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Original Research

Is Telerehabilitation a Viable Option for People With Low Back Pain? Associations Between Telerehabilitation and Outcomes During the COVID-19 Pandemic

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Abstract

Objective. The aims of this study were to examine associations between frequency of telerehabilitation (TR) and outcomes of functional status (FS), number of visits, and patient satisfaction during COVID-19 and to compare FS outcomes by TR delivery mode for individuals with low back pain.

Methods. Propensity score matching was used to match episodes of care with or without TR exposure by the probability of receiving TR. FS, visits, and satisfaction were compared for individuals without TR and those who received care by TR for "any," "few," "most," or "all" frequencies (4 matched samples), and FS was compared for individuals receiving synchronous, asynchronous, and mixed TR modes (3 matched samples). Standardized differences were used to compare samples before and after matching. Outcomes between matched samples were compared using *z* tests with 95% CI.

Results. The sample consisted of 91,117 episodes of care from 1398 clinics located in 46 states (58% women; mean age = 55 [SD = 18]). Of those, only 5013 episodes (5.5%) involved any amount of TR. All standardized differences between matched samples were <0.1. There was no significant difference in FS points (range = 0–100, with higher representing better FS) between matched samples, except for episodes that had "few" (−1.7) and "all" (+2.0) TR frequencies or that involved the asynchronous (−2.6) TR mode. These point differences suggest limited clinical importance. Episodes with any TR frequency involved significantly fewer visits (0.7–1.3) than episodes with no TR, except that those with the "most" TR frequency had non-significantly fewer visits (0.6). A smaller proportion of individuals with TR (−4.0% to −5.0%) than of individuals with no telerehabilitation reported being very satisfied with treatment results, except for those with the "all" TR frequency.

Conclusions. A positive association between TR and rehabilitation outcomes was observed, with a trend for better FS outcomes and fewer visits when all care was delivered through TR. Satisfaction tended to be lower with TR use. Overall, this observational study showed that for people with low back pain, physical therapy delivered through TR was equally effective as and more efficient than in-person care, with a trend of higher effectiveness when used for all visits during the episode of care. No differences in FS outcomes were observed between care delivered with synchronous and mixed TR delivery modes and care delivered with no TR. However, the asynchronous mode of TR was associated with worse functional outcomes than no TR. Although the majority of people were very satisfied with their treatment results with and without TR, very high satisfaction rates were reported by a slightly smaller proportion of individuals with TR versus those without TR. Our results suggest that TR is a viable option for rehabilitation care for individuals with low back pain and should also be considered in the post–COVID-19 era.

Keywords: Low Back Pain, Outcomes, Physical Therapy, Telerehabilitation

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Introduction

Telerehabilitation (TR) is increasingly recognized as a promising approach to managing individuals with chronic conditions during the Coronavirus pandemic (COVID-19).[1–6] Concomitant with the increased use of the internet as a tool to provide rehabilitation services, numerous, recent studies and systematic reviews reported that TR compared with usual care is an effective alternative care model for the management of individuals with chronic pain conditions, including low back pain.[7–10] However, the evidence supporting the effectiveness of TR for these people is still limited, partly because of methodological weaknesses in available studies, including very small sample sizes (<100) and inadequate control for the heterogeneous nature of patient characteristics.[11–13] In addition, little is known about the optimal TR frequency and mode of delivery to provide the greatest clinical improvement and best patient outcomes.[9,10,12,14,15]

A number of papers have discussed TR care for musculoskeletal and chronic pain conditions in the wake of COVID-19.[3,12,16,17] However, we are aware of only 3 studies published since the onset of the pandemic that examined clinical feasibility, patient characteristics and conditions, and/or outcomes of TR.[4,18,19] Negrini et al demonstrated that a complete shift from traditional in-person clinic care to telehealth services for 1 tertiary outpatient institute in Italy during the COVID-19 pandemic was feasible and acceptable for their medical professionals to provide ambulatory services with high levels of patient satisfaction.[18] In another recent study, Miller et al evaluated telehealth physical therapy implementation at the beginning of the pandemic (March 16 to May 16, 2020) and reported that implementation of telehealth physical therapy during COVID-19 was feasible and acceptable for both patients and physical therapists.[4] Both of these studies, however, were limited to 1 clinical setting, and results may not be generalizable. Werneke et al reported a very low adoption rate (6%) of TR by clinicians working in rehabilitation outpatient clinics in the United States during the pandemic between April 30 and September 30, 2020.[19] The authors also reported important differences in patient characteristics between those episodes with and without TR, thereby requiring risk adjustment of these patient characteristics in order to meaningfully interpret outcome comparisons between TR and no-TR subgroups.[19]

