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TITLE: Accelerating Physical Therapy Exercise Monitoring: Facilitators, Fidelity, and Fitness

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14. ABSTRACT

The purpose of this project is to study ways to bridge the gap between research supporting digital health technology and behavioral interventions in physical therapy and real-world practice. This annual report describes the progress made on the sponsored project "Accelerating Physical Therapy Exercise Monitoring: Facilitators, Fidelity, and Fitness" from July 1, 2021 to June 30, 2022. Aim 1 included interviews to compare barriers and facilitators to using digital health technology, from the perspectives of physical therapists (PT) and people with Parkinson's disease (PD), before and after they use commercially-available sensors. Aim 2 is to assess fidelity of digital health technology and behavioral intervention adoption by people with mild to moderate PD and their PT. Aim 3 is to determine whether greater use of digital health technology and behavioral intervention strategies are associated with changes in fitness and function. The qualitative manuscript describing the results of Aim 1's pre-implementation work is under review. Key resources developed include educational materials for patients, ongoing dynamic training opportunities for clinicians, and technical assistance available to both. Recruitment for Aims 2 and 3 is completed with 32 patients enrolled, 12 of whom have completed their 6 month follow-up. Additionally, The Principal Investigator has been involved in training activities including regular meetings with mentors, attending presentations on digital health technology, and translating evidence into presentations on non-motor symptoms of PD and implementation of digital health and how they can impact exercise.

15. SUBJECT TERMS: Parkinson's disease, physical therapy, behavior change, exercise, physical activity, digital health technology, fitness tracking, accelerometer, implementation, knowledge translation, health services, physical therapist

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Section 1: Introduction

Parkinson's disease (PD) is a chronic degenerative neurologic condition. Regular exercise is associated with slower declines in mobility and quality of life in people with PD. Physical therapy can proactively help people with PD to increase their amount and intensity of exercise. Research has shown that using digital health technology and behavior change techniques can improve participation in regular exercise and physical activity in people with PD. The purpose of this project is to study ways to bridge the gap between research supporting digital health technology and behavioral interventions in physical therapy and real-world practice. **This annual report describes the progress made on the sponsored project "Accelerating Physical Therapy Exercise Monitoring: Facilitators, Fidelity, and Fitness" from July 1, 2021 to June 30, 2022.**

Section 2: Keywords

Parkinson's disease, physical therapy, behavior change, exercise, physical activity, digital health technology, fitness tracking, accelerometer, implementation, knowledge translation, health services, physical therapist

Section 3: Accomplishments

What were the major goals of the project? The purpose of this project is to study ways to bridge the gap between research supporting digital health technology and behavioral interventions in physical therapy and real-world practice. We hypothesize that people with early PD who use digital health technology with behavioral interventions will improve their exercise participation, with associated improvements in physical function and fitness. The Aims of the study are as follows:

1. Aim 1: Compare barriers and facilitators to using digital health technology, from the perspectives of physical therapists (PT) and people with PD, before and after they use commercially-available sensors
2. Aim 2: Assess fidelity of digital health technology and behavioral intervention adoption by people with mild to moderate PD and their PT
3. Aim 3: Determine whether greater use of digital health technology and behavioral intervention strategies are associated with changes in fitness and function.

What was accomplished under these goals?

1. **Major activities/tasks**
    a. Regulatory protocol management (Institutional Review Board (IRB) and Human Research Protection Office (HRPO))
    b. Study team management
    c. Aim 1: Qualitative data analysis, dissemination, and knowledge translation resource development
    d. Aim 2: Enroll, train, and facilitate physical therapists' use of technology and behavior change approaches
    e. Aims 2/3: Recruit, consent, and test people with Parkinson's
    f. Aims 2/3: Preliminary data analyses

2. **Specific Objectives: Description of accomplishments under each major activity**

    a. **Regulatory protocol management:** On four instances during this reporting period, we obtained IRB approval of minor protocol modifications. After the first modification in July 2021, we communicated with HRPO to confirm that these types of minor changes were

non-substantive and did not require an HRPO amendment approval prior to implementation. The subsequent IRB changes are described in Table 1.

