic obstructive pulmonary disease; FEV: forced expiratory volume; f/u: follow-up; FVC: forced vital capacity; ITT: intent to treat; NR: not reported; RCT: randomized control trial; SD: standard deviation; TKA: total knee arthroplasty
Appendix B. References


## Appendix C. Excluded Studies

Table 5. Excluded Studies

<table>
<thead>
<tr>
<th>Reference</th>
<th>Reason for Exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prvu Bettger et al. 2020(^{81})</td>
<td>Comparator not of interest, dissimilar to nature of telehealth intervention.</td>
</tr>
<tr>
<td>Flumignan et al. 2019(^{136})</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Maddison et al. 2019(^{137})</td>
<td>Intervention not of interest.</td>
</tr>
<tr>
<td>Sarfo et al. 2018(^{138})</td>
<td>No risk of bias assessment.</td>
</tr>
<tr>
<td>Bennell et al. 2017(^{101})</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Cottrell et al. 2017(^{139})</td>
<td>Included trials do not meet inclusion criteria.</td>
</tr>
<tr>
<td>Almojaibel et al. 2016(^{140})</td>
<td>Included trials do not meet inclusion criteria.</td>
</tr>
<tr>
<td>Rawstorn et al. 2016(^{141})</td>
<td>Included trials do not meet inclusion criteria.</td>
</tr>
<tr>
<td>Chen et al. 2015(^{142})</td>
<td>Included trials do not meet inclusion criteria.</td>
</tr>
<tr>
<td>Huang et al. 2015(^{143})</td>
<td>Included trials do not meet inclusion criteria.</td>
</tr>
</tbody>
</table>

KQ: key question
Key Question 5: For patients enrolled in physical therapy, what is the result of providing 100% telerehab or hybrid care compared to traditional in-person care on user acceptability/usability?
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Key Question 5: For patients enrolled in physical therapy, what is the result of providing 100% telerehab or hybrid care compared to traditional in-person care on user acceptability/usability?

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Table 1. Interventions and Comparators .................................................. 3
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Key Question 5: For patients enrolled in physical therapy, what is the result of providing 100% telerehab or hybrid care compared to traditional in-person care on user acceptability/usability?

Summary of Evidence Base

Our searches identified 1 systematic review (SR)\textsuperscript{60} that compared telerehabilitation to in-person rehabilitation.

Table 1 lists the included studies along with information about the comparisons covered in the review, and the primary study design and methodological quality of the included studies.

We only considered evidence from SRs or RCTs published on or after January 1, 2010, to July 26, 2021. Additionally, RCTs included in the SR were not considered independently as evidence. See Table 3 for detailed information on the characteristics of the studies and patients included in the reviews. Studies excluded as evidence for this key question are presented in Table 4 of Appendices.

<table>
<thead>
<tr>
<th>Review</th>
<th>Intervention(s)</th>
<th>Evidence Base/Study Design</th>
<th>Overall Quality of Included Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cox et al. 2021\textsuperscript{60}</td>
<td>Telerehabilitation vs. in-person rehabilitation* in chronic respiratory disease</td>
<td>15 studies (including 9 RCTs) in 1 SR</td>
<td>Poor</td>
</tr>
</tbody>
</table>

RCT: randomized controlled trials; SR: systematic review

Study Quality Rating

The methodological quality of the RCTs included in the SR\textsuperscript{60} was rated by the authors of the review as Poor. Many of the RCTs in the SRs rated as poor quality had concerns around outcome reporting, low sample size, attrition, and lack of blinding. There was limited information from the studies in the reviews about other sources of bias like variations between intervention and control conditions between sites or across time and other study details.
Key Findings

Below, we describe the critical outcomes from the included studies with the GRADE strength of the evidence (SOE) rating. Note that a statement of “no difference” between treatments for outcomes does not imply equivalence. Where we judge the findings to be equivalent, it is explicitly stated in the key findings. See Table 2 for factors that influenced the SOE ratings for critical outcomes and for complete details of important outcomes, and Table 3 for more information about the characteristics of the included studies.

Chronic Respiratory Disease

Critical Outcomes

- Evidence from 1 SR\textsuperscript{60} suggests that completion of treatment is more likely in patients with chronic respiratory disease who are given telerehabilitation relative to in-person care. (SOE: Low)

Discussion

Overall, the evidence comparing telerehabilitation versus conventional in-person therapy for treatment adherence and completion is modest yet limited. Low quality evidence suggests that completion of treatment is higher in patients who participate in telerehabilitation relative to patients participating in traditional in-person care. However, these findings are limited to patients with chronic respiratory disease. Therefore, the generalizability of the findings are weak.

Low quality evidence ratings were related to concerns about the potential risk of bias of the included studies, but there were no other major concerns regarding the consistence, directness, or precision of the data. However, these findings should be taken in context with the findings from KQs 7 and 8, where it is clear that local factors, such as access to technology, patient, caregiver, and provider willingness and training, and other barriers and facilitators to care play a large role in the success or failure of implementing telerehabilitation in physical therapy practice.
## Overall Quality of Evidence Rating

### Table 2. Overall Assessment of Quality of Evidence Base

<table>
<thead>
<tr>
<th>Outcome (Rating)</th>
<th>Quantity and Type of Evidence</th>
<th>Intervention (Number of Patients) Follow-up</th>
<th>Findings</th>
<th>Study Limitations (Study Quality, Risk-of-Bias)(^a)</th>
<th>Inconsistency(^b)</th>
<th>Indirectness(^c)</th>
<th>Imprecision(^d)</th>
<th>GRADE of Evidence for Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic Respiratory Disease</td>
<td>3 RCTs in 1 SR Cox et al. 2021(^60)</td>
<td>Telerehabilitation vs. Center-based Care 3 studies, n=516 <strong>Follow-up:</strong> 6 weeks to 12 months</td>
<td>Completion of the minimum percentage of prescribed training sessions OR: 5.36; 95% CI: 3.12 to 9.21; (I^2=56%) <strong>Favors telerehabilitation.</strong></td>
<td>Very serious limitations (-2)</td>
<td>No serious inconsistency</td>
<td>No serious indirectness</td>
<td>No serious imprecision</td>
<td>Low</td>
</tr>
</tbody>
</table>

\(^a\) Methodological Quality considers the overall risk of bias rating of all the studies included in the evidence base;

\(^b\) Inconsistency of results considers if the studies demonstrated similar positive or negative results (an inconsistent rating would indicate that the findings across studies were mixed);

\(^c\) Indirectness of evidence considers the link between the interventions and patient outcomes (head-to-head comparisons provide the most direct evidence) as well as the applicability of the study population;

\(^d\) Imprecision estimates the degree of uncertainty (based on variance or sample size) around an outcome’s effect size.

CI: confidence interval; OR: odds ratio; RCT: randomized control trial; SR: systematic review
## Appendix A. Evidence Tables

### Table 3. Systematic Review/Meta-analysis

<table>
<thead>
<tr>
<th>Study Details</th>
<th>Search Strategy/Evidence Base</th>
<th>Patients/Interventions</th>
<th>Outcomes/Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reference:</strong> Cox et al. 2021</td>
<td>Cochrane Airways Trials Register, Cochrane Central Register of Controlled Trials, MEDLINE, Embase, plus four other databases and three trial registries were searched through November 2020.</td>
<td><strong>Number of Patients:</strong> 1,904</td>
<td><strong>Adherence/Completion</strong> Telerehabilitation vs. Center-based Care</td>
</tr>
<tr>
<td><strong>Country:</strong> Australia</td>
<td>The evidence base consisted of 15 RCTs comparing telerehabilitation to in-person rehabilitation, or no rehabilitation. We report the data for telerehabilitation versus in-person care.</td>
<td><strong>Diagnosis:</strong> Chronic respiratory disease of any severity and in a stable state</td>
<td>Completion of the minimum percentage of prescribed training sessions (3 studies, n=516): OR: 5.36; 95% CI: 3.12 to 9.21; I²=56%</td>
</tr>
<tr>
<td><strong>Purpose:</strong> To determine the effectiveness and safety of telerehabilitation for people with chronic respiratory disease.</td>
<td><strong>Inclusion/Exclusion Criteria:</strong> RCTs and clinically controlled trials examining telerehabilitation in adult patients with chronic respiratory disease. Intervention must have had exercise training and &gt;50% telerehabilitation in any setting. Cystic fibrosis and neuromuscular diseases were excluded. Studies with monitoring only without pulmonary rehabilitation were excluded.</td>
<td><strong>Age:</strong> Mean age between 62 to 75 years old</td>
<td>Favors telerehabilitation.</td>
</tr>
<tr>
<td><strong>Quality Rating:</strong> Poor</td>
<td>Telerehabilitation interventions were similar but not identical across studies. 4 studies used video-conferencing, 4 studies used telephone only, the remaining studies utilized web pages and mobile apps.</td>
<td><strong>Gender:</strong> NR</td>
<td></td>
</tr>
<tr>
<td><strong>Publication Bias:</strong> NR</td>
<td>Comparators: In-person, inpatient rehabilitation, in-person, outpatient rehabilitation, or no rehabilitation</td>
<td><strong>Race:</strong> NR</td>
<td></td>
</tr>
<tr>
<td><strong>Funding Source:</strong> National Institute of Health Research</td>
<td><strong>Primary Outcomes:</strong> Exercise capacity, adverse events, dyspnea, quality of life</td>
<td><strong>Intervention:</strong> Telerehabilitation was defined as pulmonary rehabilitation at a distance using telecommunication technologies.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Follow-up:</strong> 6 weeks to 12 months</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CI: confidence interval; NR: not reported; OR: odds ratio; RCT: randomized control trial
Appendix B. References


## Appendix C. Excluded Studies

Table 4. Excluded Studies

<table>
<thead>
<tr>
<th>Reference</th>
<th>Reason for Exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chaudhry et al. 2021</td>
<td>Intervention not of interest.</td>
</tr>
<tr>
<td>Barbosa et al. 2020</td>
<td>No risk of bias assessment.</td>
</tr>
<tr>
<td>Lai et al. 2020</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Lawford et al. 2020</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Øra et al. 2020</td>
<td>Intervention not of interest.</td>
</tr>
<tr>
<td>Watts et al. 2020</td>
<td>Does not meet inclusion criteria for KQ3, and no data to extract.</td>
</tr>
<tr>
<td>Wong et al. 2020</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Lovo et al. 2019</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Rothgangel et al. 2019</td>
<td>Intervention not of interest.</td>
</tr>
<tr>
<td>Lawford et al. 2018</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Sarfo et al. 2018</td>
<td>No risk of bias assessment.</td>
</tr>
<tr>
<td>Bennell et al. 2017</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Cotrell et al. 2017</td>
<td>Included trials do not meet inclusion criteria.</td>
</tr>
<tr>
<td>Boissy et al. 2016</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Hoaas et al. 2016</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Jansen-Kosterink et al. 2015</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Lloréns et al. 2015</td>
<td>Intervention not of interest.</td>
</tr>
<tr>
<td>Varnfield et al. 2014</td>
<td>Intervention not of interest.</td>
</tr>
<tr>
<td>Ortiz-Gutierrez et al. 2013</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Chumbler et al. 2012</td>
<td>Intervention not of interest.</td>
</tr>
<tr>
<td>Bowles et al. 2011</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Johansson et al. 2011</td>
<td>Included trials do not meet inclusion criteria.</td>
</tr>
</tbody>
</table>

KQ: key question
Key Question 6: For patients enrolled in physical therapy, what is the cost-effectiveness of providing telerehab compared to traditional in-person care?
Contents

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Key Question 6: For patients enrolled in physical therapy, what is the cost-effectiveness of providing telerehab compared to traditional in-person care?

Summary of Evidence Base

Our searches identified 1 systematic review (SR) and 1 randomized controlled trial (RCT) that compared telerehabilitation with conventional in-person rehabilitation and reported on costs related to care. Table 1 lists the included studies along with information about the comparisons covered in the review, and the primary study design and methodological quality of the included studies.

We only considered evidence from SRs or RCTs published on or after January 1, 2010, to July 26, 2021. Studies needed to be an RCT or analysis of an RCT describing study-related cost data, or systematic reviews of these study designs, rather than mathematical modelling studies. RCTs included in the SR were not considered independently as evidence. See Tables 3 and 4 for detailed information on the characteristics of the studies and patients included in the reviews. Studies excluded as evidence for this key question are presented in Table 5 of Appendices.

Table 1. Overview of Evidence Addressing Key Question 6

<table>
<thead>
<tr>
<th>Review</th>
<th>Intervention(s)</th>
<th>Evidence Base/Study Design</th>
<th>Overall Quality of Included Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jansson et al. 202061</td>
<td>Telerehabilitation vs. in-person rehabilitation* in TKA and THA</td>
<td>9 RCTs in 1 SR</td>
<td>Fair</td>
</tr>
<tr>
<td>Hwang et al. 2018151</td>
<td>Telerehabilitation vs. in-person rehabilitation in chronic heart failure</td>
<td>1 RCT</td>
<td>Fair</td>
</tr>
</tbody>
</table>

RCT: randomized controlled trial; SR: systematic review; THA: total hip arthroplasty; TKA: total knee arthroplasty

Study Quality Rating

The methodological quality of the RCTs included in the SR was rated by the authors of the review as Fair. Many of the RCTs in the SR rated as fair quality had concerns around outcome reporting, low sample size, attrition, and lack of blinding. There was limited information from the studies in the reviews about other sources of bias like variations between intervention and control conditions between sites or across time and other study details.
The methodological quality of the 3 individual RCTs was rated Fair using U.S. Preventative Services Task Force (USPSTF) criteria for RCTs. Fair ratings are primarily due to small lack of blinding, attrition, and some concerns around allocation procedures or data handling. See Tables 3 and 4 for study quality ratings for each paper.

**Key Findings**

Below, we describe the critical outcomes from the included studies with the GRADE strength of the evidence (SOE) rating. Note that a statement of “no difference” between treatments for outcomes does not imply equivalence. Where we judge the findings to be equivalent, it is explicitly stated in the key findings. See Table 2 for factors that influenced the SOE ratings for critical outcomes and for complete details of important outcomes, and Tables 3 and 4 for more information about the characteristics of the included studies.

**Chronic Heart Failure**

**Critical Outcomes**

- Evidence from 1 small (n=53) RCT\(^{151}\) suggests that, in patients with chronic heart failure, total healthcare costs per patient are lower with telerehabilitation relative to in-person care at up to 3 months after the intervention. (SOE: Low)

**Total Knee or Total Hip Arthroplasty**

**Critical Outcomes**

- Evidence from 1 SR\(^{61}\) indicates that, in patients with THA/TKA, the total rehabilitation cost and cost per treatment are lower with telerehabilitation relative to in-person care. (SOE: Moderate)

- Evidence from 1 SR\(^{61}\) indicates that, in patients with THA/TKA, cost per individual session is lower with telerehabilitation relative to in-person care when the treatment center is ≥30 km from the patient’s home. (SOE: Moderate)

- Evidence from 1 SR\(^{61}\) indicates that, in patients with THA/TKA, cost per single session did not vary between treatment conditions when the center was <30 km from home. (SOE: Low)

**Discussion**

Overall, the evidence comparing telerehabilitation versus conventional in-person therapy is modest yet consistent. Low\(^{151}\) to Moderate\(^{61}\) quality evidence suggests that, overall, healthcare costs are lower when treating patients using telerehabilitation in comparison to traditional in-person care. These findings are limited to patients with THA/TKA, reported in 4 studies in 1 SR\(^{61}\) and patients with chronic heart failure, reported in 1 small RCT\(^{151}\). Generalizability to other patient populations may, therefore, be limited.
Moderate quality evidence indicates that costs per session are lower with telerehabilitation than in-person care for patients with THA/TKA who live at least 30 km from the health care center.\textsuperscript{61} When looking at patients who live closer than 30 km to the health care center, cost per session did not vary between treatment conditions (SOE: Low).\textsuperscript{61}

Efficacy of treatment did not vary across most outcomes as a function of treatment condition (covered in Key Question 1/3) and adverse events (covered in Key Question 4) were overall infrequent and suggest that telerehabilitation is a safe and useful means of providing therapy to patients in need of physical therapy. These findings with respect to efficacy, safety, and cost should be taken in context with the findings from Key Questions 7 and 8, where it is clear that local factors, such as access to technology, patient, caregiver, and provider willingness and training, and other barriers and facilitators to care play a large role in the success or failure of implementing telerehabilitation in physical therapy practice.
## Overall Quality of Evidence Rating

### Table 2. Overall Assessment of Quality of Evidence Base

<table>
<thead>
<tr>
<th>Outcome (Rating)</th>
<th>Quantity and Type of Evidence</th>
<th>Intervention (Number of Patients) Follow-up</th>
<th>Findings</th>
<th>Study Limitations (Study Quality, Risk-of-Bias)a</th>
<th>Inconsistencyb</th>
<th>Indirectnessc</th>
<th>Imprecisiond</th>
<th>GRADE of Evidence for Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chronic Heart Failure</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Healthcare Cost/Patient in US$ (Critical)</td>
<td>1 RCT Hwang et al. 201815</td>
<td>Telerehabilitation vs. traditional in-person care n=53 Follow-up: 6 months</td>
<td>MD: -$1,590.45; 95% CI: -2,821.69 to -359.21 <strong>Cost lower with telerehabilitation.</strong></td>
<td>Serious limitations (-1)</td>
<td>No serious inconsistency</td>
<td>No serious indirectness</td>
<td>Serious imprecision (-1) Single small study</td>
<td>Low</td>
</tr>
</tbody>
</table>

| **Total Knee or Total Hip Arthroplasty** |
| Resource Utilization in US$ (Critical) | 1 SR of 4 studies Jansson et al. 202061 | Telerehabilitation vs. traditional in-person care 4 studies, n=NR Follow-up: Range: 2 to 8 weeks | Change in total rehabilitation cost MD: -$263; 95% CI: -$382 to -$143 **Cost lower with telerehabilitation.** | Change in cost per treatment MD: -$12.09; 95% CI: -20.90 to -$3.20 **Cost lower with telerehabilitation.** | Serious limitations (-1) | No serious inconsistency | No serious indirectness | No serious imprecision | Moderate |
| Cost per single session (distance from home to the healthcare center >30 km) mean (SD) TR: $81.3 (SD: 3.19) vs. In-person: $102.7 (SD: 19.5); p=0.02 **Cost lower with telerehabilitation.** | Cost per single session did not vary between treatment conditions when the center was <30 km from home. **No difference; data not shown.** | Serious limitations (-1) | No serious inconsistency | No serious indirectness | No serious imprecision | Moderate |

---

a Study Quality, Risk-of-Bias: GRADE assessment categories include: Low, Moderate, High.
b Inconsistency: GRADE assessment categories include: None, Low, Moderate, High.
c Indirectness: GRADE assessment categories include: None, Low, Moderate, High.
d Imprecision: GRADE assessment categories include: None, Low, Moderate, High.
Methodological Quality considers the overall risk of bias rating of all the studies included in the evidence base;

Inconsistency of results considers if the studies demonstrated similar positive or negative results (an inconsistent rating would indicate that the findings across studies were mixed);

Indirectness of evidence considers the link between the interventions and patient outcomes (head-to-head comparisons provide the most direct evidence) as well as the applicability of the study population;

Imprecision estimates the degree of uncertainty (based on variance or sample size) around an outcome’s effect size.