Pruv-Bettger and Resnik recently recommended rapid-cycle research, using existing and large patient database systems, to provide timely clinical insights on how TR care has affected rehabilitation practice.[16] The authors recommended examining TR outcome data documented by physical therapists working in everyday clinical practice to identify best clinical practices and rehabilitation therapy care models for administering TR during and after COVID-19.[16]

To address the methodological weaknesses of prior studies examining TR effectiveness, scant knowledge regarding optimal TR frequency and delivery modes, and the call for rapid-cycle research in the wake of COVID-19, we conducted a retrospective observational outcome study using a preexisting national patient database found suitable for examining TR data collected during COVID-19.[19] In this study, we aimed to examine associations between TR frequency during the episode of care and outcomes (functional status [FS], number of visits, and patient satisfaction during COVID-19) and to compare FS outcomes by TR delivery mode for individuals with low back pain.

Methods

Design and Data Collection

This was an observational retrospective study examining data from a large national patient database collected routinely in outpatient rehabilitation therapy clinics in the United States. Data included diverse patient characteristics and standardized documentation of TR use in outpatient clinics.[19] Participating clinics routinely collect patient demographics, health characteristics, and outcomes using the Patient Inquiry software developed by Focus on Therapeutic Outcomes, a Net Health (Pittsburgh, PA, USA) company that provides outcomes management software solutions for rehabilitation therapists.[19,20] Individuals who were experiencing low back pain, who were 14 to 89 years old, and for whom complete intake and discharge outcome data were included if their episode of care started no earlier than the fourth quarter 2019, were discharged by the therapist/staff between April 30, 2020, and March 31, 2021, and were treated at clinics that used TR during the study period. We analyzed each episode separately; therefore, we refer to episodes of care as patients. The study was approved by Solutions Institutional Review Board (Yarnell, AZ, USA).

Telerehabilitation

Data on the frequency of TR visits within each episode were reported by patients using the following question administered during each status survey administered during the episode of care: "How many of your current therapy visits have taken place over the internet or by phone (telehealth) instead of in the clinic?" Data from the last status survey were used to identify the final TR use and final discharge outcome. Patient response options were: none, few, most, and all. This question was administered beginning April 30, 2020. We operationally defined frequency or amount of TR delivered during the episode of care in 2 ways: dichotomously (ie, "any" vs "none") and categorically (ie, categories: "few" visits [less than one-half of the total episode visits were administered with TR], "most" visits [one-half or more, but not all, of the total episode visits were administered with TR], and "all" visits [all visits during the episode of care were administered with TR]). On August 4, 2020, a second question was added such that if the patient responded that any TR was administered, the patient was asked: "Which of these was used in your telehealth care? (Select all that apply.)" Patient response options were video call, audio call (without video), text or email messaging, links to video materials (such as YouTube clips), and other. Patient responses were categorized as synchronous real-time communication between clinician and patient (video or audio), asynchronous electronic visits not in real time (no video and no audio), and mixed if the episode of care included both synchronous and asynchronous telecommunication modes. No TR was defined as episodes of care in which treatment was delivered fully during in-person clinic visits without any TR use.

Outcomes

Effectiveness: FS

FS was assessed at intake and discharge using the Lumbar Computer Adaptive Test (LCAT) patient-reported outcome measure. The LCAT has been described previously in detail and supported for score reliability, construct validity, responsiveness, and clinical interpretability.[21–23] LCAT scores are on

a linear metric from 0 to 100, with higher scores indicating better FS. An average of 5 or more FS change points using the LCAT measure can be considered a clinically meaningful improvement.[23] The LCAT item bank captures patients' perception of their ability to perform physical activities at home, at work, and in recreation, all of which represent the "activity" and "participation" dimensions of the World Health Organization International Classification of Functioning, Disability and Health.[24]

Efficiency: Number of Visits

For our study, the authors did not have access to direct and indirect costs related to TR use. The number of therapy visits was used as a proxy to estimate trends in direct costs and health care usage incurred by TR as recommended in a recent systematic review by van der Meij.[25] The actual number of visits during the episode of care was documented by the treating rehabilitation therapist at patient discharge.

