Special Contribution

Telehealth in PM&R: Past, present, and future in clinical practice and opportunities for translational research

Adam S. Tenforde MD | Joshua J. Alexander MD | Marcalee Alexander MD | Thiru M. Annaswamy MD, MA | Conley J. Carr MD | Philip Chang DO | Monique Díaz MD | Mary A. Iaccarino MD | Stephen B. Lewis MD | Carolyn Millett | Sindhu Pandit MD, MBA | Claudia P. Ramirez MD | Robert Rinaldi MD | Megan Roop | Chloe S. Slocum MD, MPH | Gene Tekmyster DO, MBA | Deborah Venesy MD | Monica Verduzco-Gutierrez MD | Richard D. Zorowitz MD | Todd R. Rowland MD

1Department of Physical Medicine and Rehabilitation, Harvard Medical School, Spaulding Rehabilitation, Charlestown, Massachusetts, USA
2Department of Physical Medicine and Rehabilitation, University of North Carolina School of Medicine, Chapel Hill, North Carolina, USA
3Department of Physical Medicine and Rehabilitation, University of Alabama at Birmingham School of Medicine, Birmingham, Alabama, USA
4Department of Physical Medicine and Rehabilitation, Penn State Health Milton S. Hershey Medical Center Penn State College of Medicine, Hershey, Pennsylvania, USA
5Department of Physical Medicine and Rehabilitation, University of Alabama at Birmingham, Birmingham, Alabama, USA
6Department of Physical Medicine and Rehabilitation, Cedars-Sinai Medical Center, Los Angeles, California, USA
7Dignity Health, Santa Maria, California, USA
8Physiatry-Pharmacy Collaborative, NJ Institute for Successful Aging, Princeton, New Jersey, USA
9American Academy of Physical Medicine and Rehabilitation, Rosemont, Illinois, USA
10Ochsner Health System, New Orleans, Louisiana, USA
11Kelly Collaborative Medicine, Silver Spring, Maryland, USA
12Department of Physical Medicine and Rehabilitation, UT Southwestern Medical Center, Dallas, Texas, USA
13Department of Orthopedic Surgery, Keck Medicine of USC, Los Angeles, California, USA
14Cleveland Clinic, Cleveland, Ohio, USA
15Department of Rehabilitation Medicine, University of Texas Health Science Center at San Antonio, San Antonio, Texas, USA
16Department of Rehabilitation Medicine, MedStar National Rehabilitation Network, Georgetown University, Washington, District of Columbia, USA
17Duke University Hospital, Durham, North Carolina, USA

Correspondence
Adam S. Tenforde, Department of Physical Medicine and Rehabilitation, Harvard Medical School, Spaulding Rehabilitation, Spaulding Rehabilitation, 300 First Avenue, Charlestown, MA 02129, USA.
Email: atenforde@mgh.harvard.edu

Abstract
Telehealth refers to the use of telecommunication devices and other forms of technology to provide services outside of the traditional in-person health care delivery system. Growth in the use of telehealth creates new challenges and opportunities for implementation in clinical practice. The American Academy of Physical Medicine and Rehabilitation (AAPM&R) assembled an expert group to develop a white paper to examine telehealth innovation in Physical Medicine and Rehabilitation (PM&R). The resultant white paper summarizes how telehealth is best used in the field of PM&R while highlighting current knowledge
INTRODUCTION

Telehealth refers to the use of telecommunication devices and other forms of technology to provide services outside of the traditional face-to-face health care delivery system. Most commonly, telehealth visits use both audio and visual communication performed synchronously between a provider and patient. A component of telehealth includes telerehabilitation, which is referred to in this white paper to encompass the delivery of therapies by allied health providers (e.g., physical, occupational, and speech therapists) using the telehealth platform. A 2017 report reviewed the limited number of studies specific to physiatry and offered potential applications of telehealth to advance health care in the specialty of Physical Medicine and Rehabilitation (PM&R).\(^1\) Since then, the adoption and implementation of telehealth has grown rapidly, due in part to efforts to maintain health care delivery during the pandemic caused by the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Studies suggest that physicians, therapists, and patients all rated their experiences to be favorable.\(^2,3\)

The American Academy of Physical Medicine and Rehabilitation (AAPM&R) recognizes the ongoing challenges of physicians and their patients in using telehealth for health care delivery and the value of innovative strategies to address them. The objectives of this white paper are to summarize the innovative ways telehealth is being used in PM&R, identify current knowledge deficits and technological limitations, outline the strength of available evidence, and explore new and transformative opportunities for PM&R to advance translational research and patient care.

METHODOLOGY

In August of 2020, the AAPM&R Board of Governors requested that the Academy create a workgroup to examine telehealth innovation in PM&R. A workgroup was selected in late 2020 comprising a chair (T.R.R.) and six AAPM&R members (J.J.A., M.D., S.P., C.P.R., A.S.T., and D.V.) and first met in February 2021.

With input from the workgroup, the co-chairs of the white paper (A.S.T. and J.J.A.) identified telehealth content subtopics spanning inpatient and outpatient practices, including aspects of care unique to the specialty of PM&R, such as recognizing barriers to using telehealth faced by individuals with disabilities.

Literature reviews were conducted by topic authors in February and March of 2022 to identify key articles using search terms and PubMed, cross-referencing primary articles to recognize relevant articles, and an additional search was completed in August 2022. Findings were presented and discussed during two virtual meetings and developed into recommendations based on Strength of Recommendation Taxonomy (SORT).\(^4\) The resulting SORT recommendations classified patient-oriented evidence as follows:

- Strength of recommendation A: recommendations from consistent and good-quality evidence.
- Strength of recommendation B: recommendations from inconsistent or limited-quality evidence.
- Strength of recommendation C: recommendations using disease-oriented studies, usual practice, opinion, or consensus.
- Strength of recommendation Unrated: recommendations that do not have sufficient evidence but may have preliminary evidence.

RESULTS AND KEY FINDINGS

Search terms, number of initial results, and final included references for each of 11 topics are presented in Table 1.