Table 1: Protocol Modifications	
Date of Approval	Protocol Modifications
July 19, 2021	1. Modify recruitment methods to reduce burden on clinical coordinator and support recruitment efforts.
November 20, 2021	2. Add observation of participant familiarity with digital health technology and application usage on their fitness trackers. Update Informed Consent for the subset of participants who will have the option to participate in this element 3. Add survey questions to measure changes in exercise, confidence, maintenance, and satisfaction over the course of the study. 4. Revise Exit Interview for people with PD
December 4, 2021	5. Revise Exit Interview for PTs
March 3, 2022	6. Modify recruitment methods to enable research team to be more proactive about identifying potential participants 7. Clarify language to allow the Study Facilitator to speak directly with participants with PD to provide technical assistance

b. **Study team management:** Project Coordinator (S Achler) completed training. We hired a Research Assistant (K Smaller) who has assisted with developing reports and analyzing data. Due to Study Facilitator staffing changes, we hired a replacement team member (M Hendricksen) with program development experience who is undergoing facilitator training. The former Study Facilitator (J MacDonald) remains on the team as a nonclinical contractor to aid in the transition. The Blinded Assessor (B Fowler) announced a planned leave of absence anticipated to begin in October, so we have identified and begun training a replacement Blinded Assessor who is a PT with research experience (K Hohl). We continue to adapt to the ongoing training needs of clinicians. We provided centralized technical assistance upon request and dynamic ongoing training sessions.

c. **Aim 1: Qualitative data analysis, dissemination, and knowledge translation resource development:** We completed qualitative data analysis, presented the data nationally, and submitted the manuscript. The resultant barriers and facilitators were described in more detail in the previous reporting period and described in the 2021 Annual Report.

Additionally, we continued to develop and/or update a set of patient education (Table 2, Appendix A) and clinician resources (Table 3, Appendix B) based on barriers and facilitators to integrating technology into the PT clinic. The tables below summarize these resources. The full resources are included in appendices.

Appendix A includes resources for PwP:

Table 2: Resources for PwP (see ***Appendix A***)					
	Resource	Same as 2021	Revised	New	On Website
A(1)	Comprehensive list of fitness trackers, including wearables and apps, which lists out price, type of tracking, battery life, and instructions	X			
A(2)	Simple table of digital health technology options, which lists out the basic features of each device	X			
A(3)	Worksheet designed to help patients use digital health technology with a partner	X			X
A(4)	Handout with solutions to address cost as a barrier to using technology	X			
A(5)	Goal-setting worksheet designed for patients to use with their PT	X			X
A(6)	Step and Intensity Goal-Setting Worksheet			X	X
A(7)	Long-Term Engagement with PT Letter (modified to incorporate DHT language)		X		
A(8)	'Report card' to provide individual data back to each participant after they complete their 6 month assessment			X	

Appendix B includes resources for clinicians:

Table 3: Resources for PTs (see ***Appendix B***)					
	Resource	Same as 2021	Revised	New	On Website
B(1)	Documentation templates and tips for clinicians when documenting digital health intervention in the Electronic Medical Records (EMR)	X			
B(2)	Glossary of digital health terminology	X			X
B(3)	Highlighted revisions in pertinent organizational resources to improve practice based on clinician needs	X			
B(4)	Informational handout about use of education in therapy sessions	X			
B(5)	Fidelity Report for clinician documentation			X	

d. **Aim 2: Enroll, train, and facilitate physical therapists' use of technology and behavior change approaches:** In this reporting period, we consented four additional PTs to participate in the study (total n=8). After consenting, the PTs completed a brief pre-survey

measuring attitudes towards using digital health technology in clinical practice. We conducted individual educational meetings to onboard new PT participants (1/6/2022, 2/10/2022, 3/15/2022; one PT will undergo training in July 2022). The Study Facilitator also distributed the educational materials we listed above and described how to use them. The Study Facilitator then reviewed some example cases and discussed how to incorporate digital health technology into each case, including where and how to document the intervention in the EMR. ***Appendix C*** is the tool we developed and used to train PTs.

We conducted ongoing dynamic training sessions for participating PTs ('booster sessions' on 3/15/2022 and 5/19/2022). In these sessions, we discussed assessment of barriers and facilitators, provided and discussed aggregated audit and feedback, captured and shared local knowledge, and promoted program adaptability across sites. The training discussed: (1) the benefits of incorporating digital health technology into clinical care, (2) barriers and facilitators to incorporating digital health technology into clinical care, (3) basic terminology and features of different types of technology, (4) and the importance of considering digital literacy and usability when incorporating into clinical care. ***Appendix D*** includes the two booster session trainings.