Patient Satisfaction

Data on patient satisfaction with treatment results were collected using a question that was administered during the patient's discharge survey: "How satisfied were you with overall results of your treatment at this facility?" Patient response categories were as follows: very satisfied, somewhat satisfied, neither satisfied nor dissatisfied, somewhat dissatisfied, or very dissatisfied. Because of our prior experience analyzing satisfaction data, we anticipated that a large ceiling effect would be observed. Therefore, for this study, patient satisfaction with treatment results was dichotomized as very satisfied versus all other categories, and rates of being very satisfied were calculated.

Data Analyses

Study Samples and TR Use

Health and demographic patient characteristics as well as TR variables were summarized using distribution or dispersion measures as appropriate. Standardized differences were used to compare baseline patient characteristics between patients with or without TR for the main study sample and the subsample that responded to the second TR question regarding TR delivery mode. Unlike *P* values, standardized difference analyses are not influenced by sample size and can be interpreted as an effect size, with values of 0.2, 0.5, and 0.8 representing thresholds of small, medium, and large effect sizes, respectively.[26] We selected a threshold of >0.1 as recommended to interpret standardized difference values that suggest clinically important differences.[27] To estimate whether the utilization of TR had changed over the course of the early pandemic, we described TR utilization during the second, third, and fourth quarters of 2020 and the first quarter of 2021. Additionally, we calculated percentages of patients receiving "any," "few," "most," or "all" TR frequency amounts, and TR telecommunication technology delivery modes (ie, synchronous, asynchronous, and mixed).

Propensity Score Matching (PSM)

Outcomes were compared by TR frequency amounts and the telecommunication delivery modes. A PSM approach was used to match patients with TR to similar patients without TR for baseline patient variables known to be associated with FS outcomes.[28] PSM models were developed for the 3 outcomes (FS, number of visits, and satisfaction) across the 4 TR frequency amounts (4 matched samples) and FS outcome for each of the 3 TR telecommunication delivery modes (3 matched samples). PSM allows observational data analyses to mimic some of the design advantages of a randomized controlled trial, by reducing the effects of potential confounding baseline patient covariates, to estimate an exposure effect on outcomes.[29] The use of PSM to study TR was recently recommended by the Learning Health Systems Task Force of Academy Health[16] and was selected for this study for its ability to reduce or marginalize the effects of potential confounding of observed baseline patient covariates when analyzing observational data to estimate exposure effect on outcomes. PSM model diagnostics were examined by using the Stata (StataCorp LLC, College Station, TX, USA) module boxtid for the Box-Tidwell tests to assess the linearity of the continuous independent variables (age, intake FS, duration). If the Box-Tidwell test was significant, then we used the suggested transformed covariates for the logistic regression model as well as the corresponding treatment effect results. Baseline patient variables included 14 constructs: FS at intake (continuous); age (continuous); sex (male/female); practice type (3 categories); acuity of the treated condition, defined as days since onset (6 categories); type of payer (10 categories); rural–urban commuting area (5 categories)[30]; census divisions in the United States (9 categories); surgical history for low back pain (4 categories); postsurgical procedures (2 categories); exercise history (3 categories); use of medication at intake for the treatment of low back pain (yes/no); previous treatment for low back pain (yes/no); and 32 specific comorbidities. Matching was also done for duration in days from intake to discharge and time of discharge by quarters from the second quarter of 2020 to the first quarter of 2021. Episode duration was controlled because it could be associated with the natural history of improved FS, number of visits, and/or satisfaction outcomes. Period of discharge was controlled because our prior results demonstrated variability in TR use during the pandemic, that is, a 50% reduction in TR use between the second and third quarters of 2020 and the possibility that changes in COVID-19 lockdown restrictions during the study period could have affected how TR was used over time.[19]

Matching was done on all baseline patient variables using the "nearest neighbor" method with a propensity score caliper of 1% (0.01) and a matching ratio of 1:1 with replacements.[29,31] For each PSM model, if not all patients with TR were matched to patients with no TR using a caliper of 1%, then the caliper was subsequently increased iteratively by 0.1% (0.001) until matching was obtained for all patients. The propensity score was defined by logistic regression as the probability of being exposed to the administration of TR (yes/no) after controlling for all variables in the model. Standardized difference values of <0.1 were suggested to represent clinically negligible differences and support that successful matching was achieved for the purpose of PSM.[27]