Informatics

The results of each search are summarized by section topic. For informatics, the software platform utilized to perform virtual visits should meet the needs of both providers and patients. Integration within the existing electronic health records (EHRs), total cost of ownership, and market penetration each determine feasibility and likelihood of adoption.\(^5\) Telehealth platforms may require specific configurations for patients treated across the specialty of PM&R. Examples of strategies that can be considered by type of impairment can be found in Table 2.

PM&R physicians evaluate the potential barriers posed by impairments to ensure the successful completion of a visit. A task analysis can be useful to help identify the potential issues that may arise using telehealth platforms for each impairment. For example, one software program was found to interfere with augmentative and alternative communication when audio was turned on, defaulting the visit to yes/no interactions.\(^6\) Patients with limited visual acuity or hand dexterity may experience difficulties with button placement for audio/video that is low contrast, very close together, or too far
apart. Ongoing work such as the Web Content Accessibility Guidelines (WCAG) aim to ensure telehealth platforms are accessible to everyone.⁷,⁸

PM&R physicians commonly evaluate and treat patients with chronic, long-term conditions. Existing data collection and display platforms within EHRs may be used to perform telehealth rehabilitation interventions. For example, studies have documented that telehealth is effective for monitoring diabetes, epilepsy management, and diet/nutrition.⁹,¹⁰ The field of PM&R has an opportunity to expand evidence-based research to inform telehealth applications, as most studies are limited to feasibility, pilot data, and acceptability, reflecting early stage research.¹⁰

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Search strategy and key articles.</th>
</tr>
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<tbody>
<tr>
<td>Section topic</td>
<td>Search terms</td>
</tr>
<tr>
<td>Informatics</td>
<td>telehealth, EMR, EHR, integration</td>
</tr>
<tr>
<td>Evaluation and Treatment</td>
<td></td>
</tr>
<tr>
<td>Telehealth Diagnostic Strategies</td>
<td>telediagnosis, rehabilitation</td>
</tr>
<tr>
<td>Telerehabilitation</td>
<td>telerehabilitation, therapeutics, therapy, treatments,</td>
</tr>
<tr>
<td>Concussion</td>
<td>concuss* OR “mild traumatic brain” OR “head injr*” AND telehealth, OR telemedicine, OR telecare, OR mobile health, OR m-health, OR virtual</td>
</tr>
<tr>
<td>Spine and Pain Disorders</td>
<td>(virtual or telehealth or remote or telemedicine) and (spine)</td>
</tr>
<tr>
<td>Cancer Rehabilitation</td>
<td>telerehabilitation or tele-rehabilitation) OR (video visits)) OR (remote care or remote consultation)) OR (telehealth)) OR (telemedicine)) AND (((rehabilitation or physiatry) OR (rehabilitation medicine)) OR (physical medicine) AND (rehabilitation) AND (cancer or oncology))</td>
</tr>
<tr>
<td>Pediatric Rehabilitation</td>
<td>telerehabilitation, telemedicine, telehealth, physiatry, rehabilitation, handicap, cerebral palsy, spasticity, brain injury, spinal dysraphism, spinal cord injury, amputation, mental deficiency, developmental disorder, developmental delay, intellectual impairment, special needs, disability</td>
</tr>
<tr>
<td>Neurorehabilitation</td>
<td>(Telehealth or telemedicine) and (rehabilitation or physiatry or physical medicine) and (stroke or spinal cord injury or brain injury or neurologic conditions or spasticity) and adults</td>
</tr>
<tr>
<td>Frailty and Cardiac Telerehabilitation in Post-Acute Care</td>
<td>frailty, physical frailty, cognitive frailty, frailty prevention, dementia prevention, post-acute telemedicine, rehospitalization prevention, cardiac tele-rehabilitation, mobile cardiac rehabilitation, home-based cardiac rehabilitation, 4Ms model of care, self-management support, post-hospital syndrome, post-hospital disability</td>
</tr>
<tr>
<td>Health Disparities</td>
<td>“health equity” AND ((telehealth) OR (telemedicine) OR (telecare) OR (“mobile health”) OR (m-health))</td>
</tr>
<tr>
<td>Environmental Considerations</td>
<td>telerehabilitation, telemedicine, telehealth, climate change, carbon emissions</td>
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Abbreviations: EMR, electronic medical record; EHR, electronic health record.
The diagnosis of chronic medical conditions. Many studies have examined how telehealth physical examinations compare to in-person examinations for the diagnosis and management of neurological and musculoskeletal conditions. Studies have found that examinations performed via telehealth have findings similar to those performed in-person for patients with spinal conditions during pre-surgical evaluation, patients with low back pain, and patients presenting to the emergency department for evaluation of neurological symptoms. Gait analysis and evaluation of appropriate cane height can be performed using the Performance-Oriented Mobility Assessment (POMA) gait scale with both moderate validity and inter-rater reliability. One study of patients with Parkinson disease found that standardized performance measures such as the Timed Up and Go (TUG) test, Berg Balance Scale, timed stance test, steps to complete 360-degree turn, and lateral and functional reach tests could be assessed reliably using telehealth.