We provide ongoing adaption of knowledge translation resources to facilitate the use of digital health technology and behavior change approaches as needed based on the iterative feedback and implementation process. We are tracking the ongoing adaptations to report in final dissemination products in order to optimize future uptake.

e. **Aims 2/3: Recruit, Consent, and Test People with PD:** As of 6/30/22, we *consented* the full cohort of 32 participants with PD, completed *baseline* testing for 27 participants, and completed *6 month follow-up* testing for 12 participants with PD. Additional baseline testing sessions are scheduled into August to align with the participants' clinical evaluations.

f. **Aims 2/3: Preliminary data analyses:** We are monitoring the post-test participant fitness and function data. We have provided a sample of our functional outcomes using the patient-reported MDS-UPDRS Part II – Motor Experiences of Daily Living in section 3 'Significant Results or Key Outcomes'

More specifically, the accomplishments outlined on the Statement of Work (Table 4) are below:

Table 4. Statement of Work with Updated Completion Column (completion as of 6/30/2022)	Timeline (month)	Completed or person responsible
GENERAL: Project Initiation and Researcher Development		
Major Task 1: Project Initiation		
Subtask 1: Submit IRB protocol and consent documents to Northwestern University for approval	1-3	Completed
Subtask 2: Submit protocol and other required documents to HRPO for approval	1-3	Completed
Milestone Achieved: Northwestern IRB and HRPO approval obtained		Completed
Major Task 2: Researcher Development		

Subtask 1: Attend sensor technology training with outside staff (e.g. Scott Delp or Fay Horak)	3-12	Completed, and will continue looking for opportunities for training
Subtask 2: Develop symposium outline and application for non-motor barriers to exercise in people with PD	6-12	Completed (presented at APTA CSM 2022)
Subtask 3: Develop education course for implementation science for rehabilitation audiences	12-18	Completed (presented at ACRM 2021)
Subtask 4: Complete advanced research training (comparative effectiveness modules and TIGRR)	6-18	Completed local grant writing workshops. Deferred TIGRR and CER application for NCE period.
Milestone Achieved: Submit R01 grant application		Completed – Submitted February 2022 – Scored 24th Percentile (impact score 39)
AIM 1: To compare barriers and facilitators to using digital health technology, from the perspectives of people with PD and physical therapists, before and after they use commercially-available sensors.		
Major Task 1: Exploratory Interviews		
Subtask 1: Recruit 12-20 people with PD from SRAlab, NM, and Chicagoland area support groups, complete interviews, and ongoing data analysis to determine when saturation is reached	3-4	Completed
Subtask 2: Recruit 12-20 physical therapists from SRAlab and surrounding area, complete interviews, and ongoing data analysis to determine when saturation is reached	4-5	Completed
Subtask 3: Recruit 12-20 technology stakeholders through SRAlab, NU connections, and mentors' connections, complete interviews and analyze data	4-5	Completed
Subtask 4: Final qualitative analysis codebook development	5-6	Completed
Milestone Achieved: Manuscript submitted comparing barriers and facilitators between stakeholder groups at baseline		Completed – Submitted June 2022
Major Task 2: Knowledge Translation Resource Development		
Subtask 1: Draft and revise resources for participating people with PD and physical therapists in preparation for aim 2	4-6	Completed
Milestone Achieved: Final resources available to begin aim 2		Completed
Major Task 3: Exit Interviews		
Subtask 1: Exit interviews completed for a minimum of 25 people with PD completing the study (up to 32)	12-22	MR BF (Ongoing, 12 complete as of 6/30/22)
Subtask 2: Exit interviews completed with physical therapists related to their use of digital health technology and for a minimum of 25 people with PD completing the study (up to 32)	12-22	MR (Ongoing, 1 complete as of 6/30/22)