All PSM models were developed using the Stata module teffects psmatch. Outcomes of TR and their matched samples without TR were compared using *z* tests with 95% CI.[32,33] The alpha value was set to .05. All analyses were conducted using Stata version 14.[34]

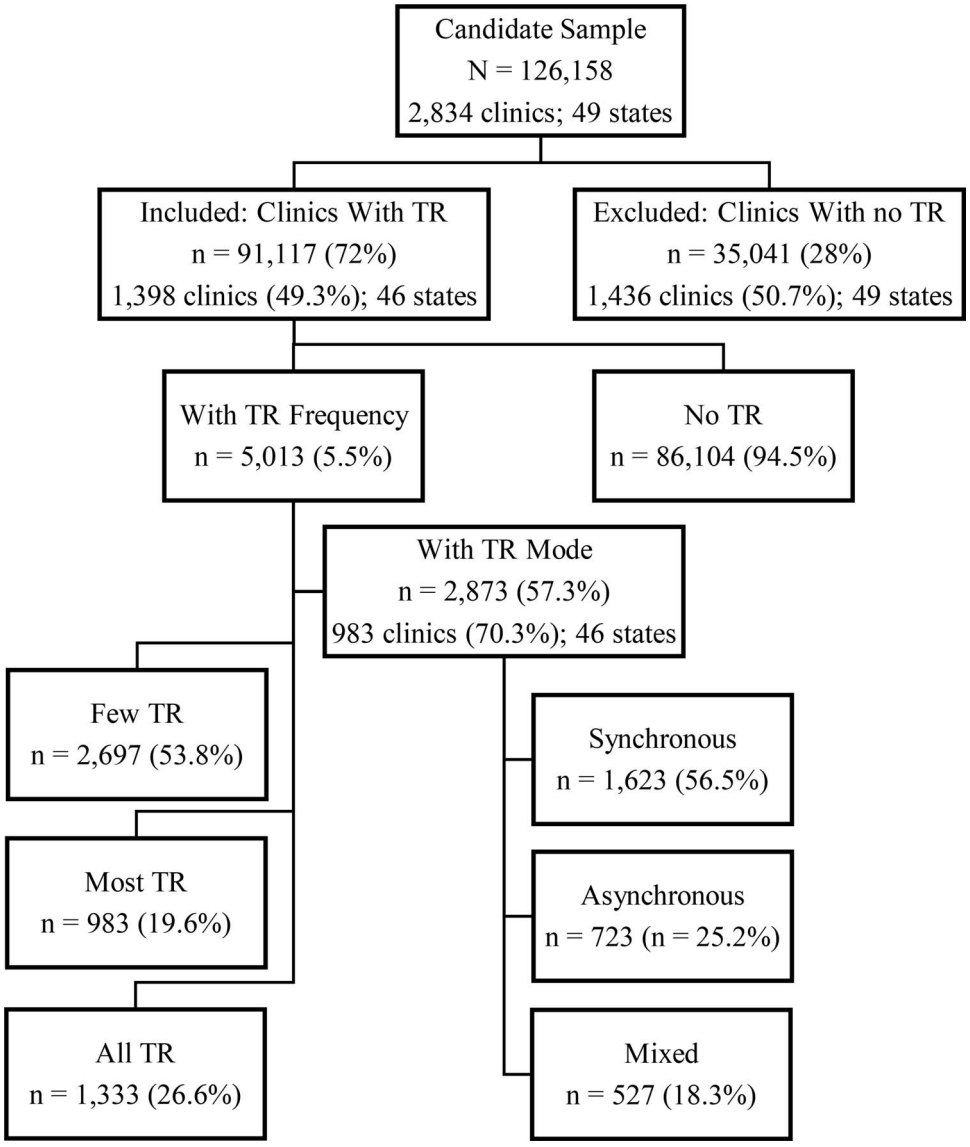

Figure 1. Patient sampling. Telerehabilitation (TR) frequencies: "any" TR = TR care regardless of the frequency amount; "few" TR = less than one-half of the total episode visits were administered with TR; "most" TR = one-half or more, but not all, of the total episode visits were administered with TR; "all" TR = all visits during the episode of care were administered with TR. TR delivery modes: synchronous = real-time 2-way interactive media, such as video and/or audio calls; asynchronous = electronic visits not in real time, such as virtual check-ins, recorded videos, or applications/links to exercises and educational platforms; mixed = both synchronous and asynchronous delivery modes were used during the episode of care.