Prior work comparing the components of the musculoskeletal examination between in-person and telehealth assessments has found some variability in terms of accuracy and arriving at a correct diagnosis. Hip and pelvis examinations conducted in-person versus via telehealth were found to have similar reliability in terms of inspection and function, but lower agreement in terms of palpation and range of motion, especially in older patients with more co-morbidities and/or a greater body mass index. Another study found that when evaluating knee injuries, gait analysis was similar between in-person and telehealth examinations, but there was less agreement for functional testing and identifying ligamentous injuries. However, a separate report suggested that in 89% of cases, clinicians performing knee assessments via telehealth arrived at the same diagnosis as those performing in-person examinations. The diagnosis of nonarticular lower limb musculoskeletal conditions may also be similar using telehealth compared with in-person visits. Range of motion of the elbow, wrist, and knee was similar for in-person compared to telehealth examinations, although less-experienced providers had reduced precision of
<table>
<thead>
<tr>
<th>System</th>
<th>System sub-area</th>
<th>Adaptation to virtual care</th>
<th>Suggested documentation for normal exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vital signs</td>
<td>Evaluate for tachypnea, cyanosis, orthostatic symptoms as applicable. May ask patient for height/weight. If patient has heart rate monitor (wrist or chest) and/or automatic blood pressure cuff, can have them provide values</td>
<td>Normal rate of breathing, appears well-oxygenated without cyanosis, reports no dizziness or orthostatic changes when asked to stand for 5 minutes after sitting</td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>Practitioner’s observation, including alertness, general appearance</td>
<td>Alert, cooperative, well-appearing, no acute distress</td>
<td></td>
</tr>
<tr>
<td>Respiratory</td>
<td>Practitioner’s observation, including labor of breathing, presence of cough or wheezing</td>
<td>Non-labored breathing, no cough or wheezing</td>
<td></td>
</tr>
<tr>
<td>Skin</td>
<td>Practitioner’s observation of patient’s skin for masses, lesions, or ulcers. Inspect and comment on any skin changes at anatomic site(s) post-injection</td>
<td>No lesions or ulcers visualized on exposed skin. No discharge, drainage, or redness at site(s) of prior injection</td>
<td></td>
</tr>
<tr>
<td>Psych</td>
<td>Practitioner’s observation of patient’s mood and affect</td>
<td>Normal mood, congruent affect; answers questions appropriately</td>
<td></td>
</tr>
<tr>
<td>Neuro</td>
<td>Mental status</td>
<td>Level of alertness, orientation to visit, able to identify objects and maintain attention to tasks</td>
<td>Alert and oriented to person, time, and reason for visit. Able to identify objects including items of clothing, electronic devices in use, and ability to perform serial 7s (or spell WORLD backwards if fluent in English or use an alternative more appropriate for education level)</td>
</tr>
<tr>
<td>Speech</td>
<td>Rate of speech, word choice, and volume</td>
<td>Fluent and normal rate of speech, no word finding difficulties</td>
<td></td>
</tr>
<tr>
<td>CN I</td>
<td>If patient accompanied, patient may be presented with familiar smell (coffee, bread) to identify with eyes closed</td>
<td>CN I confirmed intact as patient able to accurately identify presented odor</td>
<td></td>
</tr>
<tr>
<td>CN II</td>
<td>Practitioner’s observation of pupils</td>
<td>Pupils equal and round</td>
<td></td>
</tr>
<tr>
<td>CN III, IV, VI</td>
<td>Ask patient to gaze in different directions</td>
<td>Extraocular movements intact, no nystagmus, no ptosis</td>
<td></td>
</tr>
<tr>
<td>CN V</td>
<td>Ask patient to clench and release jaw</td>
<td>Jaw movements intact and symmetric</td>
<td></td>
</tr>
<tr>
<td>CN VII</td>
<td>Ask patient to smile, raise eyebrows</td>
<td>Symmetric facial movement and smile</td>
<td></td>
</tr>
<tr>
<td>CN VIII</td>
<td>Practitioner’s observation of patient’s hearing ability</td>
<td>Hearing intact to normal voice</td>
<td></td>
</tr>
<tr>
<td>CN IX/X</td>
<td>Practitioner’s observation of vocal quality</td>
<td>Normal vocal quality, no hoarseness</td>
<td></td>
</tr>
<tr>
<td>CN XI</td>
<td>Ask patient to shrug shoulders, rotate neck</td>
<td>Symmetric shoulder shrug and neck rotation</td>
<td></td>
</tr>
<tr>
<td>CN XII</td>
<td>Ask patient to stick out tongue</td>
<td>Tongue protrudes midline</td>
<td></td>
</tr>
<tr>
<td>Motor</td>
<td>Practitioner’s observation of abnormal movement at rest including tremor, dystonia, clonus; instruct patient on rapid finger tapping, pronator drift</td>
<td>No tremor, dystonia, or clonus observed. Rapid finger tapping intact. No pronator drift.</td>
<td></td>
</tr>
<tr>
<td>Tone</td>
<td>Practitioner’s observation on voluntary movement, co-contraction, posturing with position changes</td>
<td>Patient able to perform full active movements, no co-contraction, no posturing with position changes</td>
<td></td>
</tr>
<tr>
<td>Coordination</td>
<td>Practitioner instructs patient on performing rapid alternating movements, finger-to-nose with available targets (e.g., edge of computer screen), heel-to-shin</td>
<td>Rapid alternating movements intact and symmetric; finger-to-nose and heel-to-shin intact bilaterally.</td>
<td></td>
</tr>
<tr>
<td>Proprioception</td>
<td>Practitioner instructs patient on performing Romberg and tandem walking tests</td>
<td>Negative Romberg; normal tandem walking</td>
<td></td>
</tr>
<tr>
<td>Sensation</td>
<td>Practitioner asks patient or accompanying individual to gently touch appropriate dermatomal regions, simultaneously if possible, and report any abnormal sensation. May also provide diagram of dermatomes to further instruct patient. Practitioner can also ask patient to use tip of pencil and eraser to test sharp/dull sensation.</td>
<td>Sensation to light touch and sharp/dull subjectively intact</td>
<td></td>
</tr>
</tbody>
</table>
measurements and accuracy when evaluating elbow pronation and supination using telehealth. In the upper extremity, telehealth shoulder evaluation yielded reliable estimates of shoulder function and range of motion limitations compared to in-person assessments and the diagnosis of elbow conditions had high agreement.

Table 3 lists key features of musculoskeletal and neurological examination by telehealth.

**TELEHEALTH PHYSICAL EXAMINATION RECOMMENDATIONS**

SORT A: Although aspects of the physical and neurological exam such as palpation and range of motion may have less accuracy using telehealth, elements of the telehealth virtual examination have similar agreement to in-person assessments for selected musculoskeletal and neurological conditions.

SORT C: Some aspects of the physical examination are limited using telehealth compared to in-person examination and require supplemental testing for improved accuracy.