Milestone Achieved: Integrate exit interview qualitative data into final mixed methods paper, summing and comparing how the barriers and facilitators are different in people who used technology compared to the original codebooks in naïve participants		Ongoing
AIM 2: To assess fidelity of digital health technology adoption (activity sensors and exercise tracking) by people with mild to moderate PD and their physical therapists.		
Major Task 1: Identify and train physical therapists		
Subtask 1: Identify physical therapist participants (approximately n=5) from the 8 therapists trained to complete Proactive PT evals	4-6	Completed
Subtask 2: Prepare clinic processes and documentation guides for digital health technology and behavioral strategy use in the clinic	4-6	Completed
Subtask 3: Train physical therapists on use of digital health technology and behavioral strategies to address non-motor barriers of exercise using technology	5-7	Completed
Milestone Achieved: Prospective observational study begins		Completed
Major Task 2: Recruit 32 people with early PD from Proactive Physical Therapy to participate in observational study		
Subtask 1: Finalize processes for participant recruitment in Proactive PT evaluation scheduling pipeline	4-6	Completed
Subtask 2: Amend IRB protocol documents to include any new resources or processes to facilitate digital health technology and behavioral intervention use that were developed as a part of Aim 1.	5-6	Completed
Subtask 3: Recruit 32 participants from SRAlab, Northwestern Medicine, and Chicagoland community as needed using referral development procedures if needed.	6-16	Completed
Milestone Achieved: Recruitment completed and closed		
Major Task 3: Determine fidelity of digital health technology and behavioral intervention use by physical therapists		
Subtask 1: Develop fidelity checklist for physical therapy documentation inclusion/use of digital health technology and behavioral interventions	5-6	Completed
Subtask 2: Use historic data from Proactive Physical Therapy participants to assess pre-implementation digital health technology and behavioral intervention use, matching historic patients to recruited patients	10-18	MR, JM (Ongoing)
Subtask 3: Compete fidelity checklist for recruited participants during their 6 month participation in the study	12-22	MR, MH (Ongoing, up to date)
Milestone Achieved: Physical therapy fidelity data finalized		
Major Task 3: Determine fidelity of digital health technology and behavioral intervention use by people with PD at baseline and final		
Subtask 1: Complete baseline testing in 32 participants	6-16	MR, JM (27 complete, ongoing)
Subtask 2: Complete final testing in 25-32 participants (survey and exit interview)	12-22	MR, JM (12 complete of 14 enrolled, 86% retention thus far)

Milestone Achieved: Patient fidelity data finalized		
AIM 3: To determine whether greater use of digital health technology and behavioral intervention strategies are associated with changes in fitness and function 6 months after evaluation.		
Major Task 1: Clinical fitness, physical function, and non-motor symptoms data collected		
Subtask 1: Complete baseline testing in 32 participants	6-16	MR, JM (27 complete, ongoing)
Subtask 2: Complete final testing in 25-32 participants (survey and exit interview)	12-22	MR, JM (12 complete of 14 enrolled, 86% retention thus far)
Subtask 3: Retain, track and schedule patients for data collection and compensation	6-22	MR, SA (Ongoing)
Milestone Achieved: Clinical data collection complete and processed		
Major Task 2: Data analyses completed		
Subtask 1: Determine changes in fitness and physical function measures	18-22	MR, SA, BF (Ongoing)
Subtask 2: Complete correlation and exploratory regression analysis	18-22	MR, SA
Milestone Achieved: Evaluate implementation and clinical outcomes complete		
Major Task 3: Project Wrap-Up and Dissemination of final results		
Subtask 1: Disseminate overall results and resources at clinical rehabilitation conference	22-24	MR, BF
Subtask 2: Disseminate overall results and resources to people with PD	22-24	MR, SA
Subtask 3: Disseminate overall results to technology researchers at conference	22-24	MR
Subtask 4: Close-out IRB and HRPO	24	MR, SA
Milestone Achieved: Project Complete		

3. Significant Results or Key Outcomes

Methods: The Aim 1 sample included PwP (n=13), outpatient physical therapists (n=12), and advanced technology stakeholders including researchers and reimbursement specialists (n=13). Semi-structured interviews were used to elicit implementation determinants related to using DHT for activity monitoring and exercise behavior change. We used deductive coding based on the Consolidated Framework for Implementation Research to describe implementation determinants. We used directed content analysis methods to compare stakeholder groups. For Aims 2, the Study Facilitator provided training, audit/feedback, and resources for clinician participants to educate them on digital health technology and behavior change interventions. For PwP participants, we used a 'bring your own device' approach, in which they were encouraged to use technology (phone, watch, app, etc.) they could already access. For Aim 3, a blind assessor is completing pre- and post-test surveys and in-person assessments, as well as exit interviews.