CI: confidence interval; MD: mean difference; NR: not reported; RCT: randomized control trial; SD: standard deviation; THA: total hip arthroplasty; TKA: total knee arthroplasty; TR: telerehabilitation
Appendix A. Evidence Tables

Table 3. Systematic Review/Meta-analysis

<table>
<thead>
<tr>
<th>Study Details</th>
<th>Search Strategy/Evidence Base</th>
<th>Patients/Interventions</th>
<th>Outcomes/Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reference:</strong> Jansson et al. 2020&lt;sup&gt;61&lt;/sup&gt;</td>
<td>Melinda and Medline Ovid, Scopus, Ebsco Databases, and Web of Science were searched to February 2020. The evidence base consisted of 9 RCTs comparing telerehabilitation to traditional in-person care in patients with THA or TKA. <strong>Inclusion/Exclusion Criteria:</strong> RCTs comparing telerehabilitation and in-person outpatient physical therapy. Only adults (&gt;18 years) were included. Studies of assessment tools, conference abstracts, preliminary results, unpublished studies were excluded.</td>
<td><strong>Number of Patients:</strong> 1,266 <strong>Diagnosis:</strong> Patients following discharge from hospital after TKA and THA were included. Patients must be discharged with an active range of motion and the ability to walk using a walking aid. Patients must also be able to access and use a smartphone, and live in an area served by high-speed Internet within a one hour drive from the treating hospital. <strong>Age:</strong> Mean age 54.5 to 73.3 years old <strong>Gender:</strong> NR <strong>Race:</strong> NR</td>
<td><strong>Resource utilization (All in US$)</strong> Change in total cost (4 studies, n=NR): MD: -$263; 95% CI: -$382 to -$143 <strong>Cost lower with telerehabilitation.</strong> Change in cost per treatment (4 studies, n=NR): MD: -$12.09; 95% CI: -20.90 to -$3.20 <strong>Cost lower with telerehabilitation.</strong> Cost per session (distance from home to the healthcare center &gt;30 km) (4 studies, n=NR): $81.3; SD: 3.19 vs. $102.7; SD: 19.5; p=0.02 <strong>Cost lower with telerehabilitation.</strong></td>
</tr>
<tr>
<td><strong>Country:</strong> Finland</td>
<td><strong>Quality Rating:</strong> Fair Main concerns were lack of clarity blinding of patients and clinical staff, including outcome assessors. Additional concerns were related to lack of clarity around identical treatment of groups, data analysis, and reliability of outcome measures. <strong>Publication Bias:</strong> NR <strong>Funding Source:</strong> Business Finland, as a part of the “Intelligent Customer-driven Solution for Orthopedic and Pediatric Surgery Care”.</td>
<td><strong>Intervention/Comparators:</strong> Telerehabilitation, defined as an internet-based real-time two-way videoconferencing system, interactive virtual telerehabilitation software-hardware platform, asynchronous video-based software platform, internet based orthopedic care platform, or an app-based active muscle training system. Conventional in-person outpatient physical therapy. <strong>Primary Outcomes:</strong> Physical functioning, adverse events, resource utilization <strong>Follow-up:</strong> Range 2 to 8 weeks</td>
<td></td>
</tr>
</tbody>
</table>

CI: confidence interval; MD: mean difference; NR: not reported; RCT: randomized control trial; SD: standard deviation; THA: total hip arthroplasty; TKA: total knee arthroplasty
### Table 4. Individual Studies

<table>
<thead>
<tr>
<th>Study Details</th>
<th>Patients/Interventions</th>
<th>Intervention/Outcomes</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of Patients:</strong> 53</td>
<td><strong>Intervention:</strong> Telerehabilitation was delivered by a synchronous videoconferencing platform via the internet to groups of up to four participants at home.</td>
<td><strong>6 months f/u (3 months post intervention)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Diagnosis:</strong> Chronic heart failure confirmed by an echocardiogram, including heart failure with reduced or preserved ejection fraction.</td>
<td><strong>Control:</strong> Center based rehabilitation program. Over the span of 12 weeks, a physiotherapist conducts a 60-minute session twice a week at a treating hospital.</td>
<td><strong>Total healthcare cost/patient</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Mean Age Years (SD):</strong> 67 years</td>
<td><strong>Note:</strong> Control group also had additional home exercises three times a week, unsupervised.</td>
<td>Telerehabilitation (n=24) mean: $2,325.09</td>
<td></td>
</tr>
<tr>
<td><strong>Gender (% male):</strong> 75%</td>
<td><strong>Primary Outcomes:</strong> 6-minute walk test</td>
<td>Control (n=29) mean: $3,915.55</td>
<td></td>
</tr>
<tr>
<td><strong>Race:</strong> 49 (92%) Caucasian</td>
<td><strong>Follow-up:</strong> 6 months</td>
<td>Between-group difference (n=53): MD: -$1,590.45; 95% CI: -2,821.69 to -359.21</td>
<td></td>
</tr>
<tr>
<td><strong>Quality Rating:</strong> Fair</td>
<td><strong>Cost lower with telerehabilitation.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Potential recruitment bias and uneven allocation. Single blind (outcome assessors). Low attrition, ITT used.</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Funding Rating:</strong> Heart Foundation Health Professional Scholarship, Princess Alexandra Hospital Research Support Scheme Small Grant 2013, The Prince Charles Hospital Foundation Novice Researcher Grant 2012, Queensland Health: Health Practitioner Research Scheme 2012.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6MWD: 6-minute walk distance; CI: confidence interval; MD: mean difference; NR: not reported; RCT: randomized control trial; SD: standard deviation

References: Hwang et al. 2018

Country: Australia

Study Design: RCT

Purpose: To determine non-inferiority of telerehabilitation versus traditional center-based program for patients with chronic heart failure in terms of 6-minute walk distance.

Quality Rating: Fair

Potential recruitment bias and uneven allocation. Single blind (outcome assessors). Low attrition, ITT used.

Funding Rating: Heart Foundation Health Professional Scholarship, Princess Alexandra Hospital Research Support Scheme Small Grant 2013, The Prince Charles Hospital Foundation Novice Researcher Grant 2012, Queensland Health: Health Practitioner Research Scheme 2012.
Appendix B. References


Appendix C. Excluded Studies

Table 5. Excluded Studies

<table>
<thead>
<tr>
<th>Reference</th>
<th>Reason for Exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shaw et al. 2021\textsuperscript{70}</td>
<td>Does not meet inclusion criteria for KQ3.</td>
</tr>
<tr>
<td>Liu et al. 2020\textsuperscript{152}</td>
<td>Intervention not of interest.</td>
</tr>
<tr>
<td>Prvu Bettger et al. 2020\textsuperscript{151}</td>
<td>Comparator and intervention not comparable.</td>
</tr>
<tr>
<td>Fusco et al. 2016\textsuperscript{153}</td>
<td>Modelling data only.</td>
</tr>
<tr>
<td>Tousignant et al. 2015\textsuperscript{154}</td>
<td>Included in Jansson et al. 2020\textsuperscript{61}.</td>
</tr>
<tr>
<td>Kraal et al. 2013\textsuperscript{116}</td>
<td>Intervention not of interest.</td>
</tr>
</tbody>
</table>

KQ: key question
Key Question 7: What are the facilitators and barriers to telehealth implementation for patients?
Contents

Key Question 7: What are the facilitators and barriers to telehealth implementation for patients? ................................................................. 79

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  Study Quality Rating .................................................................................................................. 81
  Key Findings ............................................................................................................................. 81
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Key Question 7: What are the facilitators and barriers to telehealth implementation for patients?

Summary of Evidence Base

Our searches identified 5 studies that addressed facilitators and barriers to telehealth implementation from the patient perspective. With the exception of one systematic review, all studies were qualitative and involved semi-structured interviews of patients, with some studies including focus groups. The systematic review included 16 studies, none of which included individual study quality ratings.

Studies were categorized by clinical conditions for which patients sought telerehabilitation (TR). Two studies addressed patients with musculoskeletal conditions/injuries. The Lawford study limited TR to telephone-based exercise therapy, while the Gilbert study used videoconferencing as the delivery mechanism. The systematic review by Hellerman, which addressed patients with amyotrophic lateral sclerosis (ALS), included home-based self-monitoring and noninvasive ventilation (NIV) monitoring in addition to videoconferencing. The Tyagi study addressed stroke patients and the use of videoconferencing. The study by Jansen-Kosterink addressed patients with chronic diseases, inclusive of chronic obstructive pulmonary disease (COPD), chronic low back, pain and whiplash associated disorder, and used an exercise module and a teleconference module, both of which were available through an online portal.

All studies compiled, analyzed, and categorized patient participant interviews and focus group results according to themes or domains.

Our searches were limited to papers published on or after January 1, 2010, to July 26, 2021. See Tables 1 and 2 for detailed information on the characteristics of the studies and patient types included in the reviews. Studies excluded as evidence for this key question are presented in Table 3 of Appendices.

Study Quality Rating

All included studies addressing this key question were qualitative and involved collection and analyses of non-numerical data to arrive at concepts, themes, and preferences. Therefore, we were unable to grade study quality using the U.S. Preventative Services Task Force (USPSTF) criteria.
Key Findings

Below, we present the critical outcomes addressing barriers and facilitators to telehealth delivery and implementation as described from the patient perspective.

Use of Telerehabilitation in Patients with Amyotrophic Lateral Sclerosis (ALS)

Critical Outcomes

The Helleman systematic review included 16 studies (n ≥429 patients with ALS), none of which included individual study quality ratings. The 3 telehealth interventions addressed (videoconferencing [n=5], home-based self-monitoring [n=7], and remote NIV monitoring [n=4]) focused on treatment for ALS patients with respiratory impairment. Ten of 11 studies addressing remote monitoring focused primarily on respiratory function. Median age of the patients participating in the studies was 60.5 years. Those patients in the studies who were ventilated through NIV or tracheostomy with invasive ventilation (TIV) (68%) was higher in comparison to the general ALS population (18-36%).

Overall, the patients surveyed in the studies viewed TR positively. Perceived benefits included feelings of enablement and self-confidence in managing their disease, time-savings, and travel reduction. Patients using self-monitoring and remote devices generally reported their ease of use and showed high adherence to self-monitoring. Impediments included complexity with the self-monitoring devices, with one study reporting difficulties completing the patient-reporting protocol and another citing issues with slow data extraction. Several studies included in this review recruited a convenience sample of patients with a positive view of technology and/or where TR was likely to benefit them. In addition, TR was primarily focused on ALS patients with respiratory issues; therefore, these results are not representative of the general ALS population and need to be considered within this context.

- **Facilitators**
  - Access and Scheduling
    - Reduced travel burden
    - Time-savings
  - Human factors
    - Increased security and feeling of self-confidence
    - High adherence to self-monitoring
  - Technology
    - Devices were user-friendly
    - Comfort and familiarity with the technology
- **Barriers**
  - Human factors
• Low adherence to self-monitoring
  ○ Technology
  • Cumbersome monitoring protocol
  • Technical issues (slow connectivity, buffering, slow data extraction)

Use of Telerehabilitation (TR) in Patients with Musculoskeletal Conditions/Injuries

Critical Outcomes
We identified 2 studies147,155 (n=42) that addressed perceptions of TR for patients seeking treatment for musculoskeletal conditions. The Gilbert study155 (n=22) was conducted within a single specialist orthopedic hospital setting within the UK. Because orthopedic rehabilitation often requires “hands-on” care, the authors examined several factors influencing patient preferences for virtual consultation versus face-to-face therapy. The first factor is the patient’s care situation, which encompasses a patient’s clinical status, treatment requirements and care path, inclusive of number and length of appointments. The second factor influencing preference is the patient’s care expectations, which includes his/her desire for contact, psychological status, (i.e., motivation and self-efficacy to perform care virtually), prior care received, and perceived care requirements. The third factor is the demands on the patient respective to his/her care needs, as well as the social demands placed on him/her, such as competing/conflicting family demands that interfere with treatment. The fourth factor is the patient’s capacity to allocate resources to care, inclusive of financial, infrastructural, social, and healthcare system-related. Because this study was conducted in a single center, its results may not be generalizable to other clinical settings. In addition, the study data were collected prior to the COVID-19 pandemic, so availability of TR in practice and its uptake are likely to be more widespread than reported.

The Lawford study147 (n=20) was a qualitative study nested within a randomized controlled trial and assessed patients who received telephone-based exercise therapy for treatment of knee osteoarthritis. Patients mostly viewed the structure of telephone-based delivery positively, valuing the convenience of performing therapy from home, which enabled them to incorporate exercise into their daily life. Patients felt that the process of this delivery mechanism allowed them to easily communicate with their therapist and created a more personal consultation. Patients who expressed a preference for visual contact, either through in-person visits or videoconferencing, were concerned that their therapist could not observe their knee or exercise technique. Visual contact was most important to those who lacked confidence performing the exercises and needed to have them demonstrated. Telephone delivery was viewed as an option rather than a substitution for in-person rehabilitation, having the potential to increase accessibility, especially in the case of follow-up consultations. A reported study limitation was that enrollees volunteered to participate in the clinical trial and qualitative interviews, thus, their willingness may be indicative of a bias toward being more receptive to telephone-based therapy.
Also, 75% of study participants completed some tertiary education so the results may not reflect perspectives of patients with lower or limited education.

Below are some of the major facilitators and barriers identified in the 2 studies.

- **Facilitators**
  - Access to care
    - TR more favorable for patients with competing family and social demands
    - Eliminates travel time
  - Human factors
    - TR could reduce anxieties associated with face-to-face care
    - Patients were able to speak more freely consulting from their home
    - Telephone consultations provided patients with a sense of undivided focus/attention

- **Barriers**
  - Financial
    - Travel demands costly
  - Human factors
    - Desire for human contact
    - Less likely to perform rehabilitation remotely
    - Telephone-based therapy disallowed patients to have exercises demonstrated
  - Technology
    - Need to access to hardware and software
    - Demotivated by inconvenience of setting up equipment
    - Technical issues (slow connectivity, buffering, slow data extraction)
Use of Telerehabilitation (TR) in Stroke Patients

Critical Outcomes
The Tyagi study\(^1\)\(_{57}\) (n=13) was a qualitative study within the Singapore Tele-technology Aided Rehabilitation in Stroke randomized controlled trial (RCT). This study addressed benefits and shortcomings of TR stroke rehabilitation, emphasizing the importance patient characteristics play in determining patient preferences. Patient characteristics included patient age, level of disability, and cultural influence (i.e., a patient’s ability to hire foreign domestic employee as a surrogate caregiver). Facilitators to TR cited by patients included affordability and accessibility (e.g., no travel) of care. Barriers, especially for older patients, included challenges with using the technology and setting up the equipment. The study did not include enrollees who declined to participate in the RCT so the results may be biased toward patients more inclined to adopt TR.

- **Facilitators**
  - Access to care
    - Not bound by fixed schedules of in-person appointments
    - Eliminates travel time
    - Can serve as interim rehabilitation between face-to-face consultations
  - Financial
    - Advantage for patients “not-so-well-off”
- **Barriers**
  - Technology
    - Difficulty setting up equipment
    - Connectivity issues
    - Lack of digital literacy

Use of Telerehabilitation (TR) in Patients with Chronic Conditions/Injuries

Critical Outcomes
We identified 1 study\(^3\)\(_{4}\) that addressed TR for patients (n=188) living with chronic conditions, including COPD, chronic low back pain, and whiplash associated disorder. Patients were divided into 22 focus groups, evenly distributed over the different diagnoses, and were introduced to TR through an exercise module and a teleconference module delivered through an online portal. Patient acceptance was dependent on a variety of factors. Some advantages patients found with the online training included no travel and lower physical burden, flexibility, availability of online mentoring, cost-savings, and increased treatment intensity. Disadvantages were lack of motivation and self-discipline to exercise at home, impersonal communication, technology issues, lack of digital literacy (for some), and absence of direct contact and feedback. The study cited some limitations. Most importantly, patients participating in this study were starting outpatient rehabilitation and their feedback on TR was solicited after a brief introduction to the
online portal. The patients did not engage in TR for an extended period; therefore, their opinions may have changed from their initial feedback. Secondly, patient outcomes were not stratified by patient group, Lastly, patient outcomes may not be generalizable to all care settings. With these limitations, the study results should be considered within this context. Below are the facilitators and barriers most mentioned by the patients in the study.
• Facilitators
  o Access and Scheduling
    • No travel to appointments required
    • Able to plan treatment independently
  o Human factors
    • Motivation to train at home
    • Instruction video enables exercising at home
    • Enables online mentoring

• Barriers
  o Human factors
    • Unmotivated to train at home and need extrinsic motivators
    • Mentoring through videoconference may be experienced as impersonal communication
    • Insufficient self-discipline to continue treatment and perform exercises at home
    • Training at home is individual and group therapy is preferred
    • Prefer feedback from a healthcare professional while exercising
    • Insufficient online mentoring facilities
  o Technology
    • No or insufficient digital skills

Discussion

Presently, the evidence assessing patient barriers and facilitators to TR is limited to qualitative evidence. Three of the studies included in the evidence base were very small, with sample sizes <25 patient respondents. Although studies varied in the type of TR delivery, included different patient populations, and took place in different geographical and clinical care settings. some common themes emerged.