**Future directions**

- Remote wearable devices including accelerometers may provide more accurate measures of strength, range of motion, and measures of spasticity and tone using haptic technology and require further study.

**Augmentation of telehealth diagnostic strategies**

Telehealth diagnostics may be improved compared with in-person diagnosis through the use of augmented measures such as external devices or medical assistants who are present with the patient. For example, virtual reality (VR) may be used to evaluate both physical and cognitive function. VR may be combined with augmented reality (AR) and haptic technology to improve assessment tools. The use of VR or AR with devices such as robots, sensors, and wearables is referred to as extended reality (XR) and has been used in telehealth rehabilitation for remote monitoring, assessment, and telehealth diagnosis. The use of XR has been proposed for management of Parkinson disease to augment the evaluation of motor function through the use of wearable technology.

Augmented Reality-based Telerehabilitation System with Haptics (ARTESH) is defined as “a telerehabilitation system which uses haptic feedback and depth sensing camera technology (Red-Green-Blue-Depth/RGB-D cameras) to allow a clinician and a patient to interact remotely through video, audio, and touch.” ARTESTH compared to in-person evaluation was qualitatively measured by users with the highest ratings for ease and simplicity of use (86%) and quality of experience (85%), with lower ratings compared to in-person evaluation (58%) including limitations in measuring lower isometric strength and range of motion measures in the upper extremity. The ARTESTH remote strength and range of motion assessments were compared to in-person evaluation of 15 patients presenting with...
upper extremity pain and demonstrated variability for agreements in range of motion measures.  

**AUGMENTATION OF TELEHEALTH DIAGNOSTIC STRATEGIES RECOMMENDATIONS**

Unrated SORT: Our review identified few studies and suggests insufficient evidence to support use of VR, AR, or ER to assist with improving diagnostic accuracy in the field of PM&R.

**Future directions**

- Use of augmented reality and haptic technology requires further study given limitations in aspects of performing the musculoskeletal and neurological examination using telehealth.

**Rehabilitation therapies delivered via telehealth (Telerehabilitation)**

Systematic reviews have concluded that telerehabilitation (also referred to as telerehabilitation) may result in similar to greater outcomes compared with in-person therapy for improving physical function in musculoskeletal conditions. Multiple studies demonstrate the value of telerehabilitation in management of knee pain and knee osteoarthritis. Telehealth rehabilitation following total knee arthroplasty has demonstrated similar outcomes in physical function and higher patient satisfaction compared with in-person care. The evidence may be stronger for improving functional mobility following total knee compared with total hip arthroplasty using telehealth. More limited evidence documents outcomes using telehealth to increase physical activity in patients receiving active treatment for cancer or those living with cancer.

Findings suggest that telehealth rehabilitation may be similar to traditional in-person care in the management of a number of neurological conditions including stroke, while recognizing limitations due to variability of interventions and outcomes. Telehealth using VR interventions may improve gait and balance impairments and upper limb function after stroke. Exercise games (also known as “serious games” or “exergames”) resulted in greater gains than in-person therapy in upper limb function, activity, and participation. In patients with stroke, speech and language pathologists using telerehabilitation may achieve similar outcomes in the management of aphasia and improved activities of daily living. Similarly, patients with neurological conditions resulting in cognitive impairments may see similar to greater gains using telerehabilitation compared with in-person rehabilitation, particularly in the treatment of executive function impairments.

In contrast to stroke, fewer studies have been performed in other neurological conditions such as multiple sclerosis (MS) and pediatric traumatic brain injury (TBI). An earlier review concluded that patients with MS had a wide range of uses for telehealth but low evidence. Subsequent work suggested that an integrated telerehabilitation approach demonstrated large effects to improve motor disability, with smaller effects observed for cognitive and participation outcomes such as depression in patients with MS. Similar results were observed using telehealth rehabilitation over in-person care to improve walking and physical activity. Use of VR in patients with MS may offer greater gains than in-person therapy for improving fatigue, quality of life, and balance. More limited work in pediatric TBI suggests potential training programs (described as technology-delivered methods of addressing impairments in cognition and behavior) may be effective.

**REHABILITATION THERAPIES DELIVERED VIA TELEHEALTH (TELE REHABILITATION) RECOMMENDATIONS**

**SORT A:** Telerehabilitation treatment can result in equivalent functional outcomes in the management of knee osteoarthritis and after cerebrovascular accident.

**SORT C:** The available studies outside knee osteoarthritis and stroke management have a lower level of evidence; small comparative trials and primary sources of consensus documents and opinion pieces by external experts suggest that other musculoskeletal and neurological diagnoses may be appropriate to treat using telerehabilitation.

**Future directions**

- Additional studies may help validate the use of customized telerehabilitation solutions for different patient populations including spinal cord injury (SCI) and TBI, pediatric populations, and for individuals with compromised immune systems from cancer who would benefit from avoiding in-person visits.

**Concussion: Evaluation and management**

Telehealth to evaluate and manage concussion is an emerging health care delivery strategy. The potential to expand the care of patients with concussion using
telehealth is strong including the ability to perform clinical interviews, cognitive assessments, education, activity guidance, and medication management, with more modest need for physical examination and point of care intervention. However, no randomized trials have compared outcomes for patients with concussions using telehealth compared with in-person visits. Evidence supports the feasibility of telehealth to monitor concussion symptoms, as veterans with concussion randomized to use a smartphone application had a greater reduction of symptoms compared to in-person care.64

Three primarily descriptive studies evaluated the use of telehealth in the treatment of pediatric populations with concussion. One study reported a reduction in concussion symptoms using a mobile application during a 6-week exercise intervention.65 A smaller patient cohort with concussion managed via telehealth showed a 90% recovery rate.66 Symptom reporting after concussion with a mobile app demonstrated a 74% retention rate in participation.67 One study described evaluation and treatment of 20 pediatric patients using telehealth consultation for 90% and management for 80% of all patients.68 Overall, 90% met clinical recovery and cost avoidance was estimated to be $40,973.