Aim 1 Results Overview: The results of pre-implementation qualitative research showed that key implementation determinants were similar across stakeholder groups. Key characteristics of the participants are reported in Table 5. Essential characteristics of DHT included design quality and

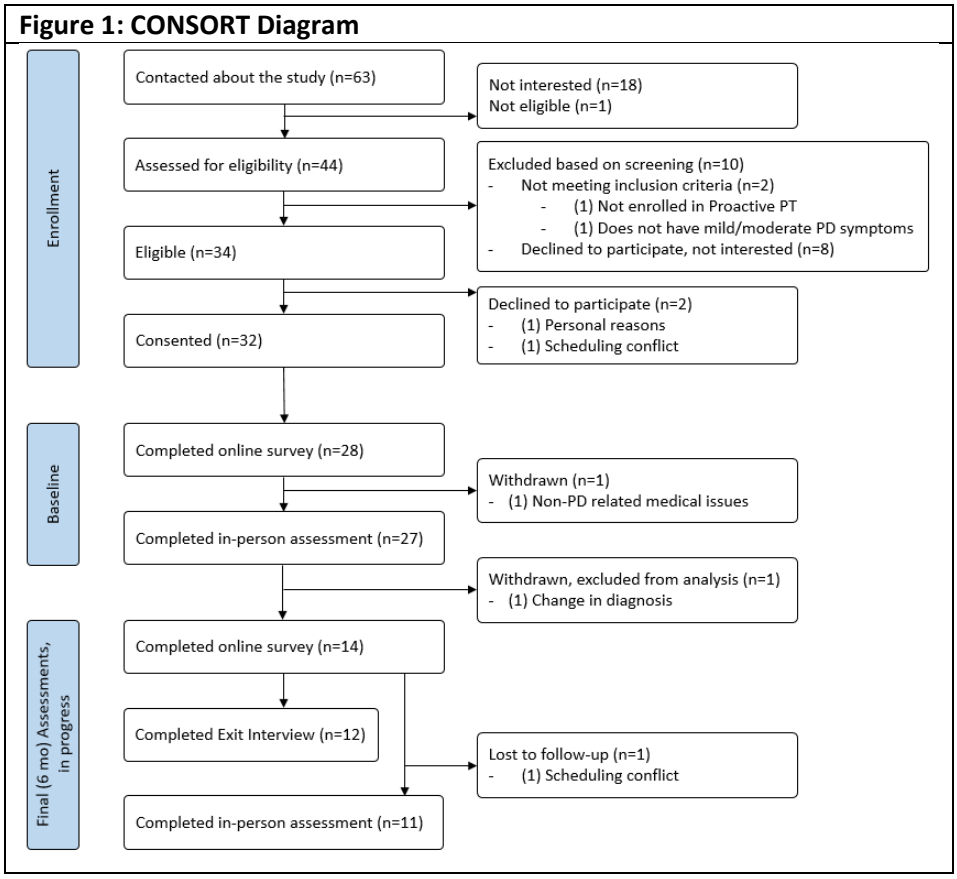
packaging, adaptability, complexity, and cost. Implementation of DHT by physical therapists and PwP was influenced by their knowledge, attitudes, and varied confidence levels in using DHT. Inner setting organizational determinants included available resources and access to knowledge/information. Process determinants included device interoperability with medical record systems and workflow integration. Outer setting barriers included lack of external policies, regulations, and collaboration with device companies. Our manuscript describing these results is currently under review for publication in the *Journal of Neurologic Physical Therapy*.

Table 5. Summary of Aim 1 Interview Participant Characteristics			
	PwP	**PTs**	**Tech Stakeholders**
Age years (mean ± SD)	65.31 ± 8.67	37.00 ± 6.35	47.38 ± 11.25
Characteristics	46% of PwP were within 3 years of diagnosis	Average 11 ± 7 years in practice	Average 14 ± 11 years in field
Confidence with Using Technology (scale of 1-10)	8.8 ± 2.8 (10 highest)	7.3 ± 1.8 (10 highest)	N/A