Common facilitators identified by patients and reported in all studies included better access to care, increased flexibility, and convenience. Not having to travel to appointments, arrange for child care, or request time off from work were considered major benefits by most patients. For patients in rural areas or for those whose disability makes travelling difficult, TR was seen as a viable alternative to in-person care. In some instances, patients felt virtual therapy served as a self-motivator to perform exercises on their own or to incorporate exercise into their daily activities. The Lawford study,147 which restricted TR to telephone-based therapy, reported that patients felt more comfortable and less anxious engaging with their therapist over the phone versus face-to-face consultations. Patients in this study also reporting feeling that their care was more personalized because their therapist’s focus was solely on them.
Barriers identified by the patients often times corresponded to their disability and severity level, co-morbidities, age, familiarity with technology, and social demands. This was emphasized in the Tyagi study,\textsuperscript{157} which examined TR for patients recovering from stroke. In some instances, these patients found initiating the virtual therapy and setting up equipment too cumbersome to do on their own, which served as a de-motivator to engage in virtual sessions. The main human factor barrier that was reported in all studies was the lack of/desire for human contact. This included patients wanting hands-on guided demonstrations of the exercises to those needing assistance with performing the exercises. In both cases, some patients were required to rely on family members, which was not always possible or desirable due to competing social demands. Lack of human contact was also considered a de-motivator for some patients to perform their rehabilitation in a virtual setting. Technology was a barrier cited in all studies and included lack of digital literacy, software/hardware issues, connectivity challenges, and slow data extraction in the case of using home/self-monitoring devices.

An overarching theme across studies is that TR is a viable supplement or interim option to face-to-face therapy. For many patients who require hands-on contact, it is not intended to serve as a replacement for in-person care. Patients need to be assessed on an individual basis, not only taking their disability into consideration, but also their ability to afford, access and navigate technology and exercise equipment, motivation/desire to perform the exercises on their own, home environment, and social support network.
## Appendix A. Evidence Tables

### Table 1. Systematic Review/Meta-analysis

<table>
<thead>
<tr>
<th>Study Details</th>
<th>Search Strategy/Evidence Base</th>
<th>Patients/Interventions</th>
<th>Outcomes/Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference: Helleman et al. 2020156</td>
<td>Therapy for Amyotrophic Lateral Sclerosis Delivered via Videoconferencing or Other Mechanisms</td>
<td>Telehealth Interventions delivered via:</td>
<td>Facilitators</td>
</tr>
<tr>
<td>Country: Netherlands</td>
<td>Number of Patients: 429</td>
<td>- videoconferencing</td>
<td>Innovation characteristics</td>
</tr>
<tr>
<td>Study Design: Systematic Review</td>
<td>Diagnosis: ALS</td>
<td>- home-based self-monitoring</td>
<td>Complexity</td>
</tr>
<tr>
<td>Purpose: Identification of patient and caregiver barriers and facilitators of telehealth implementation in the treatment of Amyotrophic Lateral Sclerosis (ALS).</td>
<td>Mean Age Years: 60.5</td>
<td>- remote NIV monitoring</td>
<td>- Robust wireless connection</td>
</tr>
<tr>
<td>Funding Source: This study was funded by the Netherlands ALS Foundation (No. 2016-51).</td>
<td>Gender % Male: 65.9%</td>
<td></td>
<td>- User-friendly devices</td>
</tr>
<tr>
<td></td>
<td>Race: NR</td>
<td></td>
<td>- Additional aids for device</td>
</tr>
<tr>
<td></td>
<td>16 included studies identified 3 main types of telehealth interventions:</td>
<td></td>
<td>Patient/caregiver characteristics</td>
</tr>
<tr>
<td></td>
<td>- videoconferencing (5)</td>
<td></td>
<td>User-experiences and benefits</td>
</tr>
<tr>
<td></td>
<td>- home-based self-monitoring (7)</td>
<td></td>
<td>- Reduced travel time and burden</td>
</tr>
<tr>
<td></td>
<td>- remote NIV monitoring (4)</td>
<td></td>
<td>- Reduced clinic burden</td>
</tr>
<tr>
<td>Inclusion Criteria: &gt;75% of the study population had to be patients with ALS and report on the use or implementation of telehealth in a healthcare setting.</td>
<td>Search Strategy: Comprehensive electronic searches were conducted using Pubmed and Embase to look for articles up until 2019. For full details on the search, see full paper.</td>
<td></td>
<td>- Fewer hospital admissions/emergency room visits</td>
</tr>
<tr>
<td>Exclusion Criteria: NR</td>
<td>Primary Outcomes: Patients and caregivers’ perceptions of barriers and facilitators to telehealth interventions in the treatment of ALS.</td>
<td></td>
<td>- Increased feeling of enablement/self-confidence</td>
</tr>
<tr>
<td></td>
<td>Follow-up: NR</td>
<td></td>
<td>- Increased feeling of security</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Videoconferencing</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 studies reported that patients were satisfied with videoconferencing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 study reported that satisfaction with telehealth was not related to disease severity or travel distance.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Reported patient benefits included reduced travel burden, reduced clinical burden and time-saving.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Remote consultation increased the continuity of care and allowed more severely disabled patients to continue receiving specialist care.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Home-based self-monitoring</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 studies reported satisfaction with telehealth. Patients reported increased awareness of the disease, more confidence in dealing with the disease and an increased</td>
</tr>
</tbody>
</table>
### Study Details | Search Strategy/Evidence Base | Patients/Interventions | Outcomes/Results
--- | --- | --- | ---
 |  |  | feeling of security for home management of respiratory symptoms.  
1 study reported a reduction in hospital admissions and another study, the number of unnecessary clinic visits was reduced, resulting in a saving in time and costs.  
**Remote NIV monitoring**  
Main benefit for patients was a reduced need to travel to the clinic for adjustment of NIV settings; fewer hospital admissions were reported.  
1 study reported patients experienced improved enablement and more confidence in managing the disease.  
**Compliance**  
- Easy to use devices  
- Comfort and familiarity with using technology  
- Caregiver assistance  
- Automatic monitoring  
- High adherence to self-monitoring  
**Videoconferencing**  
3 studies reported that patients felt comfortable and liked working with technology.  
2 studies reported that patients were willing to discuss most practical topics via remote consultation.  
**Home-based self-monitoring**  
2 studies patients reported that devices worked well and were easy to use.  
2 studies reported high adherence with a bi-weekly monitoring protocol.  
**Remote NIV monitoring**  
The bi-directional and automatic functionality limited the need for manual intervention by patients and caregivers for monitoring.  
Patients reported that the NIV devices were easy to use, and that settings were easy to change/arrange.  
1 study reported that patients appreciated the extra aids that were provided to facilitate NIV use.
<table>
<thead>
<tr>
<th>Study Details</th>
<th>Search Strategy/Evidence Base</th>
<th>Patients/Interventions</th>
<th>Outcomes/Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Barriers</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Innovation characteristics</strong></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Complexity</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Cumbersome monitoring protocol</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Technical issues</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Slow internet connection</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Slow data extraction/ buffering</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Videoconferencing</strong></td>
</tr>
<tr>
<td></td>
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<td></td>
<td>1 study reported issues with video and audio, but did not prevent any videoconferences from taking place.</td>
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<td></td>
<td><strong>Home-based self-monitoring</strong></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>1 study reported that self-monitoring seemed too cumbersome due to the large number of daily assessments and complexity of reporting.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Remote NIV monitoring</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The speed of data extraction was limited in two studies.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Patient/caregiver characteristics</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>User-experiences and benefits</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Lack of physical evaluation/contact</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Compliance</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Low adherence to self-monitoring</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Unwilling to discuss sensitive topics through telehealth</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Videoconferencing</strong></td>
</tr>
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<td></td>
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<td></td>
<td>1 study indicated reluctance of patients to discuss sensitive topics, such as acceptance/coping and end-of-life during a remote consultation.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Home-based self-monitoring</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Patients in 1 study had difficulty using a tablet device due to upper limb disability.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 study reported that patients showed low compliance with a monitoring protocol with multiple daily measurements.</td>
</tr>
</tbody>
</table>
### Table 2. Individual Studies

<table>
<thead>
<tr>
<th>Study Details</th>
<th>Patients/Interventions</th>
<th>Intervention/Outcomes</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Therapy for Musculoskeletal Conditions/Injuries Delivered via Videoconferencing and Other Mechanisms</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reference</strong>: Gilbert et al. 2021</td>
<td>22</td>
<td>Interviews were conducted on-site at the hospital or virtually using phone or Skype. Interviews were conducted by study author and lasting ~60 min with the option to amend as required. The average interview length was 48 minutes (range 28–81). All interviews were audio recorded and sent off and transcribed by an external company. All transcripts were emailed or posted to participants on receipt to give them the option to verify the data or to make any adjustments.</td>
<td><strong>Themes</strong></td>
</tr>
<tr>
<td><strong>Country</strong>: UK</td>
<td><strong>Diagnosis</strong>: Musculoskeletal problem</td>
<td><strong>Data Analyses</strong>: Interview transcripts were reviewed and uploaded into NVivo. Data analysis followed the principles of abduction as set out by Tavory and Timmermans. Coding was undertaken by study authors. Open coding techniques were used to identify empirical regularities (new themes) in the data. The new themes were interrogated for attributions about patient preferences and the factors that shape them. Attributes were assigned to codes within these new themes following discussion between study authors. Inferences were made about the ways that preferences worked, the relative position and significance of the factors that shaped them, forming abductive explanation. Themes arising from the data were mapped out in a conceptual model by study author to visualize how different factors might influence preference for VC.</td>
<td><strong>Situation of Care</strong>: Represents the ways that patients understand and explain the following factors:</td>
</tr>
<tr>
<td><strong>Study Design</strong>: Qualitative study using semi-structured interviews and abductive analysis.</td>
<td><strong>Mean Age Years (range)</strong>: 46 (20-78)</td>
<td><strong>Collection of Patient Input</strong>: Interviews were conducted on-site at the hospital or virtually using phone or Skype. Interviews were conducted by study author and lasting ~60 min with the option to amend as required. The average interview length was 48 minutes (range 28–81). All interviews were audio recorded and sent off and transcribed by an external company. All transcripts were emailed or posted to participants on receipt to give them the option to verify the data or to make any adjustments.</td>
<td>- Clinical status: Patient preferences varied based on their clinical challenges faced at that time and their capacity to meet the demands the clinical status required. The patient's orthopedic problem could stand alone or be in conjunction with other physical or mental health issues.</td>
</tr>
<tr>
<td><strong>Purpose</strong>: Identify, characterize and explain factors that influence patient preferences, from the perspective of patients and clinicians, for virtual consultations (VC) in an orthopedic rehabilitation setting.</td>
<td><strong>Gender % Female</strong>: 55 (12 women, average age 46 (range 20–78))</td>
<td><strong>Care pathway</strong>: Patient preferences influenced by the care available, including length of the appointment, number of appointments and their regularity and time of day of the appointments. Patients with infrequent appointments appeared to favor face to face (F2F), although there were exceptions.</td>
<td>- Treatment requirements: Dependent on the clinical status of the patient, in accordance with the normal management for that status.</td>
</tr>
<tr>
<td><strong>Funding Source</strong>: National Institute for Health Research (NIHR), Clinical Doctoral Research Fellowship (ICACDRF-2017-03-025)</td>
<td><strong>Race</strong>: NR</td>
<td><strong>Expectations of Care</strong>: Patients have expectations for both VC and F2F, which are influenced by the following factors:</td>
<td>- <strong>Desire for contact</strong>: Patients had beliefs about the effectiveness of VC compared to a F2F session. They preferred F2F if they believed they would have more favorable outcomes as a result. Patients also preferred F2F contact if they felt their condition was complicated and warranted a physical examination.</td>
</tr>
<tr>
<td></td>
<td><strong>Inclusion Criteria</strong>:</td>
<td><strong>Primary Outcomes</strong>: Patient preferences surrounding receipt of orthopedic rehabilitation through VC.</td>
<td>- <strong>Psychological status</strong>: Patient motivation and self-efficacy was an important consideration. Some patients felt they were less likely to complete prescribed care via VC whereas others felt VC could reduce anxieties associated with F2F and travelling into the hospital. Some patients thought it would be stressful to see themselves on a screen.</td>
</tr>
<tr>
<td></td>
<td>- Patients, over the age of 18 years, attending the host institution for Physiotherapy or Occupational Therapy</td>
<td><strong>Follow-up</strong>: NR</td>
<td></td>
</tr>
</tbody>
</table>
### Study Details

<table>
<thead>
<tr>
<th>Patients/Interventions</th>
<th>Intervention/Outcomes</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>• Previous care: Influenced patients’ preference for VC. Those who built up a good rapport with their current care team wanted F2F to continue whereas others felt that, as they trusted their healthcare professionals, they would be willing to try VC. Patients who had received suboptimal care elsewhere felt that they would be more likely to stick to the status quo if this worked well for them.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Perceived requirements: Patients who feel the need for hands on F2F care reported a preference towards F2F. Patients who did not feel F2F necessary did not feel the same way. Care requirements differed based on the patient’s individual circumstances and the length of time of the appointment. Patients who travelled less frequently preferred to receive a physical examination, often as a ‘check-up’ to assess the physical status of the problem.</td>
</tr>
<tr>
<td>Demands on the Patient: Patients may face multiple and differing demands dependent on the choices they make regarding VC or F2F. Factors include:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Care requirements: Dependent on the clinical status of the patient. Some patients may be required to complete complex exercise regimens or perform assessments, which may benefit from optimal visualization of movements. Some exercises may require hands-on facilitation. For others, manual therapy may be indicated.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Social demands: Those that interfered with healthcare (i.e., caring for elderly relatives or young children), or conflicting demands that interfered with the patient’s ability to attend their own appointments and rehabilitation, reported that in some circumstances VC could be more favorable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Consequences of choice: VC may require patient’s needing technology or rehabilitation equipment or acquiring a new skill set. Patients who did not have the space and equipment preferred to travel in for a F2F, as well as those</td>
</tr>
<tr>
<td>Study Details</td>
<td>Patients/Interventions</td>
<td>Intervention/Outcomes</td>
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</tbody>
</table>
### Study Details

**Reference:** Lawford et al. 2018

**Country:** Australia

**Study Design:** Qualitative study (semi-structured interviews) nested within an RCT. Only patients receiving telephone-based care are included in this qualitative study.

**Purpose:** Assess patients’ perceptions of telephone-delivered exercise therapy by physiotherapists for treatment of knee OA.

**Funding Source:** National Health and Medical Research Council (Partnership Project #1112133 and Centre of Research Excellence #1079078)) and the Medibank Better Health Foundation, with in-kind support from MOVE muscle, bone and joint health, HealthChange Australia and the Australian Physiotherapy Association.

### Patients/Interventions

<table>
<thead>
<tr>
<th>Number of Patients</th>
<th>Diagnosis</th>
<th>Mean Age Years (SD)</th>
<th>Gender % Female</th>
<th>Race</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>Knee OA</td>
<td>59 (9)</td>
<td>65%</td>
<td>NR</td>
</tr>
</tbody>
</table>

**Inclusion Criteria:** Patients who had completed 6-month follow-up were eligible to participate in the qualitative study.

**Exclusion Criteria:** NR

### Intervention/Outcomes

**Collection of Patient Input:** Semi-structured interviews were conducted over the telephone by a non-clinical graduate researcher experienced in qualitative methodology, and who had no other contact with the study participants. The interviews were recorded and transcribed verbatim. De-identified data were analyzed and coded using a thematic approach.

**Brief description of the key elements of the PT intervention:** Exercise therapy delivered via telephone. (For full details on the intervention, see Table 1 in the full paper.)

**Provision of Resources**

- Information folder to increase knowledge about OA and its management
- 3 resistance bands for strengthening exercises
- Log-in access to a website with video demonstrations of exercises

**Pre-Treatment Survey**

**Assessed:**
- Clinical history
- Knee symptoms
- Physical limitations
- Personal goals

**Telephone Support**

- 5-10 telephone calls from physiotherapist over 6 months

**Strengthening Exercises**

- 5-6 exercises, aiming for 3 times/week, with exercise choice and dosage negotiated between therapist and patient

**Physical Activity Plan**

- Plan based on individual needs and goals

### Results

**Themes**

**Structure of telephone-delivered exercise therapy**

**Positive Experience**

- Consulting from the comfort of their own home allowed participants to speak more freely to the physiotherapist and brought the exercise program into their everyday environment, which helped them integrate it into their lifestyle.

- Participants praised how time-efficient and flexible consulting via telephone was, allowing them to talk to the physiotherapist at a time and place convenient to them.

- Participants felt telephone consultations provided an excellent option for people in rural areas or those who want to avoid the inconvenience of travelling to a clinic or missing time at work.

**Desire for Visual Contact**

- Participants were concerned the physiotherapist could not see their knee and/or observe their exercise technique, which may be particularly important for other people who lack confidence in their exercise technique and may “need to be shown the exercises”.

**Process of telephone-delivered exercise therapy**

**Dedicated Care**

- Telephone calls provided participants with a sense of undivided focus and attention from the physiotherapist, making consultations feel “more personal” than traditional face-to-face consultations. Participants felt they could “get down to talking about what was really important”.