The limited studies in the diagnosis of concussion reported high agreement between telehealth and in-person for sideline assessment of acute sport concussion,5 for triage of pediatric patients with head injury to inpatient care or to a teleconsultation program,69 and for military TBI using teleneurology consultation to determine in-theater care or evacuation.70 The management of concussion in 18 pediatric patients using telehealth was described with 10 patients cleared for return to play in a median of 15.5 days.71 Collectively these studies suggest that early neurotrauma triage may be augmented using telehealth, but there is insufficient evidence to support replacing in-person evaluation of patients with more advanced brain injury.

The satisfaction in using telehealth for management of concussion may vary by population. Military service members enrolled in telehealth for concussion found a high degree of patient and provider satisfaction.72 Telehealth care for adolescents with concussion achieved high degree of patient and provider satisfaction, and with more limited studies evaluating VR.88 Telehealth may be particularly effective for the management of patients with spin disorders who have both advanced imaging and appropriate patient history available, including determining intervention procedures and spine surgery.89 This is supported by a consistency of recommendations and minimal differences between telehealth and an in-person visit used to determine a procedural or surgical plan.90-95 Use of telehealth has been shown to result in high physician confidence to develop treatment plans,96-97 high patient satisfaction98-100 particularly for follow-up visits101 and management of low back pain,102 including exercise programs.103

Although studies are currently limited on telehealth use for evaluating how a patient reports treatment response following the use of procedures to alleviate pain, applications of telehealth visits compared to in-person visits have been evaluated in the management of chronic pain conditions of Achilles tendinopathy and plantar fasciitis.104 Investigators have identified similar outcomes using a telehealth visit compared to in-person visit to monitor the response to shockwave therapy and noted the follow-up level of care was billed lower, in part due to time-based billing practices. A smaller report found that a similar proportion of patients met patient-reported outcome measures when initially evaluated using telehealth versus in-person prior to receiving extracorporeal shockwave therapy.105 Patients evaluated using telehealth compared to in-person had a similar high level of agreement of primary diagnosis prior to extracorporeal shockwave therapy.106

Telehealth may also address barriers to receiving spine care. Although spine telehealth services and

**Future directions**

- Telehealth should be evaluated as a strategy to ensure compliance with symptom resolution and full return to sports and school following mTBI. Telehealth should be evaluated for facilitating return to work and restoring activities of daily living (ADLs) in adults with non-sports-related concussion. Potential strategies include developing patient registries that characterize telehealth use and validated outcome measures.

**Management of spine disorders and pain**

Telehealth can be used effectively for evaluating and treating patients with spine disorders. Initial evaluation and triage via telehealth has shown high patient satisfaction and capacity to progress with treatment plans in certain spine disorders.74-77 Methods for performing the spine exam have been proposed and discussed, with some studies demonstrating high agreement of telehealth compared to in-person examinations,17,19,85-87 and with more limited studies evaluating VR.88 Telehealth may be particularly effective for the management of patients with spin disorders who have both advanced imaging and appropriate patient history available, including determining intervention procedures and spine surgery.89 This is supported by a consistency of recommendations and minimal differences between telehealth and an in-person visit used to determine a procedural or surgical plan.90-95 Use of telehealth has been shown to result in high physician confidence to develop treatment plans,96-97 high patient satisfaction98-100 particularly for follow-up visits101 and management of low back pain,102 including exercise programs.103

SORT B: Evidence suggests that concussion/mild TBI (mTBI) may be managed with similar outcomes using telehealth compared to in-person visits for neurobehavioral aspects following concussion.

Unrated SORT: Insufficient level of evidence to provide SORT rating regarding how telehealth can be used for prognosis following concussion/mTBI.
management plans varied by geography and socioeconomic groups early during the coronavirus disease 2019 (COVID-19) pandemic, adoption of telehealth services may increase access to specialty care for patients in remote areas and decrease economic burden while reducing missed visits for patients of lower socioeconomic status. The use of remote services for triage can produce significant cost savings for both health care systems and patients.

MANAGEMENT OF SPINE DISORDERS AND PAIN RECOMMENDATIONS

SORT A: Telehealth offers a viable and effective medium to assess patients with spine conditions for treatment and allows for the formulation of an accurate and consistent treatment plan that includes surgical and procedural care.

SORT B: Telehealth evaluations offer an efficient means of preoperative and preprocedural assessment of spine pathology.

SORT C: There is limited evidence for the use of telehealth to diagnose complex spine conditions, largely due to the paucity and quality of available studies.

Future directions

- The feasibility of using telehealth to determine the appropriateness for interventional spine procedures and pain treatments and follow-up visits may result from tracking outcome measures to evaluate efficacy.
- Prospective investigations with longitudinal follow-up evaluating clinical outcomes may determine the relative value of telehealth compared with in-person visits in the management of musculoskeletal and neurological conditions.

Cancer rehabilitation

Telehealth may serve as a strategy to deliver rehabilitation to patients with cancer. In 2019, more than 16.9 million Americans had a history of cancer and, in 2022, there are expected to be 1.9 million new cancer cases diagnosed in the United States. Cancer rehabilitation can improve functional status and the quality of life of patients with cancer but is limited to tertiary medical centers and often requires longer travel distances to obtain care. Earlier strains of COVID-19 were found to affect individuals with cancer much more severely, with mortality rates exceeding 20%, and telehealth services can keep patients safe from communicable disease and increase access and convenience of care. High levels of satisfaction have been reported from both patients and providers participating in telehealth cancer rehabilitation visits, although decreased satisfaction was noted for providers evaluating a new complaint, problems related to a neuromusculoskeletal issue, or lymphedema. Planning prior to telehealth visits may be important, as 11% of all telehealth assessments and follow-up encounters were identified as requiring an in-person appointment indicating inefficient visits and possibly increased cost of care.

Telehealth may facilitate exercise during cancer rehabilitation, helping patients achieve regular physical activity as recommended by American College of Sports Medicine, the National Comprehensive Cancer Network, and the American Cancer Society. Multiple single-arm feasibility studies and case series have shown that telehealth-based exercise interventions help improve quality of life and increase physical function. Similar results were found in six randomized control trials and two reviews, although there was significant heterogeneity in the exercises performed, the telehealth platform used, and the outcome measures recorded. Conversely, two other reviews indicate that there is little evidence to support that telehealth exercise interventions resulted in higher physical function in patients with cancer.