Results

Candidate Sample and Analytic Sample

The entirety of episodes recorded in the data source comprised the candidate sample of 126,158 patients treated at 2834 outpatient rehabilitation clinics located in 49 states (United States) (Fig. 1). Patients from clinics using "any" frequency amount of TR comprised the analytic sample and consisted of 91,117 patients (72%) (58% female; mean age = 55 [SD = 18]; age range = 14–89 years) treated at 1398 clinics (49%) located in 46 states. Fifty-nine percent of clinics in the analytic sample were large (ie, 4 or more clinicians), whereas only 26% of the clinics not included in the analytic sample were large. There were similar proportions of practice types in clinics included and excluded from the analytic sample, with a slightly higher rate of hospital outpatient clinics in the analytic sample (20%) than in the excluded clinics (18%), and there was a slightly lower rate of private practices in the analytic sample (79%) than in the excluded clinics (80%).

Analytic Sample (Clinics With TR)

Among clinics that utilized TR, the rate of episodes of care with any TR (5013) was 5.5%, decreasing from 13.1% in the second quarter of 2020 to 4.7% in the first quarter of 2021. For patients who received TR, 53.8%, 19.6%, and 26.6% had TR during "few," "most," or "all" visits, respectively. Of the episodes for which TR was used, 2873 (57%) also included the second TR survey question regarding type of telecommunication technology mode. The percentages by TR mode were 56.5%, 25.2%, and 18.3% for synchronous, asynchronous, and mixed modes, respectively.

Supplementary Appendix 1 shows the comparisons of baseline health and demographic patient characteristics for sam-

ples using TR (5013) and no TR (86,104). Of the 90 comparisons between the 2 samples, 26 had standardized differences of ≥0.1, indicating unbalanced samples that required successful matching between the TR and no-TR subgroups for valid outcome comparisons. Baseline health and demographic patient characteristics for samples for which TR (5013) was used, with (2873) or without (2140) TR telecommunication delivery mode data, are reported in Supplementary Appendix 2. Only 4 of the 86 comparisons (excluding the year-quarter variable) had standardized differences of ≥0.1, indicating no systematic selection bias between those with and those without TR mode data.

Comparing Matched Patients With TR and Patients Without TR

The Supplementary Table shows a comparison of the outcomes (FS, number of visits, and satisfaction), and patient characteristics for matched samples without or with TR by TR frequency amounts ("any," "few," "most," and "all"). For each TR frequency model, the standardized differences for patient characteristics was <0.1, suggesting successful matching by TR frequency.

Supplementary Appendix 3 shows FS outcomes and patient characteristics for matched samples without or with TR subgroups by TR delivery mode groups. For each TR delivery mode model, the standardized differences between patient characteristics was <0.1, suggesting successful matching by TR delivery mode.

Outcomes

Comparisons of FS, number of visits, and satisfaction outcomes by TR frequencies and delivery modes for patients receiving TR and patients receiving no TR (represented by the value 0), along with their corresponding 95% CIs and *P* values, are displayed in Figures 2 and 3, respectively.

Functional Status

Episodes with the "all" TR frequency had FS discharge scores 2.0 points higher than those with no TR ($P = .003$). Episodes with the "few" TR frequency had FS scores 1.7 points lower at discharge than those with no TR ($P = .001$) (Fig. 2A). Episodes with asynchronous TR mode had discharge FS scores 2.6 points lower ($P = .006$) than those with no TR (Fig. 3). No other significant differences in FS outcomes between TR and no-TR episodes were observed by TR frequencies or telecommunication delivery mode.

Number of Visits

Episodes using "any," "few," or "all" TR frequencies had 1.0 ($P < .001$), 0.7 ($P = .005$), and 1.3 ($P < .001$) fewer visits, respectively, than no-TR episodes. The number of visits for episodes with the "most" TR frequency was 0.6 fewer compared with those with no TR but was not significantly different ($P = .089$) (Fig. 2B).

Patient Satisfaction

Patients with "any," "few," or "most" TR frequencies were 4.0% ($P < .001$), 4.4% ($P < .001$), and 5.0% ($P = .003$) less likely to be very satisfied with their treatment results than patients with no TR, respectively. The proportion of patients reporting being very satisfied with treatment results was 2.1% lower but not significantly different ($P = .136$) for episodes with the "all" TR frequency than those with no TR (Fig. 2C).