**Confidence Performing Exercise**

- Although some desired more visual contact, all felt confident performing their exercise programs. They felt the exercise resources, particularly the photos and written instructions, were easy to follow and the physiotherapist’s verbal descriptions of each exercise were easy to understand. With the support of the...
### Study Details

<table>
<thead>
<tr>
<th>Study Details</th>
<th>Patients/Interventions</th>
<th>Intervention/Outcomes</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patients/Interventions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Training of Physiotherapists</strong></td>
<td>physiotherapist, participants believed that they were easily able to implement their exercise program into their daily life.</td>
</tr>
<tr>
<td></td>
<td>All physiotherapists were trained in behavior change support using HealthChange® Methodology (HealthChange Australia)</td>
<td><strong>Primary Outcomes</strong>: Patient perceptions surrounding receipt of PT for knee OA over the telephone.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Follow-up</strong>: 6 months</td>
<td><strong>Outcomes after telephone-delivered exercise therapy</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Health Benefits</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Muscle strength: Participants believed the intervention helped increase their muscular strength.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Improved pain: Participants also felt that their knee pain had improved.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Breaking barriers: Improvements in confidence, knee pain and physical capabilities led to participants “breaking barriers” to do things they had previously stopped doing, such as walking to the shops.</td>
<td></td>
</tr>
</tbody>
</table>

### Therapy for Treatment of Stroke Delivered via Videoconferencing

<table>
<thead>
<tr>
<th>Reference: Tyagi et al. 2018</th>
<th>Number of Patients: 13 patients and caregivers</th>
<th>Collection of Patient Input: 18 semi-structured interviews, lasting between 30 and 90 minutes, were conducted in English, Chinese, or Malay between February to April 2016.</th>
<th>Facilitators; Patient Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country: Singapore</td>
<td>Diagnosis: Stroke</td>
<td><strong>Interview guide questions addressed:</strong></td>
<td>Affordability</td>
</tr>
<tr>
<td>Study Design: Qualitative study involving semi-structured in-depth interviews and focus group discussions nested within an RCT (Singapore Tele-technology Aided Rehabilitation in Stroke Rehab).</td>
<td>Age Range Years (Mean): 43-79 (59)</td>
<td>• General experience</td>
<td></td>
</tr>
<tr>
<td>Purpose: Explore barriers and facilitators of telerehabilitation as perceived by stroke patients, caregivers, and rehabilitation therapists recruited from one of the largest telerehabilitation trials in a developed Asian country.</td>
<td>Gender % Female: 46%</td>
<td>• Barriers and facilitators</td>
<td>Accessibility</td>
</tr>
<tr>
<td>Funding Source: NR</td>
<td>Race: Chinese (9); Malay (4)</td>
<td>• Decision on whether to continue with day rehabilitation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inclusion Criteria: Stroke patients aged ≥21 years and able to understand and follow instructions, having caregiver support and having completed the telerehabilitation program were enrolled along with their caregivers.</td>
<td>• Suggestions and further input</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exclusion Criteria: NR</td>
<td><strong>Data Analysis</strong>: Interviews were transcribed and translated to English (when in Chinese and Malay) and coded using NVivo 11 software. Study author used line-by-line coding to analyze the first few transcripts, identifying the main emerging themes. Combining this inductive approach with prior literature and written memos, a preliminary coding frame was developed and finalized by the team. Thematic analysis was performed within the categories of coding frame,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Facilitators; Patient Level</strong></td>
<td>Barriers; Patient Level</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Affordability</td>
<td>Setting up equipment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 1 participant described TR as a relative advantage for the “not-so-well off”.</td>
<td>• Many participants described difficulties related to setting up the equipment and the lack of clear instructions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Accessibility</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Enhanced by eliminating the need to travel to the day rehabilitation (DR) center and the flexible nature of the program.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 1 caregiver mentioned that many people, including her care recipient, would not like to move around. This view was shared by patients.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Participants liked that they could choose their exercise timings and were not bound by the fixed schedule of the DR.</td>
<td></td>
</tr>
</tbody>
</table>

### Collection of Patient Input

- **18 semi-structured interviews, lasting between 30 and 90 minutes, were conducted in English, Chinese, or Malay between February to April 2016.**
- **Interview guide questions addressed:**
  - General experience
  - Barriers and facilitators
  - Decision on whether to continue with day rehabilitation
  - Suggestions and further input
- **Data Analysis:** Interviews were transcribed and translated to English (when in Chinese and Malay) and coded using NVivo 11 software. Study author used line-by-line coding to analyze the first few transcripts, identifying the main emerging themes. Combining this inductive approach with prior literature and written memos, a preliminary coding frame was developed and finalized by the team. Thematic analysis was performed within the categories of coding frame.
complemented by constant comparisons at different levels, between content and code within an interview, different subjects and different subject groups. The team met regularly to discuss emerging themes, and deviant cases, if any, were explored in-depth and incorporated in the final results.

**Primary Outcomes**: Perceived barriers and facilitators to telerehabilitation uptake as reported by patients and their caregivers.

**Follow-up**: 12 weeks

<table>
<thead>
<tr>
<th>Study Details</th>
<th>Patients/Interventions</th>
<th>Intervention/Outcomes</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

- 1 patient felt demotivated by the inconvenience associated with frequent adjustment of heavy parts, making it impossible to set up without his caregiver’s help.
- Another patient expressed his displeasure at the routine of equipment setup.

**Scope of exercises**
- Some felt the exercises were repetitive.
- A caregiver felt that the exercises were not comprehensive enough to meet the needs of his care recipient.

**Interaction between patient and therapist**
- A few patients and 1 caregiver referred to the connectivity problems encountered during the FaceTime session.

**Patient Characteristics**
- **Age of patient**: was a significant factor in use of the iPad system.
- **Patient’s disability** along with age affected patients’ drive to continue TR.
- **Cultural influence**: Cultural context and presence of foreign domestic workers hired as surrogate caregivers affected the motivation of patients to continue TR.
- **Perception of therapist’s role**: Different patients had different perceptions of a therapist’s role in TR, with a few expressing preferences for physical sessions involving personal touch, which they felt lacking in virtual sessions.
- **Sensory impairments**: 1 caregiver explained his wife’s decision to discontinue TR because of hearing and eyesight issues, which made it hard for her to engage.
- **Preferred choice**: Most patients who preferred TR were relatively younger with mixed disability levels; those who chose DR were older and generally had a severe disability.
## Study Details

<table>
<thead>
<tr>
<th>Reference: Jansen-Kosterink et al. 2019&lt;sup&gt;14&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Country:</strong> Netherlands</td>
</tr>
<tr>
<td><strong>Study Design:</strong> Qualitative study using an exploratory focus group.</td>
</tr>
<tr>
<td><strong>Purpose:</strong> Explore factors that contribute or hinder the acceptance of telemedicine rehabilitation for patients with chronic disease.</td>
</tr>
<tr>
<td><strong>Funding Source:</strong> NR</td>
</tr>
</tbody>
</table>

## Patients/Interventions

<table>
<thead>
<tr>
<th>Number of Patients: 188 comprising 22 focus groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosis: Chronic obstructive pulmonary disease (COPD), chronic low back pain (CLPB), and whiplash associated disorder (WAD)</td>
</tr>
<tr>
<td>Mean Age Years: NR</td>
</tr>
<tr>
<td>Gender: NR</td>
</tr>
<tr>
<td>Race: NR</td>
</tr>
<tr>
<td>Inclusion Criteria: Participants needed to be ≥18 years with a sufficient understanding of the Dutch language.</td>
</tr>
<tr>
<td>Exclusion Criteria: NR</td>
</tr>
</tbody>
</table>

## Intervention/Outcomes

<table>
<thead>
<tr>
<th>Therapy for Chronic Conditions Delivered via Videoconferencing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Telemedicine Intervention:</strong> Delivered via an online portal that supports outpatient group rehabilitation. The portal provides an exercise module, through which patients can train at home, supported by a personalized training regime and exercise videos.</td>
</tr>
<tr>
<td>The portal was implemented into the outpatient rehabilitation program in 2 ways:</td>
</tr>
<tr>
<td>• A 3-day outpatient rehabilitation program for patients with COPD CLBP, which, after implementation of the portal, became a 2-day program. During the first weeks of the program, patients received 3 treatment days at the clinic and a training how to use the portal. After this period, patients received 2 treatment days at the clinic and were expected to train at least one day at home with help of the portal.</td>
</tr>
<tr>
<td>• A 2-day outpatient rehabilitation program for patients with COPD and WAD. During the first weeks of the program, patients received training on how to use the portal. After this period, they were expected to train at home, supported by the portal.</td>
</tr>
</tbody>
</table>

## Results

### Advantages (mentioned by participants 5 times or more)

- No need to travel to the clinic to receive treatment. Participants can train at home using the portal.
- Able to plan treatment independent from treatment facility and care professionals.
- Instruction videos on the portal make it easier to correctly execute the exercises at home.
- It is an extrinsic motivator to train at home and to perform exercises.
- It enables online mentoring by care professionals.

### Disadvantages (mentioned by participants 5 times or more)

- Participants are not intrinsically motivated to train at home and need extrinsic motivators such as a healthcare professional or a group.
- Mentoring by the portal (videoconference) may be experienced as impersonal communication.
- Participants expect insufficient self-discipline to continue the treatment at home with help of telemedicine and to perform the exercises at home.
- No or insufficient digital skills to use the telemedicine at home.
- Training at home is individual and group therapy is preferred.
- Participants prefer feedback from a healthcare professional while exercising. The online mentoring facilities of telemedicine are viewed as insufficient.

### Advantages (mentioned by participants 2 to 4 times)

- Participants are intrinsic motivation to train at home due to complaints and desire to improve their health.
**Study Details** | **Patients/Interventions** | **Intervention/Outcomes** | **Results**
--- | --- | --- | ---
 |  | interview guide. After coding the first three focus groups, this coding scheme was revised and finalized and all focus groups were coded with this final coding scheme (including the first three, which were recoded). Disagreements among coders were discussed until unanimous agreement was reached. For coding and analyzing the transcripts of the focus groups, software for qualitative data analysis (atlas.ti version 7.5.12) was used. Afterwards, participants were not able to provide feedback on the analysis.
Primary Outcomes: Patients’ acceptance of telemedicine services for rehabilitation care for treatment of chronic disease.
Follow-up: NR | • By replacing care at the clinical by care at home using the portal health care costs can be saved.
• Learning how to use the portal can be a first experience with a computer and therefore to gain digital skills.
• It enables a personalized training regimen, which leads to personalized care.
Disadvantages (mentioned by participants 2 to 4 times)
• There is a lack of time of use telemedicine and train at home.
• Telemedicine or internet connection for videoconferencing could hamper or fail.
• Participants are anxious to use a computer, due to no/little experience.
• The quality of instruction provided by telemedicine is subordinate to the instructions provided by a therapist.
• Training at home, means training alone. There is no social context.
• As additional care, the training at home using telemedicine is experienced as a psychological burden.
• As partially replaced care, there are fewer treatment days at the clinic.
• Participants do not like to record oneself on video.
• Participants experienced training at home as a privacy infringement.
Advantages (mentioned by participants 1 time)
• Fewer sick leave days for working participants, as care at the clinic is replaced by care at home.
• Participants can see their self on video and check the execution of the exercise.
• When exercising at home and something goes wrong, participants can contact your healthcare professionals. This provides a sense of safety.
<table>
<thead>
<tr>
<th>Study Details</th>
<th>Patients/Interventions</th>
<th>Intervention/Outcomes</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>• After the program, telemedicine could provide aftercare, as a follow-up treatment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• By replacing care at the clinic by care at home using telemedicine more patients can be helped, increasing care capacity.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• By training at home using telemedicine, participants can share their experience with family members.</td>
</tr>
</tbody>
</table>

**Disadvantages** (mentioned by participants 1 time)

• No energy to train at home. Training at home is experienced as a physical burden.
• The use of a computer leads to additional complaints, such as headaches.
• When participants train at home using telemedicine, they have no contact with peers with the same complaints.
• There is insufficient space at the participant’s home to train.
• By training at home using telemedicine, family members will be involved.
• Participants feel uncomfortable, viewing themselves on video.
• Hard to guarantee up-to-date exercise instructions.

ALS: Amyotrophic Lateral Sclerosis; CLBD: chronic low back pain; COPD: chronic obstructive pulmonary disorder; DR: day rehabilitation; F2F: face-to-face; NR: not reported; OA: osteoarthritis; RCT: randomized control trial; TR: telerehabilitation; VC: virtual consultations; WAD: whiplash associated disorder
Appendix B. References


## Appendix C. Excluded Studies

### Table 3. Excluded Studies

<table>
<thead>
<tr>
<th>Reference</th>
<th>Reason for Exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bennell et al. 2021158</td>
<td>Does not address barriers/facilitators to care.</td>
</tr>
<tr>
<td>Lambert et al. 2021159</td>
<td>Only includes 9 patients.</td>
</tr>
<tr>
<td>Lewis et al. 2021160</td>
<td>Feasibility of delivery.</td>
</tr>
<tr>
<td>Miller et al. 2021161</td>
<td>Does not address KQ.</td>
</tr>
<tr>
<td>Peterson et al. 2021162</td>
<td>Describes patient expectations.</td>
</tr>
<tr>
<td>Ramage et al. 2021163</td>
<td>Scoping review.</td>
</tr>
<tr>
<td>Hale-Gallardo et al. 2020164</td>
<td>Does not focus on PT.</td>
</tr>
<tr>
<td>Lai et al. 202078</td>
<td>Comparator not of interest.</td>
</tr>
<tr>
<td>Lam et al. 2020165</td>
<td>Letter.</td>
</tr>
<tr>
<td>Leochico et al. 2020166</td>
<td>Does not focus on PT.</td>
</tr>
<tr>
<td>Roberts et al. 2020167</td>
<td>Letter.</td>
</tr>
<tr>
<td>Cronstrom et al. 2019168</td>
<td>Does not address barriers/facilitators to care.</td>
</tr>
<tr>
<td>Lawford et al. 2019169</td>
<td>Does not address barriers/facilitators to care.</td>
</tr>
<tr>
<td>Lovo et al. 2019145</td>
<td>Does not address barriers/facilitators to care.</td>
</tr>
<tr>
<td>Rossen et al. 2019170</td>
<td>Does not appear to capture a physical therapy component.</td>
</tr>
<tr>
<td>St Clair et al. 2019171</td>
<td>Does not focus on PT.</td>
</tr>
<tr>
<td>Brouns et al. 2018172</td>
<td>Does not address barriers/facilitators to care.</td>
</tr>
<tr>
<td>Cranen et al. 2017173</td>
<td>Does not address barriers/facilitators to care.</td>
</tr>
</tbody>
</table>

KQ: key question; PT: physical therapy
Key Question 8: What are the facilitators and barriers to telehealth implementation for providers?
Contents

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Table 3. Excluded Studies .................................................................................................................................................................. 134
Key Question 8: What are the facilitators and barriers to telehealth implementation for providers?

Summary of Evidence Base
Our searches identified 8 studies\(^{42,155-157,174-177}\) that addressed facilitators and barriers to telehealth implementation from the healthcare provider perspective. Provider study participants included physical therapists, physiotherapists, respiratory physiotherapists, therapy technicians, occupational therapists, and non-therapist clinicians. With the exception of one systematic review,\(^{156}\) all studies were qualitative and involved semi-structured interviews of providers, with some studies including self-reported questionnaires, surveys and/or focus groups. The systematic review\(^{156}\) focused on patients with amyotrophic lateral sclerosis (ALS). This study included videoconferencing, home-based self-monitoring and NIV monitoring as telerehabilitation (TR) delivery mechanisms. Three studies\(^{42,155,157}\) surveyed providers who treated patients with musculoskeletal conditions/injuries and included TR delivered through videoconferencing. Two studies\(^{174,175}\) addressed TR delivery to patients with chronic respiratory conditions. Two studies\(^{176,177}\) addressed delivery of TR to patients with unspecified conditions, one of which\(^{177}\) was targeted toward the pediatric population.

In addition to addressing TR barriers and facilitators regarding specific health conditions, 1 study was specific to delivering TR within an orthopedic rehabilitation setting\(^{155}\) and 2 studies addressed implementation of TR during the COVID-19 pandemic.\(^{176,177}\) All studies compiled, analyzed, and categorized participant interview/survey results according to themes or domains.

Our searches were limited to papers published on or after January 1, 2010, to July 26, 2021. See Tables 1 and 2 for detailed information on the characteristics of the studies and patient types included in the reviews. Studies excluded as evidence for this key question are presented in Table 3 of Appendices.

Study Quality Rating
All included studies addressing this key question were qualitative and involved collection and analyses of non-numerical data to arrive at concepts, themes, and preferences. Therefore, we did not rate study risk of bias using the U.S. Preventative Services Task Force (USPSTF) criteria.
Key Findings

Below, we present the critical outcomes addressing barriers and facilitators to telehealth delivery and implementation as described from the provider perspective. Note, not all papers reported all listed barriers and facilitators.

Use of Telerehabilitation in Patients with Amyotrophic Lateral Sclerosis (ALS)

Critical Outcomes

The Helleman systematic review\(^\text{156}\) included 16 studies (n ≥429 patients with ALS), none of which included individual study quality ratings. The 3 telehealth interventions addressed (videoconferencing [n=5], home-based self-monitoring [n=7], and remote NIV monitoring [n=4]) focused on treatment for ALS patients with respiratory impairment. The patients included in the studies who were ventilated through NIV or TIV (68%) was much higher compared to the general ALS population (18-36%). The number of provider respondents was not reported in the studies, and more than half of the studies did not evaluate healthcare professionals’ experience with or perceptions of TR. For those studies that did include provider feedback, major barriers were financial (i.e., lack of reimbursement and lack of any cost-effectiveness analyses) in addition to concerns with performing comprehensive medical assessments using TR. Potential facilitators to implementation were training and ongoing support using the technologies. Because this study primarily focused on respiratory function affecting patients with ALS, the results are not representative of the general ALS population and need to be considered within this context.

- **Facilitators**
  - Cost
    - Cost-effective MI-E rental/ NIV use
    - Inexpensive commercial devices
    - Reduced hospitalization costs
  - Human Factors
    - Increased feeling of security
    - Better communication
  - Technology
    - Home-based self-monitoring enables providers to monitor symptoms and provide timely support and decision-making
    - Remote NV monitoring enables providers to monitor and adjust settings

- **Barriers**
  - Clinical Concerns
    - Inability to perform comprehensive medical assessments
  - Cost
    - Lack of reimbursement
    - No time saving/ costing extra time
  - Human factors
Lack of physical contact evaluation

Use of Telerehabilitation in Patients with Musculoskeletal Conditions/Injuries

Critical Outcomes

We identified 3 studies\(^{42,155,157}\) (n=59) that addressed provider perceptions of TR for patients with musculoskeletal conditions. The Gilbert study\(^{155}\) (n=22) was conducted within a single specialist orthopedic hospital setting within the UK. This study included both patient and provider opinions. Key enablers and obstacles to TR implementation, according to providers, were dependent on patients’ clinical status, treatment requirements, and care expectations, as well as availability of corporate and patient resources as it relates to technology and infrastructure. The Tyagi study\(^{157}\) (n=11) was a qualitative study within the Singapore Tele-technology Aided Rehabilitation in Stroke randomized controlled trial. This study addressed patient and provider benefits and shortcomings of TR stroke rehabilitation. Limitations of TR, cited by providers, was the inability to touch and physically test patients’ muscle strength and balance. TR was viewed as a complementary or interim treatment to in-person treatments. The Cottrell study\(^{42}\) (n=26) recruited providers from neurosurgical and orthopedic physiotherapy screening clinics located throughout Queensland, Australia. Providers also perceived TR as an interim treatment to in-person therapy and felt TR exercises were limited in scope. Additional perceived barriers were with respect to technology and equipment. Providers cited patient access to care, convenience, and cost and time savings (i.e., no travelling required) as significant benefits to patients within this particular geographical area.