CANCER REHABILITATION RECOMMENDATIONS

SORT B: Cancer rehabilitation may be advanced using telehealth-based exercise interventions aimed to improve quality of life, physical function, and adherence to physical activity recommendations.

SORT C: In cancer rehabilitation, patients presenting with stable problems, medication prescription/titration, or education/counseling can be managed with telehealth.

Future directions

- Future areas of study should include exploring cost differences between telehealth and in-person visits, effects of telehealth on meaningful patient outcomes, effects of telehealth on overall health care utilization, and standardization of telehealth-based exercise interventions and outcome measures in research.

Pediatric rehabilitation

Research characterizing the use of telehealth in pediatric PM&R is not well described in the literature. A survey study of 78 pediatric PM&R physicians from multiple practice settings (80% academic setting, 13%
non-academic hospital-based practice, and 7% private practice) reported that 14.5% of respondents used telehealth earlier compared with the use by nearly all (97.4%) since the start of the COVID-19 pandemic. Most physicians were satisfied (85%) and “strongly agreed” or “agreed” that they would expand their use of telehealth to patients who live in remote geographic areas or have barriers to access clinical care, whereas a majority (57%) planned to expand use for all patients in their practices. A recent cluster-randomized, crossover study investigating parent and PM&R physician experiences and perceived quality of care between telehealth-based school health clinic visits and in-person clinic visits demonstrated that a telehealth model of care for children with special health care needs was equal to an in-person visit both in experience and perceived quality of care. Although both studies are descriptive, each suggests high acceptance of telehealth rehabilitation models in pediatric PM&R practice.

PEDIATRIC REHABILITATION

RECOMMENDATIONS

SORT C: Pediatric rehabilitation can be delivered effectively using telehealth with outcomes similar to in-person visits.

Future directions

- Pronounced gaps in pediatric PM&R-specific telehealth research exist, including the assessment of cost-effectiveness/economics/school days saved and missed, quality of care, satisfaction (provider and patient), novel applications and models of care, and functional outcomes. It is imperative that more pediatric-specific PM&R research be done to capture these outcomes related to use of telehealth rehabilitation.

Neurorehabilitation

Telehealth in PM&R neurorehabilitation presents challenges, as impairments resulting from brain injuries and SCIs create barriers to participating in telehealth visits. Mental status or speech deficits may prevent patients from providing adequate histories. Motor strength deficits, apraxia, and muscle tone/spasticity may prevent patients from cooperating with physical examinations. Thus these patients may require assistance during the telehealth visit.

Published work specific to telehealth neurorehabilitation within PM&R are limited to reviews for patients with SCI. One review identifies categories of communication: provider to provider, direct to consumer, store-and-forward, web-based treatments, and interactive home monitoring studies. Proposed methods of telehealth communication for patients with SCI may include audio-only, audio-visual, and other platforms. A second review advocates for telehealth to be utilized for transitions of care, access to care in rural areas, preventive health and wellness, bowel and bladder management, chronic pain, anxiety, and depression.

A separate publication from the neurology literature that applies to PM&R practice advocates for the use of telehealth visits in the management of neurological conditions to minimize time lost from work and eliminate the need for transportation to complete an in-person visit, along with avoiding the costs and logistics of parking. The authors concluded that neurorehabilitation telehealth visits were more successful for follow-up appointments with established patients, patients with stable diagnoses, visits not requiring interventions, and visits for medication management.

NEUROREHABILITATION

RECOMMENDATIONS

SORT B: Limited evidence suggests efficacy and acceptance of telerehabilitation models in neurological PM&R practice.

Future directions

- Expansion of studies during acute inpatient rehabilitation along with outpatient follow-up management for conditions in patients with TBI, stroke, and other neurological impairments should evaluate outcomes to further substantiate these findings.

Frailty and cardiac telerehabilitation in post-acute care

Older patients who are hospitalized often develop hospital-associated functional decline and disability. This can occur from the functional manifestations of the index diagnosis itself or from known co-morbidities but also from preventable risk factors connected to the hospital experience. These risk factors include enforced immobility, poor nutrition, complex medication regimens, disrupted sleep, and stressful environments. Evidence-based frameworks for managing similar risk factors include cardiac rehabilitation, the 4Ms model for an “age-friendly health system,” the Acute Care for Elders model, and the Lancet Commission findings for dementia prevention. These multi-modal, best-practice models for care target improved functional capacity, improved cardiorespiratory fitness, and...
reduced frailty as principal end points for the care of older adults. They center care delivery around what matters most to older patients—maximizing functional capacity and independence at home.\textsuperscript{158}

Traditional skilled nursing facilities, home care agencies, and nurse-navigator programs connect post-acute patients to traditional medical and rehabilitation services but often fail to integrate standardized best practices,\textsuperscript{152} such as routinely measuring and monitoring cardiorespiratory fitness,\textsuperscript{159} frailty,\textsuperscript{160} or quality of life throughout the post-acute episode. Self-management education (such as medication adherence) and coaching support are limited in post-acute care to treat chronic conditions and improve lifestyle, both of which have the potential to enhance mobility and cognition within aging populations.\textsuperscript{160-163} These same gaps are observed in pre-acute models of primary care and may result in accelerated frailty, increased falls, cognitive decline, and the need for unplanned acute hospitalizations for older adults residing in the community.\textsuperscript{160,164}

Providers in PM&R may utilize telehealth to address the gaps in care for debilitated older patients and those requiring cardiac rehabilitation. For example, telehealth services may be reimbursable for PM&R providers including home-based consultations, annual wellness visits, remote patient monitoring, and chronic care management, which may expand the delivery of technology-enabled versions of medical rehabilitation or multi-modal cardiac rehabilitation in the home after discharge from a hospital or skilled nursing facility. Medical and cardiac rehabilitation delivered through telehealth may enhance patient self-management support for an expanded list of evidence-based risk factors and co-morbidities identified to affect fitness, functional capacity, and quality of life at home.\textsuperscript{160,161,165,166}