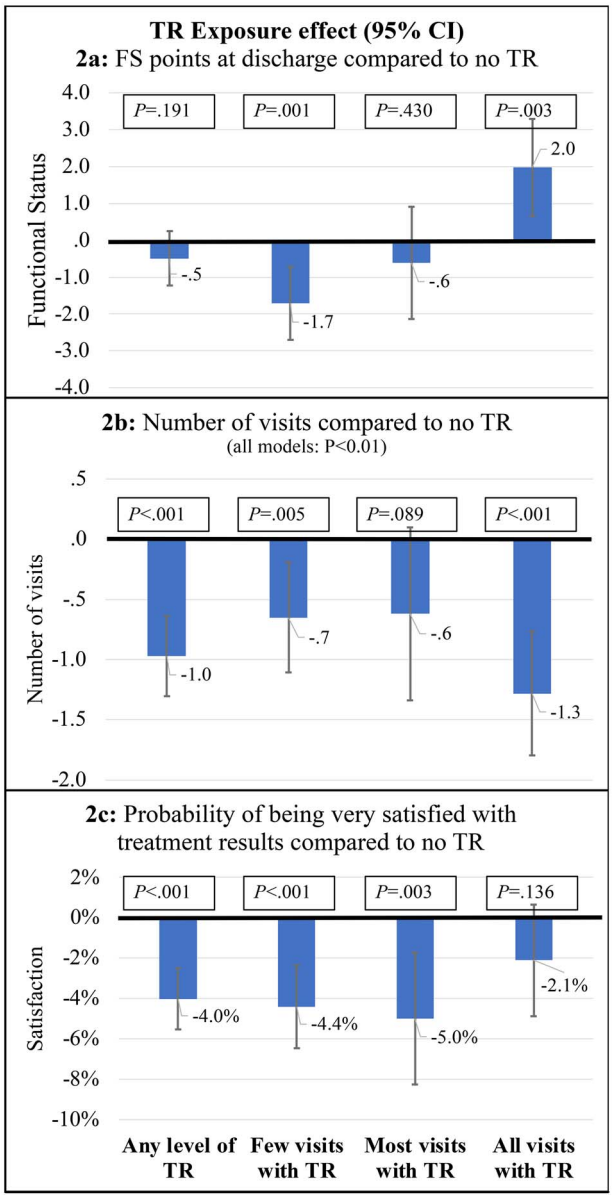

Figure 2. Functional status (FS), number of visits, and satisfaction outcomes by frequency of telerehabilitation (TR) versus no TR. The value of 0 for each outcome represents the comparison group of matched patients with no TR. The 95% CIs of outcomes for patients with TR are shown. TR frequencies: "any" TR = TR care regardless of the frequency amount; "few" visits with TR = less than one-half of the total episode visits were administered with TR; "most" visits with TR = one-half or more, but not all, of the total episode visits were administered with TR; "all" visits with TR = all visits during the episode of care were administered with TR.

Discussion

Major Findings

The 3 major findings for the primary aim of the present study were as follows: the overall results supported TR as an effective care model compared with in-person care alone, with a trend for better FS outcomes when "all" visits were delivered by TR; episodes involving "any" TR frequency

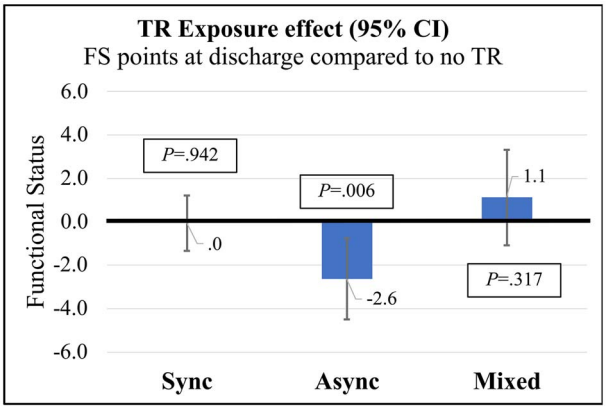

Figure 3. Functional status (FS) outcomes by mode of delivery of telerehabilitation (TR) versus no TR. The value of 0 for each outcome represents the comparison group of matched patients with no TR. The 95% CIs of outcomes for patients with TR are shown. TR delivery modes: synchronous (Sync) = real-time 2-way interactive media, such as video and/or audio calls; asynchronous (Async) = electronic visits not in real time, such as virtual check-ins, recorded videos, or applications/links to exercises and educational platforms; mixed = both synchronous and asynchronous delivery modes were used during the episode of care.