- Facilitators
  - Access and Scheduling
    - Telerehabilitation (TR) can address a service gap while waiting for face-to-face appointments
    - No travel time required to attend appointments
  - Cost
    - No need for patients to request time off from work to attend appointments
  - Human factors
    - Videoconferencing provides an opportunity for better communication

- Barriers
  - Cost
    - Lack of reimbursement
    - Need for corporate resources
  - Human factors
    - Lack of physical contact with the patient (i.e., inability to test muscle power and balance)
    - Potential limitation to offer empathy via TR
    - Some exercises may benefit from optimal visualization of the movements or require hands-on facilitation
  - Technology
Patient and provider issues with interface, connectivity, and equipment for videoconferencing
- Lack of time to help patients manage videoconferencing
- Additional Variables and/or Considerations to TR Implementation
  - Patient’s clinical status will influence provider willingness to adopt TR

Use of Telerehabilitation in Patients with Chronic Respiratory Conditions

Critical Outcomes
We identified 2 studies that addressed TR delivery for patients with chronic obstructive pulmonary disease (COPD). The Slevin study\textsuperscript{174} included 32 participants, 4 of whom were respiratory physiotherapists. Study participants were from private and public general practice clinics in the greater Dublin area and were not required to have prior knowledge of digital health technology (DHT). In general, respondents felt less assured receiving patient-generated health data and identified digital literacy as a major barrier; specifically with regard to patients’ ability to accurately self-monitor, collect, and report their data (i.e., lung volume measurements). Low digital literacy along with lack of clinical practice guidelines and evidence to support improved patient outcomes were considered significant barriers to DHT adoption. Patient education and training on the use of DHT offered through pulmonary rehabilitation and/or community-based outreach programs were seen as opportunities for introducing DHT as a treatment option.

The Damhus study\textsuperscript{175} (n=19 physiotherapists; 6 nurses) involved focus group interviews of providers with and without TR experience working in hospitals or municipalities in Denmark. A major barrier for providers without prior TR experience was concern with effectively communicating and properly assessing patients’ COPD symptoms online. The majority of respondents thought TR could serve as a supplement to conventional COPD rehabilitation but did not think it would be suitable for all patients. A major facilitator was the potential to treat patients who otherwise would not seek treatment due to their health limitations traveling to appointments. In both studies, participants were limited to specific settings or geographic areas so the results may not be generalizable outside the study samples.

- Facilitators
  - Clinical considerations
    - Opportunity for training and education regarding digital health technology (DHT). Pulmonary rehabilitation was a possible existing option for educating and raising patient awareness regarding DHT
    - TR should not replace conventional COPD rehabilitation but allocating the right type of rehabilitation to patients is an essential part of the provider’s role
  - Human factors
    - The need for providers to improve their own digital literacy to effectively support patients with the adoption of DHT
    - Development of new communication skills
Barriers

Clinical considerations
- Absence of strong evidence and lack of clinical practice guidelines are preventing adoption and willingness to prescribe digital health technology as a treatment option
- Some providers indicated that they did not feel completely safe about TR and would push the patients less when exercising

Human factors
- Data quality concerns regarding patients’ level of diligence to generate complete datasets
- Accuracy of the data generated by patients may be questionable and could raise safety concerns if inaccurate readings cause undue health anxieties
- Patient digital literacy and/or presence of co-morbidities, including cognitive impairments, may make interpreting readouts from DHT a challenge
- Difficult to get an interpersonal connection with patients on the screen
- Some social situations would not be possible on the screen

Resources
- Some clinical settings lack resources to oversee or manage utilization of the data generated by DHT
- Possible ethical concerns in the event data are unable to be acted upon appropriately due to sparsity in resources
- Hiring IT staff to install and introduce the patients to the screen would not be prioritized

Technology and Equipment
- Consumer devices may not meet the expected clinical standards
- Perceived the screen as a barrier to communicate with patients
- Fixing technical issues or installing tele-equipment should not be a part of the providers’ job or professional role
- Difficult to provide sufficient rehabilitation when patients were located in their home with no access to training venues or equipment

Use of Telerehabilitation in Patients with Unspecified Conditions/Injuries

Critical Outcomes

One large study (n=273) conducted in Kuwait addressed physical therapists’ willingness to use TR during the COVID-19 pandemic. The survey was conducted over a 3 month-period (June-August 2020). The majority of respondents found TR to be a viable solution to deliver patient care during and after the pandemic but felt that the initial patient assessment required in-person contact to establish patient-clinician rapport. It also provided an opportunity for the therapist to practice hands-on techniques. Major impediments to TR implementation were the lack of
technological readiness within their facilities and the absence of training in the use of equipment. Since survey participants were limited to providers working in government hospitals in Kuwait, and did not include therapists practicing in private hospitals or other clinical settings, and therapist input was received at the early stages of the pandemic, the study results cannot be generalized outside the study sample.

- **Facilitators**
  - Culture
    - PTs had become more motivated towards and interested in TR over time
    - Most PTs (in the department) could use the technology and were happy and satisfied with the patient outcomes

- **Barriers**
  - Clinical considerations
    - TR makes it difficult to detect some physical problems
    - Lack of patient and therapist privacy
    - Lack of hands-on interventions
    - Lack of perceived clinical effectiveness in identifying some patient problems
  - Technology and Equipment
    - Main barriers hindering the successful use of TR were the unavailability of adequate equipment, poor network coverage, and a lack of hospital and IT support

- **Additional Variables and/or Considerations to TR Implementation**
  - Guidelines, policies, and protocols are required to protect both patients and staff from legal allegations and to ensure safe and effective TR practice

### Use of Telerehabilitation in Pediatric Patients with Unspecified Conditions/Injuries

#### Critical Outcomes

One large study (n=259) conducted in the US reported barriers and facilitators for TR effectiveness in pediatric PT settings. Both parent and provider engagement were found to be critical for TR delivery in the pediatric population. Parent engagement and access to stable technology were considered the most important factors for TR to be effective. Other factors cited that were hindrances to successful implementation included the child's behavior, age, home environment, and family factors. This study was conducted opportunistically during the early period of the COVID-19 pandemic (May-June 2020) and represents data from a time period where implementation of TR was not necessarily a voluntary process so these data should be considered in this context.

- **Facilitators**
  - Human factors
Level of caregiver engagement is the most important feature necessary for effective telehealth

Parent engagement must be much higher as the therapist cannot be interactive with the child hands-on

- Technology
  - Good Internet and savvy tech parents
  - Good connectivity and access to a device

- Barriers
  - Cost
    - Some families don’t want to use their data minutes on phone visits because they don’t have enough money to pay overage fees
  - Culture
    - Lack of parent coaching during therapy sessions
  - Technology
    - Some families have landlines only
    - In rural settings, poor Internet speed and computer/technology access is a factor
    - The pandemic has created added difficulties because many families have multiple children on a virtual platform. Many families are just overwhelmed due to parents working from home and children’s schedules with virtual learning

Discussion

As noted above, despite the limitations of sample size and heterogeneity of the included patient/provider populations, there are a number of common factors across studies, both here and in the evidence for Key Question 7 that highlight the elements needed for successful delivery of TR in PT settings.

Presently, the evidence assessing provider barriers and facilitators to TR is limited to descriptive, thematic evidence. Most of the studies included in the evidence base were small, with sample sizes of <30 provider respondents in 5 studies. Two studies\(^{176,177}\) had sample sizes ranging from 150-273 respondents, and 1 study\(^{156}\) did not report the number of provider participants. For those studies that included physical therapists along with other clinicians, responses were not separated out by respondent type. Although most studies were small, took place in different geographical locations and clinical settings, and included different patient populations, some common themes emerged.

Patient Facilitators

Common facilitators identified by providers in the majority of studies was that TR improved patient access to care and was convenient, especially for those patients who had long commutes to appointments. For those patients where travel was a deterrent due to their health condition, TR
was considered a good treatment alternative. TR was also viewed as an interim treatment between in-person appointments. Cost savings was cited in cases where patients had to request time off from work or arrange/pay for childcare to attend in-person therapy sessions.

**Provider Facilitators**

Therapists considered TR as an opportunity to improve patient-therapist communication skills for enabling successful patient encounters and outcomes. In several studies, therapists saw the potential for TR to serve as a training and educational opportunity in their patient engagement. In the study that included home-based and remote-monitoring systems, therapists found these devices to be cost-effective and useful in monitoring patient symptoms and for providing timely support.

**Patient Barriers**

Obstacles that influenced therapists’ perception of TR for their patients included patients’ access to the appropriate equipment, poor (or lack of) Internet connectivity, ability to navigate the technology, ability to perform the exercises without hands-on assistance, and overall receptiveness to participate in virtual therapy.

**Provider Barriers**

An overarching theme across studies was the importance for providers to perform comprehensive physical assessments to evaluate a patient’s condition and therapy needs to determine whether TR was an appropriate form of care delivery. Most said an initial assessment was essential in order to appropriately evaluate and physically guide the patient in the exercises. Some therapists felt that the lack of “hands-on” contact in subsequent visits could lead to having symptoms or issues go undetected.

Technology was another major barrier addressed by providers across studies. For those patients with low digital literacy, therapists were concerned their sessions would entail resolving technical issues, which was outside their professional role. In studies conducted outside of the US and UK, limitation of resources within therapists’ clinical setting was also a concern.

In the study addressing pediatric patients, the major theme was the therapists’ reliance on parents to be an active participant in their child’s therapy session and the need for parents to deliver the hands-on contact. In situations where parents left the child to engage with the therapist on his/her own and the home environment was not conducive to performing virtual therapy in private without disruption from family members, this was noted as a major barrier to success.

While the GRADE framework can accommodate assessing confidence in the quality of evidence from qualitative studies (CERQual), we did not perform formal assessment of the literature base. The findings were primarily thematic in nature, and identified both barriers and facilitators from
the perspective of the providers. These data were relevant to the key question, but some studies had relatively few participants and there were some concerns about the adequacy and paucity of the data. There were no major methodological concerns with the included studies. It is unlikely that the studies included in the evidence base addressing barriers and facilitators will inform actionable recommendations in the same manner as intervention trials. However, the information from these studies may be useful in devising training and educational materials for physical therapist clinicians and their patients, and useful for informing best practices with regard to patients, health conditions, and/or clinical settings most appropriate for TR implementation.
# Appendix A. Evidence Tables

## Table 1. Systematic Review/Meta-analysis

<table>
<thead>
<tr>
<th>Study Details</th>
<th>Search Strategy/Evidence Base</th>
<th>Patients/Interventions</th>
<th>Outcomes/Results</th>
</tr>
</thead>
</table>
| **Reference:** Hellemann et al. 2020 | PubMed and EMBASE were searched to 2019. The evidence base consisted of 16 studies. | **Number of Patients:** 429  
**Diagnosis:** ALS  
**Age:** 60.5  
**Gender:** 65.9%  
**Race:** NR | **Facilitators**  
**Healthcare professional characteristics**  
**User-Experiences and Benefits**  
- Increased feeling of security  
- Insight into remote monitoring of data  
- Better communication |
| **Country:** Netherlands  
**Purpose:** Identification of patent and caregiver barriers and facilitators of telehealth implementation in the treatment of Amyotrophic Lateral Sclerosis (ALS)  
**Funding Source:** Netherlands ALS Foundation (No. 2016-51) | **Inclusion/Exclusion Criteria:** >75% of the study population had to be patients with ALS and report on the use or implementation of telehealth in a healthcare setting. | **Videoconferencing**  
1 study showed that healthcare professionals were generally satisfied with the communication and provision of care during videoconferences.  
2 studies reported that healthcare professionals were able to discuss most, but not all, topics (as reported by patients).  
**Home-based Self-monitoring**  
Telehealth allowed healthcare professionals to monitor symptoms effectively, provide timely support and make appropriate decisions in care.  
1 study reported that telephone-assisted self-monitoring increased healthcare professionals’ feeling of security for home management of respiratory symptoms.  
**Remote NIV Monitoring**  
1 study reported that remote monitoring facilitated communication with the patient in all studies, healthcare professionals had the ability to remotely monitor NIV and adjust settings, which would not be possible with usual in-clinic care. | **Available Resources**  
- Ongoing support for end-users  
- Training of end-users  
- Standardized clinical assessment)
<table>
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**Videoconferencing**
Studies showed that the care protocol for videoconferences was the same as for in-clinic care, including equal staff requirement during consultations.

**Home-based Self-monitoring**
Studies reported that medical support could be requested through a telephone call, message system, or email and that support was provided by either a therapist or nurse.

**Remote NIV Monitoring**
2 studies reported that the number of NIV setting changes was 50% lower over the entire period of NIV use, compared to usual care, hence saving time.

**Finance and Legislation**
- Sustainable in costs and time requirement
- Cost-effective MI-E rental/ NIV use
- Inexpensive commercial devices
- Reduced hospitalization costs

**Videoconferencing**
1 study reported a lack of reimbursement for telehealth.

**Home-based Self-monitoring**
On-demand MI-E rental was cost-effective compared to continuous rental and that fewer hospital admissions reduced hospitalization costs.

**Remote NIV Monitoring**
1 study reported that a large initial investment is required to set up telehealth and that remote NIV monitoring in ALS care is cost-effective.

Another study reported that the number of hospital admissions was reduced, which resulted in lower hospitalization costs.

**Barriers**

**Healthcare professional characteristics**

**User-Experiences and Benefits**
- Lack of physical evaluation/ contact
- Uncertainty about comprehensive medical assessment
### Videoconferencing

Several studies indicated the lack of a sense of touch perceived by healthcare professionals.

1 study reported that healthcare professionals might be uncertain about whether videoconferencing allows for an appropriate medical assessment.

In 1 study, healthcare professionals expressed dissatisfaction with the quality of the video and audio, and reported that telehealth was not equal to in-person care.

1 study reported mixed opinions on time requirement and ease of the process of the store and forward method.

### Home-based Self-monitoring

1 study reported that information was often not detailed enough and that repetitive alerts lead to frustration.

### Remote NIV Monitoring

1 study reported that healthcare professionals missed the sense of touch.

### Inner and outer setting

### Finance and Legislation

- Big initial investment
- Large variety of fixed and variable costs
- Lack of reimbursement
- Lack of cost-effectiveness analyses

### Videoconferencing

1 study reported a lack of reimbursement for telehealth.

### Home-based Self-monitoring

Reported barriers to the continuation of telehealth use were a lack of information on cost-effectiveness and a lack of reimbursement.

A large variety of fixed and variable costs related to teleassistance were seen in two studies.

### Remote NIV Monitoring

Reported barriers to telehealth implementation were a lack of robust cost-effectiveness analysis and issues with reimbursement.

ALS: amyotrophic lateral sclerosis; MI-E: mechanical in-exsufflation; NIV: non-invasive ventilation; NR: not reported
### Table 2. Individual Studies

<table>
<thead>
<tr>
<th>Study Details</th>
<th>Patients/Interventions</th>
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<tbody>
<tr>
<td><strong>Reference</strong>: Gilbert et al. 2021[155]</td>
<td><strong>Number of Healthcare Professionals</strong>: 22</td>
<td><strong>Collection of Patient Input</strong>: Interviews were conducted on-site at the hospital or virtually using phone or Skype. Interviews were conducted by study author and lasting ~ 60 min with the option to amend as required. The average interview length was 48 minutes (range 28 – 81). All interviews were audio recorded and sent off and transcribed by an external company. All transcripts were emailed or posted to participants on receipt to give them the option to verify the data or to make any adjustments.</td>
<td><strong>Themes</strong>&lt;br&gt;Situation of Care: Represents the ways that patients understand and explain the following:&lt;br&gt;- <strong>Clinical status</strong>: Healthcare professionals had an awareness of the volatile nature of patient’s clinical status. Patients with a long-term orthopedic condition had an awareness that their clinical status has the potential to both worsen and improve with some patients experiencing this degree of volatility.&lt;br&gt;- <strong>Treatment requirements</strong>: Dependent on the clinical status of the patient, in accordance with the normal management for that status. A spectrum of management strategies may be required, some of which traditionally require hands-on treatment and others, which can be delivered without physical contact.&lt;br&gt;- <strong>Care pathway</strong>: Healthcare professionals commented on the rigidity of corporate resources, with some finding the volume of workload reduced their capacity to be flexible, for instance finding time to support patients managing their VC.&lt;br&gt;- <strong>Expectations of Care</strong>: Patients have expectations for both VC and F2F, which are influenced by the following factors:&lt;br&gt;- <strong>Desire for contact</strong>: Healthcare professionals believed that VCs were not capable of delivering the physical aspect of a session.&lt;br&gt;- <strong>Psychological status</strong>: Healthcare professionals had an awareness of the potential limitations to offer empathy via VC to the patients who desired it.&lt;br&gt;- <strong>Previous care</strong>: Influenced patients’ preference for VC. Those who built up a good rapport with their current care team wanted F2F to continue whereas others felt that, as they trusted their healthcare professionals, they would be willing to try VC. Healthcare professionals were sensitive to the varied experiences and expectation of patients.</td>
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<tr>
<td><strong>Country</strong>: UK</td>
<td><strong>Gender % Female</strong>: 64%</td>
<td><strong>Diagnosis</strong>: Patients with musculoskeletal problem</td>
<td><strong>Exclusion Criteria</strong>: Physiotherapists or Occupational Therapists who do not currently treat, or have no experience of treating patients with orthopedic/musculoskeletal disorders.</td>
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<tr>
<td><strong>Study Design</strong>: Qualitative study using semi-structured interviews and abductive analysis.</td>
<td><strong>Inclusion Criteria</strong>: Physiotherapists or Occupational Therapists (or assistants) who treat patients with orthopedic/musculoskeletal disorders.</td>
<td><strong>Data Analyses</strong>: Interview transcripts were reviewed and uploaded into NVivo. Data analysis followed the principles of abduction as set out by Tavory and Timmermans. Coding was undertaken by study authors. Open coding techniques were used to identify empirical regularities (new themes) in the data. The new themes were interrogated for attributions about patient preferences and the factors that shape them. Attributions were assigned to codes within these new themes following discussion between study authors. Inferences were made about the ways that preferences worked, the relative position and significance of the factors that shaped them, forming abductive explanation. Themes arising from the data were mapped out in a conceptual model by study author to visualize how different factors might influence preference for VC. This research sought abductive ‘surprises’ (new themes) in addition to those gained from the authors’ previous work.</td>
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<td><strong>Purpose</strong>: To identify, characterize and explain factors that influence patient preferences, from the perspective of patients and clinicians, for virtual consultations (VC) in an orthopedic rehabilitation setting.</td>
<td><strong>Therapy for Musculoskeletal Conditions/Injuries Delivered via Videoconferencing or Other Mechanisms</strong>&lt;br&gt;Physiotherapists (13)&lt;br&gt;Treatment technicians (NR)&lt;br&gt;Occupational therapists (NR)&lt;br&gt;Therapists who do not currently treat, or have no experience of treating patients with orthopedic/musculoskeletal disorders.</td>
<td><strong>Funding Source</strong>: National Institute for Health Research (NIHR), Clinical Doctoral Research Fellowship (ICACDRF-2017-03-025)</td>
<td><strong>Country</strong>: UK</td>
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</table>
Primary Outcomes: Patient preferences, from the perspective of clinicians, surrounding receipt of orthopedic rehabilitation through VC.