Home-based cardiac rehabilitation, facilitated by telehealth and remote patient monitoring, has been shown to be as effective and safe as center-based settings.\textsuperscript{162,163,167-170} Data collected in the home from wearables and from self-reported outcome measures offer the promise of improving advanced data analytics such as machine learning for enhanced decision support of both providers and patients.\textsuperscript{171} Telehealth has the potential to transform pre- and post-acute care by providing home-based programs that may improve fitness, functional capacity, and quality of life for most chronic health conditions, including in patients receiving cardiac rehabilitation.\textsuperscript{159,160,166,172-175}

FRAILTY AND CARDIAC TELEREHABILITATION IN POST-ACUTE CARE RECOMMENDATIONS

SORT A: Home-based, technology-enabled cardiac rehabilitation to prevent cardiac-related frailty can be delivered as effectively as center-based care.

SORT C: Limited evidence suggests that the core components of multi-modal cardiac rehabilitation can improve fitness and functional capacity and prevent hospitalization within non-cardiac senior populations delivered in outpatient settings.

**Future directions**

- Future research may substantiate the value of cardiac telerehabilitation across different post-acute settings. Future research should explore whether machine learning algorithms can enhance decision support using personalized home-based cardiac rehabilitation data.
- Future research should report on cardiac rehabilitation outcomes for non-cardiac patients as a strategy to rehabilitate frailty and pre-frailty and to prevent hospitalizations.

**Healthcare disparities**

Telehealth offers tremendous promise to expand access to physiatric care for many individuals with both acute and chronic impairments from disabilities and injuries. However, although the COVID-19 pandemic accelerated the integration of telehealth of many health systems for both inpatient and outpatient care, vulnerable and marginalized patients still face significant barriers to accessing telehealth services. For example, during the early stages of the COVID-19 pandemic, patients with high social vulnerability had less access to videoconferencing technology, were more likely to access primary care services via telephone,\textsuperscript{176} and had more limited benefits in telehealth used for stroke care.\textsuperscript{177} Multi-level interventions, including but not limited to access to technology platforms, are required to address the health needs of underserved populations across the care continuum, range of impairments, and lifespan for all patients.\textsuperscript{178}

The universal design of telehealth programs and workflows should equitably expand access to telehealth for populations with cognitive disability and/or hearing or vision impairment, and account for the involvement of caregivers or interpreters used during the clinical encounter. Physicians and health systems must also engage in advocacy to champion accessible design features in telehealth platforms that improve patient access. The financial landscape of health care delivery creates ongoing challenges that limit access and delivery of telehealth. These obstacles include restrictions or elimination of reimbursement to health care providers and facilities along with the lack of incentives to promote ongoing services, particularly to the most vulnerable.
<table>
<thead>
<tr>
<th>Section Topic</th>
<th>SORT Rating</th>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informatics</td>
<td>C</td>
<td>Expert opinion supports use of telehealth integration into EHR for PM&amp;R practice, as supported by evidence demonstrating efficacy in management of other chronic medical conditions</td>
</tr>
<tr>
<td>Telehealth physical exam</td>
<td>A</td>
<td>While aspects of the physical and neurological exam such as palpation and range of motion may have less accuracy using telehealth, elements of the telehealth virtual examination have similar agreement to in-person assessments for selected musculoskeletal and neurological conditions</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>Some aspects of the physical examination are limited using telehealth compared to in-person examination and require supplemental testing for improved accuracy</td>
</tr>
<tr>
<td>Augmentation of telehealth</td>
<td>Unrated</td>
<td>Our review identified few studies and suggests insufficient evidence to support use of virtual, augmented or extended reality to assist with improving diagnostic accuracy in the field of PM&amp;R</td>
</tr>
<tr>
<td>diagnostic strategies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Telerehabilitation</td>
<td>A</td>
<td>Telerehabilitation treatment can result in equivalent functional outcomes in the management of knee osteoarthritis and after cerebrovascular accident</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>The available studies outside knee osteoarthritis and stroke management have lower level of evidence; small comparative trials and primary sources of consensus documents and opinion pieces by external experts suggest other musculoskeletal and neurological diagnoses may be appropriate to treat using telerehabilitation</td>
</tr>
<tr>
<td>Concussion</td>
<td>B</td>
<td>Evidence suggests concussion/mTBI may be managed with similar outcomes using telehealth compared to in-person visits for management of neurobehavioral aspects following concussion</td>
</tr>
<tr>
<td></td>
<td>Unrated</td>
<td>Insufficient level of evidence to provide SORT rating regarding how telehealth can be used for prognosis following concussion/mTBI</td>
</tr>
<tr>
<td>Management of spine and pain disorders</td>
<td>A</td>
<td>Telehealth offers a viable and effective medium to assess patients with spine conditions for treatment and allows for formulation of an accurate and consistent treatment plan that includes surgical and procedural care</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>Telehealth evaluations offer an efficient means of pre-operative and pre-procedural assessment of spine pathology</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>Limited evidence supports use of telehealth to diagnose complex spine conditions, largely from the paucity and quality of available studies</td>
</tr>
<tr>
<td>Cancer rehabilitation</td>
<td>B</td>
<td>Cancer rehabilitation may be advanced using telehealth-based exercise interventions aimed to improve quality of life, physical function, and adherence to physical activity recommendations</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>In cancer rehabilitation, patients presenting with stable problems, medication prescription/titration, or education/counseling can be managed with telehealth</td>
</tr>
<tr>
<td>Pediatric rehabilitation</td>
<td>C</td>
<td>Pediatric rehabilitation can be delivered effectively using telehealth with similar outcomes to in-person visits.</td>
</tr>
<tr>
<td>Neurehabilitation</td>
<td>B</td>
<td>Limited evidence suggests efficacy and acceptance of telerehabilitation models in neurological PM&amp;R practice</td>
</tr>
<tr>
<td>Frailty and cardiac</td>
<td>A</td>
<td>Home-based, technology enabled post-acute care including cardiac rehabilitation to prevent cardiac-related frailty can be delivered just as effectively as center-based care</td>
</tr>
<tr>
<td>telehabilitation in post-acute care</td>
<td></td>
<td>Limited evidence suggests that the core components of multi-modal cardiac rehabilitation can improve fitness, functional capacity and prevent hospitalization within non-cardiac senior populations delivered in outpatient settings</td>
</tr>
<tr>
<td>Health disparities</td>
<td>C</td>
<td>Expert opinion supports telehealth benefits for patients with physical and cognitive disabilities by addressing barriers to accessing care. Patients with neurological conditions often have physical and mental impairments that necessitate telehealth delivery of care in PM&amp;R practice. Furthermore, the elevated risk for secondary complications and financial costs associated with traveling longer distances for in-person care (e.g., pressure injuries related to long car or van rides, time missed from work or school) are best addressed by preserving access to telehealth particularly in the most vulnerable and marginalized patients with disabilities</td>
</tr>
<tr>
<td>Environmental considerations</td>
<td>A</td>
<td>Telehealth results in positive environmental impact compared to traditional in-person visits</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>Using telehealth may facilitate remote monitoring and earlier interventions for persons with disabilities who are disproportionately affected by weather disasters and require disaster aid</td>
</tr>
</tbody>
</table>