amount assessed had fewer visits than those with no TR, suggesting better efficiency of care; and although the majority of patients were very satisfied with their treatment results with and without TR, very high satisfaction rates were reported by a slightly smaller proportion of patients with TR than by patients without TR. For our second aim, the major finding was that worse FS outcomes were observed when only the asynchronous TR delivery mode was used during the episode of care, compared with not receiving TR. The clinical importance of the significant FS point change differences observed between the TR and no-TR groups may be limited.[22,23]

Effectiveness

Prior studies investigating TR care examined TR in conjunction with usual in-person care[35–42] or in replacement of usual care.[3,13,15,43,44] Collectively, these studies as well as prior systematic reviews demonstrated that TR can provide improvements in FS that are similar or slightly better than traditional in-person care alone for patients with musculoskeletal pain.[10,45] Two other recent reviews suggested that utilizing TR care may optimize the effects of in-person clinic visits in improving FS outcomes for certain low back pain populations.[8,9] Overall, our results are consistent with these findings supporting TR for patients with low back pain as equally effective as usual care, with a statistical trend toward better FS outcomes when TR was used in replacement of in-person office visits. Yet unexpectedly, using TR in conjunction with in-person care for only a "few" visits was associated with slightly lower, that is, 1.7 fewer FS points at discharge.

The underlying mechanism for these differences is not understood. Prior reports suggested that patients who received TR may have been highly motivated to participate in therapy during the pandemic; thereby, they were somehow different than those who did not receive TR and thus more likely to achieve better outcomes.[46] Further research is needed to better understand these findings.

There is no consensus on optimal TR frequency amount for achieving best patient outcomes. In prior research, TR frequency was largely determined by the authors' study's protocol. For examples, the study protocols by Amorin et al and Kloek et al consisted of 12 fixed TR sessions in conjunction with 1 or more in-person clinic visits during the patient's episode of care,[39,47] whereas in another study the authors examined the effect of only 1 TR session on outcomes.[48] In a recent systematic review, O'Brien et al[10] examined the effectiveness of TR interventions for managing spinal pain and cited 5 studies analyzing the associations of TR frequency during the patient's episode of care with patient outcomes.[49–53] Briefly, the authors reported that 3 of these studies found no association between TR frequency and patient outcomes,[49,51,53] and 1 study found greater clinical improvement in physical function for episodes with higher TR utilization.[50] In our study, TR frequency was determined at the discretion of the treating therapist/clinic and was undoubtedly influenced by the patients' preferences and expectations regarding TR treatments, the state of community spread, lockdown orders, and local policies during COVID-19. Future research is warranted to identify optimal TR frequency use to guide clinical decisions to maximize patient outcomes in the post COVID-19 era.

Our results also demonstrated similar FS outcomes for TR synchronous and mixed delivery modes, and lower FS outcomes for asynchronous TR delivery mode, compared with in-person clinic visits alone. We are not aware of other studies examining associations between patient outcomes and TR delivery modes utilized during the COVID-19 pandemic. However, studies prior to the pandemic, in contrast to our findings, reported favorable outcomes using asynchronous TR mode such as automated text messaging or web-based applications.[35,39,44,54,55] Differences between these study findings and our results may be partially explained by the inclusion of different patient samples and educational and website materials as well as the period of data collection. Based on our results, we recommend that asynchronous TR mode be combined with synchronous delivery mode. This combination offers the clinician unique intervention advantages. For example, the synchronous video mode allows the therapist to observe the patient performing usual activities in home or at work while controlling pain. Improving a patient's movement strategies in their own home environment is a plus and cannot in many instances be simulated during an office visit. Asynchronous TR offers the patient a pathway for the therapist to follow-up or check on the patient's progress and home program during treatment and/or after discharge. Future studies examining optimal combinations of TR telecommunication delivery modes and frequency amounts are warranted to identify best clinical practice and patient outcomes.

Efficiency

Our results showed that episodes of care that included "any" TR frequency amount involved fewer total visits compared with traditional in-person physical therapy clinic visits alone. Our efficiency results support the expansion of reimbursement, local and national policies, and regulations addressing TR. That said, we cannot say with certainty whether the decrease in the number of visits observed during the episode of care was due to the use of TR alone or reflects the challenges of delivering rehabilitation services during the COVID-19 pandemic when patients were reluctant to receive in-person care because of health and safety concerns. Prior literature evaluating the effect of TR use on efficiency are scant and

were utilized pre-COVID efficiency data.[25,45] We recommend future research in the post-COVID era to confirm or refute our findings.