- Perceived requirements: Patients who feel the need for hands-on F2F care reported a preference towards F2F. Patients who did not feel F2F necessary did not feel the same way. Care requirements differed based on the patient's individual circumstances and the length of time of the appointment.

Demands on the Patient: Patients may face multiple and differing demands dependent on the choices they make regarding VC or F2F. Factors include:

- Care requirements: Some patients may be required to complete complex exercise regimens or perform assessments, which may benefit from optimal visualization of movements. Some exercises may require hands-on facilitation. Preferences are likely to be mediated by what the healthcare professional believes and the consequence of choice will change the demands on patients. These changes may be burdensome depending on the patient’s capacity.

- Social demands: Those that interfered with healthcare (i.e., caring for elderly relatives or young children), or conflicting demands that interfered with the patient’s ability to attend their own appointments and rehabilitation, reported that in some circumstances VC could be more favorable.

- Consequences of choice: VC may require patient’s needing technology or rehabilitation equipment or acquiring a new skill set. Overcoming the lack of physical contact and adapting assessments proved to be an issue for some patients. The lack of a suitable rehab environment was a concern to some healthcare professionals.

Patient Capacity to Allocate Resources to Care

- Financial: Travel demands of attending physical appointment can be costly (i.e., long journeys by public transport). Some patients were required to take unpaid leave from employment or risk losing their job. Healthcare professionals were aware of these financial challenges faced by patients.
Infrastructural: Patients needed access to the hardware and software and understand how to use the technology for successful VC. There did not appear to be any relationship with type of hardware and software combination and preference. Some devices with larger screens were thought to be more beneficial and influence expectations. Patients needed access to a suitable environment and equipment in order to undergo VC.

Social capacity: Patients who had a support network available to them found this was a useful resource. Healthcare professionals reported ways in which patients could enhance capacity through their social networks.

Healthcare system: Provides capacity, which is an important mediator of preference as it dictates whether a patient has the available resources to meet the demands of the situation and the expectations. Some patients received hospital-funded transport making attendance at the hospital easier. Expectations of success may provide patients with additional motivation and self-efficacy to achieve the demands required of them.

Reference: Tyagi et al. 2018

Country: Singapore
Study Design: Qualitative study involving semi-structured in-depth interviews and focus group discussions nested within an RCT (Singapore Tele-technology Aided Rehabilitation in Stroke Rehab).
Purpose: To explore barriers and facilitators of TR as perceived by stroke patients, caregivers, and rehabilitation therapists recruited from one of the largest TR trials in a developed Asian country.
Funding Source: NR

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<td></td>
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<td>• Infrastructural: Patients needed access to the hardware and software and understand how to use the technology for successful VC. There did not appear to be any relationship with type of hardware and software combination and preference. Some devices with larger screens were thought to be more beneficial and influence expectations. Patients needed access to a suitable environment and equipment in order to undergo VC. • Social capacity: Patients who had a support network available to them found this was a useful resource. Healthcare professionals reported ways in which patients could enhance capacity through their social networks. • Healthcare system: Provides capacity, which is an important mediator of preference as it dictates whether a patient has the available resources to meet the demands of the situation and the expectations. Some patients received hospital-funded transport making attendance at the hospital easier. Expectations of success may provide patients with additional motivation and self-efficacy to achieve the demands required of them.</td>
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<tr>
<td>Number of Provider Participants: 11</td>
<td>Occupational therapists (8) Physiotherapists (3)</td>
<td>Collection of Therapist Input: 18 semi-structured interviews, lasting between 30 and 90 minutes, were conducted in English, Chinese, or Malay between February to April 2016. Interview guide questions addressed: • General experience • Barriers and facilitators • Decision on whether to continue with day rehabilitation • Suggestions and further input</td>
<td>Facilitators; Provider level Address a service gap • TR was also perceived as an interim rehabilitation while waiting for the DR sessions, which could range from 2 to 4 weeks. Unexpected health benefits • Therapists monitored patients’ general fitness, including blood pressure before each FaceTime session and one such encounter allowed a therapist to detect her patient’s uncontrolled hypertension, which was resolved later.</td>
</tr>
<tr>
<td>Diagnosis: Patients with stroke</td>
<td>Provider Age Range Years (Mean): 23-37 (27)</td>
<td>Data Analysis: Interviews were transcribed and translated to English (when in Chinese and Malay) and coded using NVivo 11 software. Study author used line-by-line coding to analyze the first few transcripts, identifying the main emerging themes. Combining this</td>
<td>Barriers; Provider level Patient assessment • One of the main barriers perceived by the therapists was patient assessments, highlighting the inherent limitations of the virtual platform like inability to physically test muscle power or balance.</td>
</tr>
<tr>
<td>Gender % Female: 100%</td>
<td>Inclusion Criteria: Tele-therapists aged ≥21</td>
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<tr>
<td>Exclusion Criteria: NR</td>
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# APTA Telerehabilitation Evidence Synthesis Report

<table>
<thead>
<tr>
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<td>inductive approach with prior literature and written memos, a preliminary coding frame was developed and finalized by the team. Thematic analysis was performed within the categories of coding frame, complemented by constant comparisons at different levels, between content and code within an interview, different subjects and different subject groups. The team met regularly to discuss emerging themes, and deviant cases, if any, were explored in-depth and incorporated in the final results. <strong>Primary Outcomes:</strong> Perceived barriers and facilitators to TR uptake as reported by tele-therapists. <strong>Follow-up:</strong> 12 weeks</td>
<td>Interface-related problems • Therapists described problems like screen size and complicated graphs, which might demotivate future providers. Except for a few, who felt the issue was with the screen size, most viewed it more as a placement problem, which could be solved by tilting or adjusting the iPad. • Almost half of the therapists perceived the graphs on the interface as complicated and hard to understand. <strong>Scope of exercises</strong> • Therapists who talked about the TR exercises agreed on their limited scope. <strong>Interaction between patient and therapist</strong> • Almost half of the therapists referred to the connectivity problems encountered during the FaceTime session.</td>
</tr>
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</table>

**Reference:** Cottrell et al. 2017

**Country:** Australia

**Study Design:** Qualitative descriptive study design

**Purpose:** To evaluate Neurosurgical & Orthopedic Physiotherapy Screening Clinic and Multidisciplinary Service (N/OPSC&MDS) service providers’ views on current barriers to patients’ accessing recommended healthcare for their chronic musculoskeletal condition; and whether TR could positively influence these barriers; and the potential barriers and facilitators to the implementation of TR.

**Number of Healthcare Providers:** 26

Survey participants recruited (June 2015-January 2016). Participants had been affiliated with the N/OPSC&MDS on average 5.5 years (range 1-11 years). Participants were predominately physiotherapists due to the nature of the service which is physiotherapy-led and managed through the hospital’s Physiotherapy Department. (For full details on the survey participants’ characteristics, see Table 1 in the full paper.)

**Diagnosis:** Patients with chronic musculoskeletal conditions

**Inclusion Criteria:** NR

**Exclusion Criteria:** NR

**Survey Development:** Where possible, interviews were completed face-to-face (n=15), with the remainder completed via telephone (n=11). All interviews were audio-recorded (duration 21-46 min) and transcribed verbatim. Interviews were conducted by a single investigator, a Musculoskeletal Physiotherapist and N/OPSC&MDS treating clinician.

**Survey Questions:** Questions were composed around 3 domains:
1. Current perceived barriers to patients’ accessing the N/OPSC&MDS;
2. Whether TR could address these barriers; and
3. Potential barriers and facilitators to successfully implement TR.

**Analysis of Survey Data:** Transcribed data was analyzed and managed using QRS International’s NVivo10 qualitative data analysis software. Preliminary coding

**Themes**

**Barriers to some patients’ accessing current N/OPSC&MDS services are complex & multifaceted.**

**Sub-themes**

**Individual patient factors**
- Financial limitations
- Access to transport
- Health literacy
- Motivation to engage
- Work/career commitments
- Inconvenience of appointment times
- Medical comorbidities
- Pain

**Patient residence often dictates access to care**
- Distance from service can make attendance difficult
- Limited rural healthcare options available

**Coordination of patient care can be difficult**
- Limited primary care options

- Limited primary care options
<table>
<thead>
<tr>
<th>Study Details</th>
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<th>Intervention/Outcomes</th>
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</table>
|               | was undertaken using the Inner Regional data set (n=8), where initial codes were generated and emerging themes identified. Refinement of themes subsequently occurred, with the finalized template reapplied to the full data set. The number (n) of participants who commented on each sub-theme, as well as the number of times each sub-theme/category (code) was referred to was also recorded, to examine possible heterogeneity between the three groups. Categories, sub-themes and themes were reviewed and refined by co-authors at regular intervals. A random sample (n=3) of transcripts was independently cross-checked for transcribing accuracy and consensus coding by the second author. Participants were provided with a summary of identified themes and sub-themes (‘member checking’) in order to confirm the investigator’s analysis of the data. Eleven participants responded and confirmed the accuracy of the investigator’s analysis. | | • Awareness of appropriate and available referral pathways  
• Scheduling multiple appointments  
**Difficult to access current evidence-based practice**  
• Gap in clinician’s knowledge  
• Poor access to early care  
• Poor acceptance of EBP  
**Services are often under-resourced & over-burdened**  
• Staffing of service  
• Funding restrictions  
**Surrounding barriers**  
**TR could improve patient access to appropriate management for their musculoskeletal condition.**  
**Sub-themes**  
**It would be much easier for patients to attend**  
• Improved attendance rates  
• Reduced need to travel  
• Reduced patient-related costs  
• Improved patient engagement  
**Access to best practice care, regardless of where they live**  
**Improvement in communication between healthcare professionals**  
**Allows flexibility to standard healthcare delivery**  
“It is (was) the difference between this and what they can access now”  
**TR may have limitations when compared to standard face-to-face care for the management of chronic musculoskeletal conditions.**  
**“It won’t be able to fix the current problems”**  
• Waitlists or time efficiency  
• Attendance rates  
• Clinician availability |
### Study Details

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<tr>
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</thead>
</table>

#### Building patient rapport

- Physical examination would not be as thorough
- Hands-on techniques would be lost
- Patient safety & wellbeing
  - “I just don’t think it’s going to be as good as face-to-face”

#### The delivery of TR within the N/OPSC&MDS should be flexible & dependent on individual patient circumstances.

#### Sub-themes

- “it really depends on the patient and what they need”
  - TR directly in the home is more convenient for patients
  - Allow clinician to see patients in their own environment
  - Safety & privacy concerns
  - Dependent on technology

#### TR into the local healthcare facility

- Better resourced
- “Maintains appointment feeling”
- Access issues would still exist

#### Involvement of a remote end healthcare professional

- “it would contribute to better patient care”
- “They would have to be the same discipline as me”
- “They could be any discipline as long as they underwent training”
- “it needs to be someone that I could trust”

#### TR could be used at various stages of patient care

- “it would be good to see the patient in person for the initial appointment”
- “I would consider using TR for an initial appointment”
- “It could be used for to screen patients prior to a full assessment”
- “TR would be fine for review appointments”
### Therapy for Chronic Respiratory Conditions Delivered via Digital Health Technology

<table>
<thead>
<tr>
<th>Study Details</th>
<th>Patients/Interventions</th>
<th>Intervention/Outcomes</th>
<th>Results</th>
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</thead>
<tbody>
<tr>
<td><strong>Reference:</strong> Slevin et al. 2020</td>
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</tr>
<tr>
<td><strong>Country:</strong> Ireland</td>
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<tr>
<td><strong>Study Design:</strong> Qualitative study using one-to-one semi-structured interviews.</td>
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<tr>
<td><strong>Purpose:</strong> To qualitatively explore the barriers and facilitators healthcare providers perceive for the use of DHT in the management of COPD.</td>
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<tr>
<td><strong>Number of Survey Participants:</strong> 32</td>
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<td></td>
</tr>
<tr>
<td>General practitioners (GPs) (8)</td>
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</tr>
<tr>
<td>Respiratory specialist nurses (4)</td>
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<tr>
<td>Respiratory physiotherapists (4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-consultant hospital doctors (8)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Respiratory consultant physicians (8)</td>
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</tr>
<tr>
<td><strong>Diagnosis:</strong> Patients with COPD</td>
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<tr>
<td><strong>Survey Development:</strong> The first author performed the one-to-one semi-structured interviews. An interview topic guide followed a semi-structured format and was used to frame the interviews. An initial version of the interview topic guide was informed by relevant literature. This version was then trialed by interviewing authors after which a final version was drafted collaboratively with these authors. Questions explored participant's perceptions of the barriers and facilitators.</td>
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</tr>
<tr>
<td><strong>Barriers</strong></td>
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</tr>
<tr>
<td><strong>Data quality</strong></td>
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<tr>
<td>Participants perceived that consumer devices often do not meet the expected clinical standards, e.g., they may lack validation and calibration.</td>
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<tr>
<td>Accuracy of the data generated may be questionable which could create patient safety concerns if inaccurate readings cause undue health anxieties.</td>
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</tbody>
</table>

**Perceived barriers to the successful implementation of TR within the N/OPSC & MDS.**

**Sub-themes**
- Resistance to change
- Poor computer literacy
- Lack of knowledge to adapt clinical practice

**Resource limitations**
- Patient-related
- Service-related

**Financial limitations**
- Resource limitations
- Patient-related
- Service-related

**Organizational barriers**
- "No barriers will be insurmountable"
- Adapting practice
- Staff upskilling
- Patient acceptance
- Clinician acceptance
- "I would be willing to give it a go"
- "There is a need to change"
<table>
<thead>
<tr>
<th>Study Details</th>
<th>Patients/Interventions</th>
<th>Intervention/Outcomes</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funding Source:</td>
<td>Inclusion Criteria: There was no requirement for participants to have prior knowledge of DHT to partake.</td>
<td>for the use of DHT in the management of COPD. The semi-structured format of the interview guide along with the use of open-ended questioning, allowed for new areas of conversation to emerge, and subsequently, these were discussed in-depth.</td>
<td>• Participants questioned the diligence of their patients to generate complete datasets and discussed how this may impact the reliability of the data being captured by DHT.</td>
</tr>
<tr>
<td></td>
<td>Exclusion Criteria: NR</td>
<td></td>
<td>Evidence-based care</td>
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<tr>
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<td></td>
<td>• Participants discussed a need for a strong evidence base before they could adopt DHT in clinical practice. They perceived this absence of evidence affecting their ability to safely prescribe these technologies, while also impacting their willingness to encourage or recommend DHT as a treatment.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>• The lack of clinical guidelines describing the use of DHT in COPD creates a further significant barrier for their adoption.</td>
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<td></td>
<td>Resource constraints</td>
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<td>• Participants spoke about the challenges their clinical setting would face if data from DHT was to become part of routine care. They were mainly concerned that the necessary level of resources would be unavailable to oversee the management or utilization of the data generated by DHT.</td>
</tr>
<tr>
<td></td>
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<td>• Others felt ethical concerns would arise if data could not be acted upon appropriately due to sparsity in resources.</td>
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<td></td>
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<td></td>
<td>Patient digital literacy</td>
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<td></td>
<td>• Participants suggested that patients who have poorer levels of digital literacy may find interpreting readouts from DHT a challenge.</td>
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<td>• Participants also highlighted the presence of co-morbidities, including cognitive impairments, may potentially affect the degree to which patients can understand DHT.</td>
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<td></td>
<td></td>
<td></td>
<td>Facilitators</td>
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<td></td>
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<td></td>
<td>DH training and education</td>
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<td></td>
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<td>• Participants highlighted a number of strategies they perceived would facilitate the adoption of DHT for patients and hcps. Pulmonary rehabilitation was discussed as a possible existing option for educating and raising patient awareness regarding DHT.</td>
</tr>
</tbody>
</table>

**Survey Data Analysis:** The duration of interviews ranged from 30 to 60 minutes and were recorded, transcribed verbatim and anonymized. NVivo 12 software (QSR International Pty Ltd, Victoria, Australia) was employed to conduct a thematic analysis of the transcripts. Analysis of the data was inductive and cyclical, this approach entailed reading and rereading each transcript closely to become familiar with the data, identifying emergent patterns, coding the data with unique labels and then generating themes and sub-themes. Two study authors independently coded the data, and afterwards collaboratively scrutinized and compared any inconsistencies or contrasts, which were deliberated and resolved. At the point when no new data, themes or patterns were being identified in analysis, it was determined data saturation was complete.