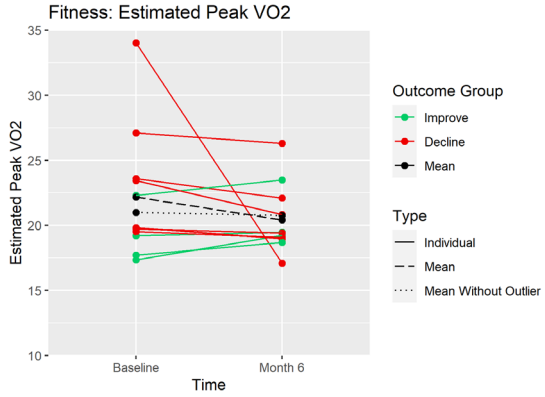
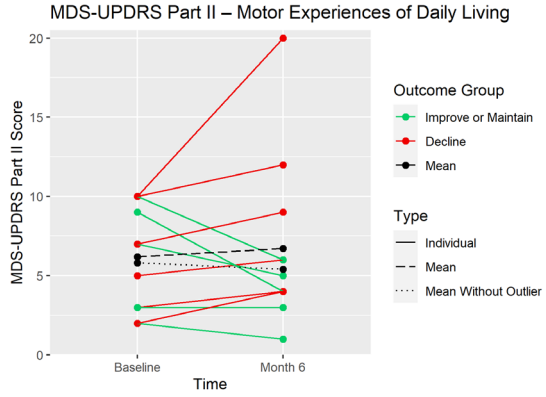
Aim 2/3 Results:

- **Recruitment and Retention:** A key result of this early career award was to understand our recruitment and retention rates for future larger studies. Our recruitment rate (32 enrolled / 63 contacted about the study) was 51%. Recruitment and retention (in progress) are depicted in Figure 1. 27 of 28 participants scheduled thus far have completed all baseline assessments. 11 of 14 (79%) anticipated participants have completed in-person final assessments. We are on track to achieve the 75% retention rate that we predicted.

Figure 1: CONSORT Diagram



- **Preliminary data on implementation outcomes:** At evaluation, trained physical therapists are documenting information about digital health technology 84.6 % of the time. This is compared to 65.4 % of the time in a retrospective review of gender and age (+/- 2 years) matched, historic control data. We also saw an improvement in specific documentation about wearable technology and fitness application use from 11.5% to 69.2% and 3.8 to 30.8%, respectively.
- **Preliminary data on fitness and functional outcomes.** We are tracking clinical outcomes. Fitness and functional outcomes appear stable over 6 months, except for one outlier who worsened. Figure 2A below shows 4 of 11 participants had improved or maintained estimated peak VO_2 over the 6 month study period. Figure 2B below shows 5 of 11 had improved or maintained self-reported motor experiences of daily living over the 6 month study period.

Figure 2A: Fitness Outcome Example	**Figure 2B: Function Outcome Example**
	
Individual outcomes of estimated peak VO_2 scores. Lower values indicate worse aerobic capacity.	Individual outcomes on self-reported "motor experiences of daily living" from the Movement Disorders Society (MDS) revision of the Unified Parkinson's Disease Rating Scale (UPDRS) Part 2 Questionnaire. Higher values indicate worse self-reported motor function.

4. **Other Achievements:** Nothing to report

What opportunities for training and professional development has the project provided? This early career award includes specific training activities for the professional development of the PI related to digital health technology, non-motor symptoms of PD, and behavior change interventions. This includes attending education, attending mentoring meetings, and preparing presentations to educate others on the topics of interest, which requires research and self-directed learning.

- **Mentoring Meetings**
  I continue to regularly meet with my mentors, Dr. Arun Jayaraman and Dr. Jennifer Goldman to discuss project progress and my personal professional development. During the past year, I met with Dr. Jayaraman approximately quarterly and Dr. Goldman monthly. They are both responsive to all email requests for meetings outside of regularly scheduled meeting times.