Patient Satisfaction

Our findings that most patients are very satisfied with treatment results using either TR or in-person clinic visits are consistent with studies published prepandemic[11,12,40,43,47] or in the wake of COVID-19.[4,18,56] In our study, we also compared satisfaction regarding treatment results by TR frequency. We observed slightly lower rates of patients who reported being very satisfied for any TR frequency amount. Additional research is warranted to identify ways to achieve higher patient satisfaction using TR.

Low TR Administration Rate

Recent studies suggest that telehealth is being rapidly recognized and implemented in the wake of COVID-19.[2,12,16,17] Despite these reports, we observed a very low adoption rate (5.5%) by therapists in our study. A similar low adoption TR rate (6%) during the pandemic was also reported for a variety of orthopedic and neurological conditions.[19] The low adoption rate highlights the significant challenges clinicians and patients face in implementing and using TR during everyday practice. These challenges have been well identified in previous studies.[6,13,17,57] Our results indicating that clinics that used TR were typically larger than those not using TR and that patients living in small towns and rural areas are less likely to receive TR highlight potential TR inequalities created by lack of financial and technological support available to small clinics and unequal access to digital devices or broad band internet services.[46]

Limitations

Caution is recommended to avoid overinterpretation of our outcome results given that TR frequency amount and telecommunication delivery mode were patient reported at discharge and, as such, may have been subject to recall bias. Validating the patient-reported TR frequency amount and modes using medical records data, which were not available to us, are recommended for future research. We were unable to examine patterns in mode of TR telecommunication over time because delivery mode data were not collected between April 30 (start of the study period) and August 4. This was an observational study in which patients were not randomly assigned to treatment groups. Although we successfully matched patients based on measured characteristics, we acknowledge that there may be other important patient and health variables that were not available to us that may have influenced the outcomes.

Our analytic approach has additional limitations. Our approach provided estimates average treatment effects for TR versus non-TR episodes; however, this approach did not examine whether there were specific subgroups of patients who were more or less likely to benefit from TR or specific TR modalities. We did not conduct sensitivity analyses to assess the risk of bias due to unmeasured confounders in our PSM. Such analyses are complex and beyond the scope of this paper. Future studies to assess the robustness of our models are recommended to test how different distributions of potential unobserved confounders might impact findings of positive or negative outcomes.[58] We also acknowledge that some selection bias may exist in that patients who did not have complete outcomes data at intake and discharge were excluded from this study. Lastly, we acknowledge that the satisfaction measure used was not a validated measure and that other measures of treatment satisfaction may have yielded different results.

Our results demonstrate that the use of TR was associated with similar outcomes compared with usual in-person care for individuals experiencing low back pain and managed by rehabilitation therapists in outpatient settings during the COVID-19 pandemic. Although our research found overall similar and acceptable FS outcomes and fewer visits during the episodes of care compared with in-person clinic visits, there were some significant trends and differences observed that could be examined in future studies. For instance, not all frequency amounts and telecommunication delivery modes yielded equivalent FS outcomes between the TR and no-TR groups, and satisfaction with treatment results was slightly lower when TR was used than when no TR was used. Research examining these trends using prospective experimental designs is warranted.

Author Contributions

Concept/idea/research design: M. Werneke, D. Deutscher, D. Hayes
Writing: M. Werneke, D. Deutscher, L. Resnik, D. Grigsby
Data collection: D. Hayes, J. Mioduski
Data analysis: M. Werneke, D. Deutscher, L. Resnik, D. Grigsby
Project management: D. Hayes
Consultation (including review of manuscript before submitting): M. Werneke, D. Deutscher, L. Resnik, D. Grigsby, D. Hayes

Ethics Approval

This study was performed at Net Health Systems, Inc., Pittsburgh, PA, USA.

This study was approved by the institutional review board of Solutions IRB, a private institutional review board located in Yarnell, AZ, USA, and given exempt status based on federal guidelines (IRB #: IORG0007116).

Disclosures

The authors completed the ICMJE Form for Disclosure of Potential Conflicts of Interest and reported no conflicts of interest.

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