**Primary Outcomes:** Healthcare providers’ perceived barriers and facilitators to DHT in the management of COPD.

**Follow-up:** NR
### Study Details

<table>
<thead>
<tr>
<th>Study Details</th>
<th>Patients/Interventions</th>
<th>Intervention/Outcomes</th>
<th>Results</th>
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</thead>
</table>
| **Reference:** Damhus et al. 2018 | **Number of Survey Respondents:** 25  
Physiotherapists (19)  
Nurses (6) | **Survey Structure:** 4 focus group interviews with health professionals having no TR experience. 2 focus group interviews and 3 individual interviews with participants having TR experience.  
All interviews were conducted by the first author, while the second and third authors observed the interviews, wrote field notes, and asked supplementary questions during the interviews. The focus group interviews and the individual interviews lasted between 50 and 70 minutes with a mean duration of 1 hour. The interviews were audio recorded and further transcribed using the Express Scribe Transcription Software version 6.00 (NCH Software, Inc., Canberra, Australia). | • For those hcp's with access to community-based outreach programs, they felt the individualized care provided through these approaches offered a favorable method for supporting patients to adopt DHT. |
| **Country:** Denmark | **Inclusion Criteria:** In the no-tele-experienced group, previous experience providing COPD rehabilitation either patient education or exercise training was required; in the tele-experienced group, participants were only included if they had experience applying exercise or education to COPD patients via real-time video telemedical technology.  
**Exclusion Criteria:** NR | **Survey Data Analysis:** The semi-structured interview guide was based on the 14 domains in theoretical domain framework and pilot tested.  
Initially, survey transcripts were analyzed using content analysis to identify meaning units in the data. These meaning units were then applied in a deductive analysis. |
| **Study Design:** Qualitative study using semi-structured individual and focus group interviews. | **Diagnosis:** Patients with COPD  
**Gender % female:** 92% | **Domains** |
| **Purpose:** To examine the barriers and enablers of health professionals to online exercise-based TR (TR) in patients with chronic obstructive pulmonary disorder (COPD). | **No-tele-experienced Group** | **Skills**  
**Communication skills-Subtheme** |
| **Funding Source:** NR | **Tele-experienced Group** | **Perceived the screen as a barrier to communicate with patients. They presumed that patients would interrupt each other when speaking on the screen or that guiding the patients would be time-consuming compared with current practice.**  
**Some participants said that they would have to learn how to express themselves loud and clear on a screen.** |
| | | **Tele-experienced Group** | **Emphasized that they had developed new communication skills to perform rehabilitation on a screen.**  
**On-screen communication had been a challenge in the beginning but had become a natural way to communicate with the patients.** |
<table>
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<tbody>
<tr>
<td>in which TDF was used as a coding framework. Meaning units were not restricted to one domain but were cross-indexed when they were relevant to more than one domain. The meaning units were clustered into categories which were ordered into subthemes in each domain.</td>
<td>A need for creative health professionals-Subtheme</td>
<td></td>
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</tr>
<tr>
<td><strong>Primary Outcomes:</strong> Health professionals’ perceptions of barriers and enablers of TR in the treatment of COPD.</td>
<td><strong>No-tele-experienced Group</strong></td>
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<tr>
<td><strong>Follow-up:</strong> NR</td>
<td>• Majority of the participants within the no-tele-experienced group presumed that performing TR would call for a more creative approach to exercise training than their current practice.</td>
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<tr>
<td><strong>Professional Role and Identity</strong></td>
<td><strong>Getting the right type of rehabilitation to the right patients-Subtheme</strong></td>
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<tr>
<td></td>
<td>• All participants agreed that TR is a task that belongs within their field of work as nurses or physiotherapists.</td>
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<td></td>
<td>• Health professionals emphasized that TR should not replace conventional COPD rehabilitation and that allocating the right type of rehabilitation to the patients was an essential part of their professional role.</td>
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<td><strong>Online vs. physical meeting with the patients-Subtheme</strong></td>
<td><strong>No-tele-experienced Group</strong></td>
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<tr>
<td></td>
<td>• Emphasized that they would prefer to perform physical, conventional COPD rehabilitation instead of TR. A common explanation was the barrier to get an interpersonal connection with the patients on the screen.</td>
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<td></td>
<td><strong>Tele-experienced Group</strong></td>
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<td></td>
<td>• Could not relate to this issue, but most of them acknowledged the benefit of having an individual meeting with the patients before TR. Another barrier of the screen was the concern of being able to read the patients’ symptoms online.</td>
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<tr>
<td><strong>Tasks not included in professional role-Subtheme</strong></td>
<td>• Participants did not think that fixing technical issues or installing tele equipment should be a part of their job or professional role.</td>
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<td></td>
<td>• Technical issues were the most often mentioned barrier.</td>
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<tr>
<td>Study Details</td>
<td>Patients/Interventions</td>
<td>Intervention/Outcomes</td>
<td>Results</td>
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<td></td>
<td>No-tele-experienced Group</td>
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<tr>
<td></td>
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<td></td>
<td>• Participants in this group presumed that they would not get sufficient IT support and were concerned that they would have to fix technical issues themselves.</td>
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<td></td>
<td>Tele-experienced Group</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• All participants in this group had experienced technical issues and described them as frustrating and as barriers to perform TR.</td>
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<td></td>
<td>Beliefs about Capabilities</td>
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<td></td>
<td>Feeling safe when performing TR- Subtheme</td>
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<tr>
<td></td>
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<td></td>
<td>• All participants emphasized that they felt capable of doing TR.</td>
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<td></td>
<td>No-tele-experienced Group</td>
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<td>• Comments from some participants indicated that they did not feel completely safe about TR.</td>
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<td></td>
<td>• This barrier resulted in more participants saying that they would push the patients less when exercising.</td>
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<td></td>
<td></td>
<td>Tele-experienced Group</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Some participants indicated that after some practice they found themselves good, competent, and safe when performing TR.</td>
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<td></td>
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<td></td>
<td>• The majority of participants in this group was not afraid to physically challenge patients.</td>
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<td></td>
<td>Beliefs about Consequences</td>
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<tr>
<td></td>
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<td></td>
<td>Interpersonal communication and relations on screen- Subtheme</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>No-tele-experienced Group</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>• The screen acts as a barrier for the patients to interact.</td>
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<td></td>
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<td></td>
<td>• Some believed that some social situations would not be possible on the screen.</td>
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<td></td>
<td>Tele-experienced Group</td>
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<tr>
<td></td>
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<td></td>
<td>• “Missing situations” were not mentioned in this group.</td>
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<tr>
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<td></td>
<td>• They emphasized how social interactions happened between the patients on the screen.</td>
</tr>
<tr>
<td>Study Details</td>
<td>Patients/Interventions</td>
<td>Intervention/Outcomes</td>
<td>Results</td>
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<td></td>
<td>Performing rehabilitation with no exercise equipment-Subtheme</td>
</tr>
<tr>
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<td></td>
<td><strong>No-tele-experienced Group</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• A barrier of TR, often mentioned by participants, was to provide sufficient rehabilitation when patients were located in their home with no access to training venues or equipment.</td>
</tr>
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<td></td>
<td><strong>Tele-experienced Group</strong></td>
</tr>
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<td></td>
<td>• None of the participants in this group could relate to this issue as they believed they provided an efficient exercise session with simple equipment.</td>
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<td></td>
<td><strong>Environmental Context and Resources</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Transportation-Subtheme</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• All participants agreed that a great enabler of TR is that the patients do not need the long transportation and waiting time, which is undesirable and exhausting for the COPD patients.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td><strong>Resources-Subtheme</strong></td>
</tr>
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<td></td>
<td></td>
<td></td>
<td><strong>No-tele-experienced Group</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• There was a common understanding that adequate resources would not be available if TR was implemented in their department.</td>
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<td></td>
<td>• They presumed that hiring IT staff to install and introduce the patients to the screen would not be prioritized.</td>
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<td><strong>Social Influences</strong></td>
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<td></td>
<td><strong>Cooperation with other health professionals about TR-Subtheme</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Participants emphasized that a close collaboration with colleagues and other health professionals, such as doctors and managers, is essential to perform TR.</td>
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<td></td>
<td>• Most participants said that their board of directors in general was favorable to TR but did not prioritize it as much as conventional COPD rehabilitation.</td>
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<td></td>
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<td></td>
<td>• Other participants mentioned how they had experienced issues when cooperating and communicating with doctors about TR.</td>
</tr>
</tbody>
</table>
**Study Details**  

<table>
<thead>
<tr>
<th>Reference</th>
<th>Albahrouh &amp; Buabbas 2021¹²³</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Country:</strong></td>
<td>Kuwait</td>
</tr>
<tr>
<td><strong>Study Design:</strong></td>
<td>Cross-sectional survey and face-to-face semi-structured interviews</td>
</tr>
<tr>
<td><strong>Purpose:</strong></td>
<td>Investigate physiotherapists’ perceptions of and willingness to use TR in Kuwait during the COVID-19 pandemic and to explore the barriers that may hinder the use of TR in this sector.</td>
</tr>
<tr>
<td><strong>Funding Source:</strong></td>
<td>NR</td>
</tr>
</tbody>
</table>

**Patients/Interventions**  

**Therapy for Treatment of Unspecified Conditions/Injuries Delivered via Telehealth**

<table>
<thead>
<tr>
<th>Number of Survey Respondents: 273/747 Physical therapists</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Physiotherapy/senior physiotherapy practitioner 100 (36.6%)</td>
</tr>
<tr>
<td>• Physiotherapy/senior physiotherapy specialist 118 (43.2%)</td>
</tr>
<tr>
<td>• Superintendent PT 55 (20.1%)</td>
</tr>
</tbody>
</table>

**Response Rate:** 36.5%

**Diagnosis:** Patients with unspecified diagnosis

**Gender % female:** 65%

**Age Range Years of Majority of Respondents (%):** 35-50 (59%)

**Inclusion Criteria:** NR

**Exclusion Criteria:** NR

**Questionnaire Structure:** A self-reported questionnaire was used, which included 25 items divided into five sections:

1. Demographic data (age, gender, nationality, years of experience, and area of work)
2. Technological background
3. Perception about TR system
4. Comfort and technology
5. Willingness about TR

Answers for questions in section 3-5 were provided using a four-point Likert scale (from strongly disagree to strongly agree). Some of the questionnaire items were adapted to suit the physiotherapy profession.

**Interview Structure:** Semi-structured, in-depth, face-to-face interviews were conducted with physiotherapy managers, which required pre-arranged meetings. An interview topic guide was developed based on the aim of the study, utilizing questions from similar previous research.

**Survey Data Analysis:** Descriptive data analysis was conducted, which included calculating the frequencies and percentages of the participants’ demographic data. A cross-tabulation technique was used to find the associations between the variables, in which chi-square tests were used to identify the significance of the results, where p <0.05.

Thematic content analysis was used by the main investigator to analyze the transcripts. The coding process was done manually using word-processing software. A couple of randomly chosen transcripts with codes and quotations were sent back to the participants to check the accuracy.

**Willingness to use TR**

- Majority of the respondents (93.8%) were happy to use TR systems to obtain consultations from other medical centers/hospitals.
- Most of the respondents (89%) were willing to deliver physiotherapy via TR
- 60.4%: healthcare ICT is not available in the hospital
- 87.5%: TR saves effort
- 83.3%: TR saves time & money
- 96%: Internet has a potential role in healthcare
- 86.8%: TR is a viable approach for providing medical care services to patients
- 89%: TR is a solution for patients with physical problems during pandemic

**Barriers to the use of TR Systems**

- 23%: negative attitudes of staff involved
- 23.8%: perceived increase in workload
- 25.5%: lack of perceived clinical usefulness
- 26.7%: high cost of equipment
- 38.4%: lack of user-friendly software
- 40%: lack of connection between ICT experts and clinicians
- 38%: lack of suitable training to practice TR
- 38%: patient privacy and confidentiality of their data

**Interview Themes**

**TR practices**

- All managers said that they used TR systems in their departments; they confirmed the usefulness of TR techniques during the pandemic, particularly when the Ministry of Health locked down the outpatient departments.
- Only 1 manager said that their hospital IT department had provided a landline with a smartphone and the Internet.
<table>
<thead>
<tr>
<th>Study Details</th>
<th>Patients/Interventions</th>
<th>Intervention/Outcomes</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>of the contents. The reliability of the data was also checked through peer-checking.</td>
<td>• PTs used different platforms, such as WhatsApp, Zoom, and Skype, to conduct video-call sessions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Primary Outcomes:</strong> Physiotherapists’ willingness to use TR and their perceived barriers to its implementation in practice.</td>
<td><strong>The need for TR systems</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Follow-up:</strong> NR</td>
<td>• All managers stated that because of the pandemic, their departments were offering TR to prevent the spread of COVID-19 &amp; ensure the safety of both patients and staff, as well as to provide safe healthcare services for vulnerable patients, such as elderly people.</td>
</tr>
<tr>
<td></td>
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<td>• TR systems can be used to reduce waiting lists, manage many chronic non-urgent cases from a distance, provide flexible appointment times, and save patients the effort of attending clinics.</td>
</tr>
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<td></td>
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<td>• TR systems can encourage patients to perform exercises at home.</td>
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<td></td>
<td><strong>Factors facilitating TR in clinical practice</strong></td>
</tr>
<tr>
<td></td>
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<td>• All managers indicated that most of the PTs in their departments were willing &amp; happy to use TR through video-calls. Most of their PTs could use the technology and were happy and satisfied with the patient outcomes.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>• Managers indicated that the pts had become more motivated towards and interested in TR over time.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>• Only 50% of the managers stated that their hospital management teams were happy with the TR system.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Barriers to successful TR use</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• All managers indicated that the main barriers hindering the successful use of TR were the unavailability of adequate equipment, poor network coverage, and a lack of hospital and IT support.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Managers said that TR has many disadvantages, such as difficulty in detecting some physical problems, a lack of patient and therapist privacy, a lack of hands-on interventions, and a lack of perceived clinical effectiveness.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Managers stated that some of their pts had not accepted the use of TR because they did not trust the effectiveness of TR in identifying some patient problems, so they preferred in-person sessions.</td>
</tr>
</tbody>
</table>
TR implementation requirements
• All the managers indicated that they needed full support from the hospital management and the Ministry of Health to facilitate the implementation of TR in their physiotherapy departments, including ICT support, smartphones, iPad, advanced computers with cameras, and adequate network connections.
• Managers also mentioned that guidelines, policies, and protocols are required to protect both patients & staff from legal allegations & to ensure safe and effective TR practice.

Reference: Hall et al. 2021
Country: U.S.A.
Study Design: Cross-sectional survey using qualitative and quantitative data.
Purpose: To identify important factors, facilitators, and barriers for telehealth effectiveness defined by pediatric physical therapists, transitioning from in-person to telehealth during the COVID-19 pandemic.
Funding Source: NR

Number of PT Survey Respondents:
• 259 respondents completed all parts of the Likert scale factors question
• 158 completed the open-ended question about factors
• 223 completed the question about facilitators, and 234 completed the question about barriers
(For full details on the respondent demographics, see Table in the full paper.)

Diagnosis: NR
Inclusion Criteria: PTs providing pediatric telehealth in the United States for at least 2 weeks during the COVID-19 pandemic; services provided were synchronous or in real time; PTs’ practice was not primarily telehealth before the pandemic; and PTs were English speaking.
Exclusion Criteria: NR

Survey Development: Study authors developed the survey using the Qualtrics online survey platform (Qualtrics, Provo, Utah) based on results from a literature review, researchers’ expertise in pediatric PT, and 2 researchers’ experiences providing telehealth services during COVID-19. The survey was piloted by 3 pediatric PTs practicing in different settings, different states, and providing telehealth and was revised on the basis of their feedback. The survey consisted of 41 questions and was available from May 20, 2020, to June 30, 2020.
Respondents accessed the survey online through an anonymous link or QR code. An introduction to the survey assured the respondents that their participation was voluntary and outlined the study purpose, inclusion criteria, and our working telehealth definition.

Survey Questions: The survey questions were grouped into 3 categories for analysis:
1. Questions related to describing the pediatric PT’s telehealth practice,
2. Questions related to PT perceptions of factors, facilitators, and barriers influencing effectiveness of telehealth services, and
3. Questions related to the telehealth session (%; 95% CI):
   • Child/caregiver interaction (99.2; 97.3 to 99.9)
   • Internet connection (99.2; 97.3 to 99.9)
   • Family factors (95.8; 92.6 to 97.9)
   • Therapist’s skill (93.1; 89.3 to 95.9)
   • Child’s behavior (90.8; 86.6 to 94.0)
   • Home environment (82.3; 77.1 to 86.8)
   • Child’s age (68; 61.9 to 73.6)
   • Child’s diagnosis (59.2; 53.0 to 65.3)

Themes
Caregiver Engagement: Respondents reported the level of caregiver engagement as the most important feature necessary for effective telehealth.
Facilitator: “Parent engagement must be much higher as the therapist cannot be interactive with the child hands-on.”
Barrier: “At the beginning, many parents wanted to put the screen in front of the child and have therapy services delivered directly to the child without parent coaching.”
Technology: Stable Internet connection and access to appropriate devices were considered the minimum requirement for a telehealth session.
Facilitator: “Good Internet and savvy tech parents.”
### Study Details | Patients/Interventions | Intervention/Outcomes | Results
--- | --- | --- | ---
3. Questions related to PT’s willingness to continue telehealth after the pandemic ends

This study reports on the results of the second category of questions that includes 1 multipart Likert scale question and 3 open-ended questions from the survey. These questions were as follows:

1. Please rank the importance of the following factors on the effectiveness of telehealth treatment from very important to not important:
   - child’s age
   - child/caregiver interaction
   - child’s diagnosis
   - home environment
   - child’s behavior
   - quality of the Internet connection
   - therapist’s skill
   - family factors

2. Please explain your experiences with the factors above and how they may or may not affect the effectiveness of telehealth services.

3. From your experience, what are the greatest barriers to effectively delivering telehealth services?

4. From your experience, what are the greatest facilitators to effectively delivering telehealth services?

**Analysis of Survey Data:** Braun and Clarke’s thematic analysis method was used to analyze the 3 open-ended questions. All 3 researchers performed initial coding using descriptive codes. Researchers met and compared initial codes, reconciling any differences and establishing a codebook of codes and code descriptions. Each researcher

**Barrier:** “Families have only landlines, others don’t want to use their data minutes on phone for the visits because they don’t have enough money to pay overage fees.

**Resilience:** Included a change in mindset while adopting an unknown service delivery model and embracing new roles during physical therapy sessions.

**Facilitator:** “Just being open to knowing that any little morsel of help is something and allowing patience and knowing that we will learn more and become more effective as we continue in these ways.”

**Barrier:** “Honestly if the parent and therapist expect the therapist to “treat” the kiddo it’s a short visit. Lots of parent coaching needed.”

**Sub-themes**

**Personal Attributes:** Included respondent perceptions of important caregiver, child, and PT factors contributing to the effectiveness of telehealth.

**Facilitator:** Caregiver: “Caregiver that is comfortable with being uncomfortable (either in learning their own new motor skills—or working through the children doing ‘work’ rather than just playing/caregiving).” Child: “Good attitude and willingness of the kids.”