*Strength of Recommendation Taxonomy (SORT): A: recommendations from consistent and good-quality evidence; B: recommendations from inconsistent and limited-quality evidence; C: recommendations using disease-oriented studies, usual practice, opinion, or consensus; Unrated: recommendations that do not have sufficient evidence but may have preliminary evidence.
HEALTH CARE DISPARITIES

RECOMMENDATIONS

SORT C. Expert opinion supports telehealth benefits for patients with physical and cognitive disabilities by addressing barriers to accessing care. Patients with neurological conditions often have physical and mental impairments that necessitate telehealth delivery of care in PM&R practice. Furthermore, the elevated risk for secondary complications and financial costs associated with traveling longer distances for in-person care (e.g., pressure injuries related to car or van rides, time missed from work or school) are best addressed by preserving access to telehealth, particularly in the most vulnerable and marginalized patients with disabilities.

Future directions

- Advocacy is critical to ensure that patients with disabilities have access to telehealth care.
- Future research to evaluate barriers and access to telerehabilitation diagnosis and treatments is necessary to evaluate outcomes in populations with health disparities.

Environmental considerations

Climate change is considered the biggest health care problem of the 21st century and individuals with disabilities are among the most susceptible to the effects of climate change. Telehealth decreases carbon emissions and air pollution associated with vehicular travel for both patients and providers and can be beneficial in creating a carbon-neutral health care system. This is important to consider both domestically and globally, given that 14 countries have made a pledge for carbon neutrality as have a number of health care systems.

Studies on the environmental impact of telehealth include both prospective and retrospective studies and all demonstrated consistent findings of reduced CO2 emissions across geography and patient populations served. One study evaluated the environmental impact of telehealth in an urban academic rehabilitation setting in patients using telehealth, including one-third of telehealth patients who were non-ambulatory, and estimated avoiding an average travel distance of 95 miles, resulting in decreased CO2 and other organic gas outputs. Multiple reports emphasized the savings to patients of time and financial costs of travel and hotel.

Telehealth may also serve an important role in early warning capacity and assist in natural disaster response. This is critical for addressing health concerns resulting from climate change that affect patients with impairments such as reduced mobility or pulmonary function. For example, the ongoing study Mitigating the Health Effects of Desert Dust Storms Using Exposure-Reduction Approaches (MEDEA) childhood asthma study aims to use ehealth and epidemiologic strategies to compare indoor versus outdoor interventions to protect children with asthma from Saharan dust storms using wearable global positioning system (GPS) alerts, actigraphy, health parameter sensors, and air pollution samples to assess exposure and outcomes. Telehealth may serve as an alternative strategy to assist during natural disasters and eliminate the effects of carbon emissions related to travel.

- Quantifying outcomes related to sustainability can include using techniques such as a carbon calculator or through further education, advocacy, or research.

ENVIRONMENTAL CONSIDERATIONS

RECOMMENDATIONS

SORT A: Telehealth results in a positive environmental impact compared to traditional in-person visits.

SORT C: Using telehealth may facilitate remote monitoring and earlier interventions for persons with disabilities who are disproportionately affected by weather disasters and require disaster aid.

Future directions

- Measuring the benefits of telehealth on environmental impact should include the use of a carbon calculator.

SUMMARY

Telehealth has multiple uses within the field of PM&R and is expected to grow in level of evidence for patient-specific conditions. Telehealth can improve access to care over in-person encounters but limited studies document outcomes. The current state of telehealth in the field of PM&R supports ongoing use for a variety of patients, particularly those with chronic conditions, as a substitute for and complementary to in-person visits. This white paper highlights levels of evidence for key topics; this is not intended to be expansive to all aspects of PM&R practice. Some providers and patients may require or prefer in-person visits over telehealth. Future work may help characterize the value of telehealth within condition-specific populations while identifying strategies to ensure impairments do not limit access to this care. The value of telehealth for cost savings, improving quality of care, and addressing environmental impacts of traditional face-to-face encounters will support future use.
DISCLOSURE

ORCID
Adam S. Tenforde  https://orcid.org/0000-0002-3966-8070
Thiru M. Annaswamy  https://orcid.org/0000-0002-3969-9221
Philip Chang  https://orcid.org/0000-0003-1194-5440
Mary A. Iaccarino  https://orcid.org/0000-0001-9020-9390
Megan Roop  https://orcid.org/0000-0002-6644-6852
Gene Tekmyster  https://orcid.org/0000-0002-6644-0928
Monica Verduzco-Gutierrez  https://orcid.org/0000-0003-0964-5908
Richard D. Zorowitz  https://orcid.org/0000-0001-8938-786X

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