**Physical therapist:** “Parent coaching using a reflective practice model.”

**Barrier:** Caregiver: “Overwhelmed families who feel therapy is the last thing they want to deal with.”

**Equity:** Respondents described aspects of equity as positively or negatively impacting access to telehealth.

**Facilitator:** “Good connectivity and access to a device.”

**Barrier:** “In rural settings poor Internet speed and computer/technology access is a factor.”

**COVID-Specific Considerations:** Arose because of the unique experience of providing telehealth during the pandemic. The experience of providing and receiving services during a pandemic is likely to be different than other times.

**Facilitator:** “Availability of the family during the COVID-19 crisis.”
<table>
<thead>
<tr>
<th>Study Details</th>
<th>Patients/Interventions</th>
<th>Intervention/Outcomes</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>performed secondary coding for an individual question, beginning to develop categories. Categories were further collapsed and themes developed. The research team collaborated to identify themes consistent among the 3 open-ended questions of interest. Trustworthiness was established by using a well-accepted analysis method. In addition, study authors allowed respondents to skip questions if desired. The authors analyzed the multipart Likert scale question by grouping &quot;very important&quot; and &quot;important&quot; responses together for each factor and calculating percentages and confidence limits using SAS (SAS, Cary, North Carolina). <strong>Primary Outcomes:</strong> Perceptions of pediatric PTs in the United States on determinants of the effectiveness of telehealth sessions in the midst of the COVID-19 pandemic. <strong>Follow-up:</strong> NR</td>
<td></td>
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</tbody>
</table>

**Barrier:** “This pandemic has created added difficulties because many families have multiple children on a virtual platform. Many families are just overwhelmed due to parents working from home and children’s schedules with virtual learning.”

CI: confidence intervals; COPD: chronic obstructive pulmonary disease; DHT: digital health technology; DR: day rehabilitation; F2F: face-to-face; ICT: information and communication technology; IT: information technology; N/OPSC&MDS: Neurosurgical & Orthopaedic Physiotherapy Screening Clinic and Multidisciplinary Service; NR: not reported; PT: physical therapist; RCT: randomized controlled trial; TDF: Theoretical Domains Framework; TR: telerehabilitation; VC: virtual consultations
Appendix B. References


120. Chumble NR, Quigley P, Li X, et al. Effects of telerehabilitation on physical function and disability for stroke patients: A randomized, controlled trial. *Stroke*. 2012;43(8):2168-2174. doi:[http://dx.doi.org/10.1161/STROKEAHA.111.646943](http://dx.doi.org/10.1161/STROKEAHA.111.646943)


169. Lawford BJ, Bennell KL, Campbell PK, Kasza J, Hinman RS. Therapeutic alliance between physiotherapists and patients with knee osteoarthritis consulting via telephone: a


180. Baadjou VA, Hollander MD, Meulenbroek TV, Verbunt JA, Timmers I. Clinicians' initial experiences of transition to online interdisciplinary pain rehabilitation during the COVID-19


Appendix C. Excluded Studies

Table 3. Excluded Studies

<table>
<thead>
<tr>
<th>Reference</th>
<th>Reason for Exclusion</th>
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<tr>
<td>Bennell et al. 2021</td>
<td>Does not address barriers/facilitators to care.</td>
</tr>
<tr>
<td>Heiskanen et al. 2021</td>
<td>Does not address barriers/facilitators to care.</td>
</tr>
<tr>
<td>Tully et al. 2021</td>
<td>Included studies do not focus on physical therapy interventions.</td>
</tr>
<tr>
<td>Baadjou et al. 2020</td>
<td>Mixed clinical population, does not focus on physical therapy.</td>
</tr>
<tr>
<td>Odole et al. 2020</td>
<td>Does not address barriers/facilitators to care.</td>
</tr>
<tr>
<td>Lawford et al. 2019</td>
<td>Does not address barriers/facilitators to care.</td>
</tr>
<tr>
<td>Lawford et al. 2019</td>
<td>Does not address barriers/facilitators to care.</td>
</tr>
<tr>
<td>Lovo et al. 2019</td>
<td>Does not address barriers/facilitators to care.</td>
</tr>
<tr>
<td>Brouns et al. 2018</td>
<td>Does not address barriers/facilitators to care.</td>
</tr>
<tr>
<td>Lawford et al. 2018</td>
<td>Does not address barriers/facilitators to care.</td>
</tr>
</tbody>
</table>

Appendix A.

1 Literature Search Strategy

2 | Name | Date Limits | Platform/Provider |
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Bibliographic Databases</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Cumulative Index to Nursing and Allied Health Literature (CINAHL)</td>
<td>January 1, 2010 through July 26, 2021</td>
<td>EBSCO</td>
<td></td>
</tr>
<tr>
<td>EMBASE (Excerpta Medica) and MEDLINE</td>
<td>January 1, 2010 through July 26, 2021</td>
<td>Elsevier</td>
<td></td>
</tr>
<tr>
<td>PubMed (In-process and Publisher records)</td>
<td>January 1, 2010 through July 26, 2021</td>
<td>NLM</td>
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</tr>
</tbody>
</table>

3 EMBASE and MEDLINE with EMBASE.com syntax

<table>
<thead>
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<th>Set #</th>
<th>Concept</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Population: patients (or caregivers) seeking or enrolled in physical therapy</td>
<td>’athletic rehabilitation’/de OR ’functional training’/de OR ’geriatric rehabilitation’/de OR ’physical medicine’/exp/mj OR ’physiotherapy’/exp/mj OR ’pulmonary rehabilitation’/de OR ’rehabilitation care’/de</td>
</tr>
<tr>
<td>#2</td>
<td></td>
<td>((’physical therapy’ OR therapeutic* OR physiotherapy* OR exercise*) AND rehabilitation):ti,ab,kw OR ’exercise rehabilitation’:ti,ab,kw OR exercise-training:ti,ab,kw OR (physical NEXT/2 therap*):ti,ab,kw</td>
</tr>
<tr>
<td>Set #</td>
<td>Concept</td>
<td>Strategy</td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
<td>----------</td>
</tr>
<tr>
<td>#3</td>
<td>((rehabilitation OR rehabilitate OR physiotherapy OR ‘physcial therapy’ OR (phys* NEXT/2 therapy)):ti</td>
<td></td>
</tr>
<tr>
<td>#4</td>
<td>#3 AND ((replace*:ti OR arthroplasty*:ti) AND (knee* OR hip OR joint)):ti,ab,kw</td>
<td></td>
</tr>
<tr>
<td>#5</td>
<td>#3 AND ((back NEXT/3 pain*) OR ‘cerebrovascular accident’ OR ‘chronic obstructive pulmonary disease’ OR COPD OR CHF OR disability OR disabilities OR injur* OR ‘low back pain’ OR ‘motor performance’ OR post-surg* OR recover* OR spine OR spinal OR stroke):ti,ab</td>
<td></td>
</tr>
<tr>
<td>#6</td>
<td>Combine 1 OR #2 OR #4 OR #5</td>
<td></td>
</tr>
<tr>
<td>#7</td>
<td>Interventions: telehealth, telemedicine, televideo, etc.</td>
<td>‘teleconference'/de OR ‘teleconsultation'/de OR ‘telediagnosis'/de OR ‘telehealth'/exp/mj OR ‘telemedicine'/exp/mj OR ‘telerehabilitation'/de OR ‘teletherapy'/de OR ‘videoconferencing'/de OR ‘virtual rehabilitation system'/de OR (‘health care delivery'/exp/mj AND (teleconsult* OR telerehab* OR televideo* OR videoconferencing*: OR virtual OR remote OR synchronous)):ti</td>
</tr>
<tr>
<td>#8</td>
<td>(“e health*” OR “e care” OR “e consult*” OR “e medicine” OR “e therap*” OR ((distan* OR electronic OR remote* OR video* OR virtual OR real-time OR ‘real time’ OR realtime OR synchronous) NEAR/2 (care OR communicat* OR conferenc* OR consult* OR monitor* OR health* OR rehab* OR therap* OR treatment”)):ti,ab</td>
<td></td>
</tr>
<tr>
<td>#9</td>
<td>(tele NEXT/1 (car* OR conferenc* OR consult* OR counsel* OR health OR homecare* OR intervention* OR manag* OR medicine OR refer* OR support* OR therap* OR treat* OR visit*)):ti,ab</td>
<td></td>
</tr>
<tr>
<td>#10</td>
<td>(ecare OR econsult* OR ehealth* OR emedicine* OR etherap* OR ‘interactive virtual rehabilitation’ OR internet-based OR mhealth* OR ‘remote rehab*’ OR ‘remote technolog*’ OR telecare* OR teleconference* OR teleconsult* OR telecounsel* OR telehealth OR telehomecare* OR teleintervention* OR telemanag* OR telemed* OR telerefer* OR telerehab* OR tele-rehab* OR telesupport* OR teletherap* OR teletreat* OR teleypsych* OR ‘videoconf*’ OR ‘video conf*’ OR ‘virtual rehab*’ OR zoom OR skype):ti,ab,kw</td>
<td></td>
</tr>
<tr>
<td>#11</td>
<td>Home based care ('home based' OR ‘in home’ OR ‘at home’ OR telerehab*):ti,ab AND (synchronous OR ‘real time’ OR virtual OR ‘real time’):ti</td>
<td></td>
</tr>
<tr>
<td>#12</td>
<td>Computer/Electronic applications 'android'/de OR ‘iphone’/de OR ‘mobile health application’/de OR ‘mobile phone’/exp OR ‘rehabilitation software’/exp OR ‘self-care software’/exp OR ‘smartphone’/de OR ‘web-based intervention’/de</td>
<td></td>
</tr>
<tr>
<td>#13</td>
<td>(Android* OR app OR apps OR cellphone* OR cell-phone* OR computer OR ‘computer based’ OR digital OR email OR ‘e mail’ OR facetime OR ‘face time’ OR internet OR mhealth* OR ‘m health’* ‘internet based’ OR ipad* OR iphone* OR online OR ‘on line’ OR ‘mobile health’ OR (mobile NEXT/3 health) OR smartphone* OR ‘smart phone*’ OR tablet* OR ‘technology supported management’ OR ‘technology based intervention*’ OR text OR texting OR texts OR ‘web based’):ti,ab</td>
<td></td>
</tr>
<tr>
<td>#14</td>
<td>Remote monitoring ‘online monitoring’/de OR ‘telemonitoring’/de OR ‘telemonitor’ OR ((digital OR ‘distant’ OR remote* OR synchronous OR video* OR virtual): NEAR/2 monitor'):ti,ab OR ‘wearable sensor*’:ti,ab</td>
<td></td>
</tr>
<tr>
<td>#15</td>
<td>Remote coaching (((‘home based’ OR remote OR telerehab*) AND coach*) OR ‘remote coaching’ OR telecoach* OR ‘tele coach*’):ti,ab,kw</td>
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</tr>
<tr>
<td>#16</td>
<td>Combine interventions #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15</td>
<td></td>
</tr>
<tr>
<td>#17</td>
<td>Combine population and interventions (KQ1 through KQ5) #6 AND #16</td>
<td></td>
</tr>
<tr>
<td>Set #</td>
<td>Concept</td>
<td>Strategy</td>
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</tr>
<tr>
<td>#18</td>
<td>Population KQ7, KQ8 Patient seeking and enrolled in PT</td>
<td>‘athletic rehabilitation’/de OR ‘functional training’/de OR ‘geriatric rehabilitation’/de OR ‘physical medicine’/exp/mj OR ‘physiotherapy’/exp/mj OR ‘pulmonary rehabilitation’/de OR ‘rehabilitation care’/de</td>
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<td></td>
<td>#18 OR #19 OR #21 OR #22 OR #23</td>
</tr>
<tr>
<td>#22</td>
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<td>#3 AND ((replace*:ti OR arthroplasty*:ti) AND (knee* OR hip OR joint)):ti,ab,kw</td>
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<td>#23</td>
<td>PTs providing PT via telehealth</td>
<td>‘physiotherapist’/de OR ‘physiotherapy practice’/de OR ‘physical therapist’<em>:ti,ab OR ((‘health care professional’/exp OR ‘outpatient department’/de OR ‘professional practice’/exp) AND (‘physical therapist’</em>:ti OR physiotherapy’*:ti))</td>
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<td>Combine population (KQ7, KQ8)</td>
<td>#18 OR #19 OR #21 OR #22 OR #23</td>
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<tr>
<td>#25</td>
<td>Barriers – providers</td>
<td>‘health personnel attitude’/exp OR ‘barrier’ OR (accept OR acceptance OR adapt* OR attitude* OR perception* OR prefer* OR dissatisfied OR dis-satisfied OR barrier* OR challenge* OR concern* OR difficult* OR disadvantage* OR hurdle* OR issue* OR obstacle*):ti</td>
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<td>‘clinical competence’/exp OR ‘competence’/exp OR ‘competency’/de OR ‘logistics’/de OR (competen* OR logistic* OR prepar* OR security OR set-up OR setup OR training OR toolkit OR tools OR resources OR platform OR software OR equipment OR laptop* OR computer OR broadband OR broadband):ti</td>
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<td>‘confidentiality’/exp OR ‘informed consent’/exp OR ‘medical liability’/exp OR ‘insurance’/exp OR ‘legal liability’/exp OR ‘malpractice’/exp OR ‘medicare’/exp OR ‘medicaid’/exp OR ‘health insurance’/exp OR ‘reimbursement’/exp OR (comply OR compliance OR confidential* OR ethic* OR ‘informed consent’ OR govern* OR manage* OR protocol* OR “HIPAA” OR laws OR legal* OR legislat* OR liability OR liabilities OR regulate* OR regulation* OR privacy OR protect* OR consent* OR malpractice OR cost OR costs OR economic* OR expenditure* OR insurance* OR Medicaid OR medicare OR payor* OR payer* OR payment OR reimburs* OR financ*):ti</td>
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<td>Barriers – patients</td>
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<tr>
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<td>Combine barriers – providers or patients</td>
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<td>#30</td>
<td>Combine population (KQ7, KQ8) and barriers</td>
<td>#24 AND #29</td>
</tr>
<tr>
<td>#31</td>
<td>Final sets</td>
<td>#17 OR #30</td>
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**Apply Limits**

<p>| #32 | | #31 AND [2010-2021]/py AND [English]/lim AND [humans]/lim |</p>
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<th>Concept</th>
<th>Strategy</th>
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</thead>
<tbody>
<tr>
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<td>#32 NOT (((animals)/lim NOT [humans]/lim) OR (animal* OR experimental OR (vitro NOT vivo) OR canine OR dog OR dogs OR mouse OR mice OR murine:ti OR pig OR pigs OR piglet* OR porcine OR rabbit* OR rat OR rats OR rodent* OR sheep OR swine):ti)</td>
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<td>#35</td>
<td>#34 AND ('meta analysis'/exp OR 'systematic review'/de OR [cochrane review]/lim OR systematic*:ti OR (cochrane OR metaanaly* OR &quot;meta analy&quot; OR (search* AND (databases OR electronic OR methodolog* OR embase* OR ebsco* OR medline* OR ovid* OR scencedirect* OR scopus* OR systematic OR web)) OR (systematic* NEAR/2 review*)):ti,ab)</td>
<td>#34 AND ('random sample'/de OR 'randomized controlled trial'/de OR randomization/de OR (random* OR RCT):ti,ab)</td>
</tr>
<tr>
<td>#36</td>
<td>#34 AND ('random sample'/de OR 'randomized controlled trial'/de OR randomization/de OR (random* OR RCT):ti,ab)</td>
<td>#34 AND ('cohort analysis' OR 'comparative study'/exp OR 'controlled study'/exp OR 'evaluation study'/de OR 'longitudinal study'/de OR 'major clinical study'/de OR 'observational study'/de OR 'prospective study'/de OR 'retrospective study'/de OR 'treatment outcome'/de OR 'between groups':ti,ab OR 'case control':ti,ab OR cohort*:ti,ab OR compar*:ti,ab OR 'control group':ti,ab OR 'controlled study':ti,ab OR 'controlled trial':ti,ab OR 'cross over':ti,ab OR crossover:ti,ab OR 'double blind':ti,ab OR 'double blinded':ti,ab OR longitudinal:ti,ab OR 'matched controls':ti,ab OR ((observational NEXT/3 study):ti,ab) OR placebo*:ti,ab OR prospective:ti,ab OR retrospective:ti,ab OR random*:ti,ab OR sham:ti,ab OR versus:ti OR vs:ti)</td>
</tr>
<tr>
<td>#37</td>
<td>#34 AND ('cohort analysis' OR 'comparative study'/exp OR 'controlled study'/exp OR 'evaluation study'/de OR 'longitudinal study'/de OR 'major clinical study'/de OR 'observational study'/de OR 'prospective study'/de OR 'retrospective study'/de OR 'treatment outcome'/de OR 'between groups':ti,ab OR 'case control':ti,ab OR cohort*:ti,ab OR compar*:ti,ab OR 'control group':ti,ab OR 'controlled study':ti,ab OR 'controlled trial':ti,ab OR 'cross over':ti,ab OR crossover:ti,ab OR 'double blind':ti,ab OR 'double blinded':ti,ab OR longitudinal:ti,ab OR 'matched controls':ti,ab OR ((observational NEXT/3 study):ti,ab) OR placebo*:ti,ab OR prospective:ti,ab OR retrospective:ti,ab OR random*:ti,ab OR sham:ti,ab OR versus:ti OR vs:ti)</td>
<td>Combine final sets #35 OR #36 OR #37</td>
</tr>
</tbody>
</table>
Appendix B. List of All Included Studies by Key Question

Key Question 1/3: For patients seeking or enrolled in physical therapy, what is the efficacy of providing 100% telerehab or hybrid care compared to traditional in-person care for patient clinical and functional outcomes?


Key Question 2: In patients seeking physical therapy, what is the accuracy of telerehab compared to traditional in-person care for diagnosing conditions requiring physical therapy?

Key Question 4: For patients enrolled in physical therapy, what is the efficacy of providing 100% telerehab or hybrid care compared to traditional in-person care for occurrence of adverse/negative events?


Key Question 5: For patients enrolled in physical therapy, what is the result of providing 100% telerehab or hybrid care compared to traditional in-person care on user acceptability/usability?


Key Question 6: For patients enrolled in physical therapy, what is the cost-effectiveness of providing telerehab compared to traditional in-person care?


Key Question 7: What are the facilitators and barriers to telehealth implementation for patients?


**Key Question 8: What are the facilitators and barriers to telehealth implementation for providers?**