- **Providing Education as a Part of Professional Development**

Table 6: Providing Education as a Part of Professional Development – Gray rows indicate presentation was in prior years.			
Date	**Presenters/Authors**	**Topic**	**Audience**
8/4/2020	Santiago Toledo, Erica Sieg, Miriam Rafferty (organizer: Jennifer Goldman)	Motor and non-motor problems related to sleep impairment in PD	People with PD and caregivers
11/10/2020	Discovery Moment: Pro in Proactive in Parkinson's Care	Role of Rehabilitation (I present programmatic changes, Dr. Goldman presented non-motor symptoms	Community
2/6/2021	Daniel Corcos and Miriam Rafferty (organizer: Jennifer Goldman)	Exercise and non-motor Symptoms	Community
8/2022 and 10/2022	Miriam Rafferty	Developing Healthy Habits for PD using Digital Health Technology	Community (NU Support Group and Patient/Family Symposium)
8/2022	Miriam Rafferty, Lori Quinn	Physical Therapist-Led Interventions to Facilitate Exercise Uptake in Early Stage Parkinson's Disease: In-Person and Remote Delivery	Clinicians (ANPT Annual Meeting)
2/13/2022	Miriam Rafferty, Elissa Held Bradford, Meredith Roberts	Reframing the Revolving Door: Alternative Delivery Models to Optimize Outcomes in Neurologic Physical Therapy	Clinicians (APTA Combined Sections Meeting)

Additionally, this study contributes to the professional development of the PTs enrolled as participants. We conducted educational meetings and ongoing training. Participating PTs were trained in a dynamic, interactive session to provide education about digital health technology use. Additional touchpoints with an implementation facilitator occur formally in ongoing training sessions ('booster sessions') and informally at the request of PTs. Aim 1 results helped to inform the delivery of training and structure of supporting PTs during this process.

Additional work to inform and gain leadership support occurred in this time frame. On June 8, 2022, the Study Facilitator joined a standing meeting with physicians, researchers, and administrators to inform multiple opinion leaders of study progress.

How were the results disseminated to communities of interest? Thus far, our results from exploratory interviews from Aim 1 were disseminated through the knowledge translation resources and training session led by the clinical facilitator. These resources and training session have reached 7 participating physical therapists. Additionally, we disseminated results through the following mechanisms:

- October 1-3, 2021 (poster presentation; virtual): **Bridget Fowler** presented on behalf of herself, **Jillian MacDonald**, and **Dr. Miriam Rafferty** at the Academy of Neurologic Physical Therapy Conference, *"Barriers and Facilitators to Using Digital Health Technology in an Outpatient Clinic"* (*Appendix E)*
- October 2, 2021 (presentation; virtual): **Dr. Miriam Rafferty** co-presented with Dr. Lori Quinn at the Academy of Neurologic Physical Therapy 2021 Annual Conference, *"Physical Therapist-Led Interventions to Facilitate Exercise Uptake in Early Stage Parkinson's Disease: In-Person and Remote Delivery."*
- October 9, 2021 (presentation; virtual): **Dr. Miriam Rafferty** presented at the Northwestern Medicine Patient and Family Symposium, *"Developing Healthy Habits for PD using Technology."* This presentation had also been presented at a Northwestern patient support group in August.
- February 13, 2022 (presentation; hybrid in-person virtual): **Dr. Miriam Rafferty** presented at the American Physical Therapy Association Combined Sections Meeting with Dr. Elissa Held Bradford and Dr. Meredith Roberts on *"Reframing the Revolving Door: Alternative Delivery Models to Optimize Outcomes in Neurologic Physical Therapy"*
- April 1, 2022 (publication): **Rafferty, M. R**., Held Bradford, E. C., Fritz, S., Hutchinson, K. J., Miczak, K., Resnick, A., & Billinger, S. A. (2022). Health Promotion and Wellness in Neurologic Physical Therapy: Strategies to Advance Practice. *Journal of neurologic physical therapy: JNPT, 46*(2), 103–117. https://doi.org/10.1097/NPT.0000000000000376
- April 28, 2022 (poster presentation; Washington, DC): **Dr. Miriam Rafferty** presented a poster for the 2022 Claude D. Pepper Older Americans Independence Centers National Annual Meeting, *"Barriers and Facilitators to Using Digital Health Technology in an Outpatient Clinic: A Recurrent Cross Cross-Sectional Qualitative Study." (Appendix F)*
- Resources for PwP posted on our website: Step and Intensity Goal-Setting Worksheet, Technology Goal-Setting Worksheet, Partner Technology Worksheet
- June 16, 2022: Aim 1 manuscript submission to *Journal of Neurologic Physical Therapy*

What do you plan to do during the next reporting period to accomplish the goals?

1. **Aim 1 Dissemination.** Manuscript revision and publication
2. **PT Facilitation (Aim 2):** Continue ongoing training with PTs, and continue fidelity checking EMRs to ensure that PTs are successfully using their resources and training to execute the intervention.
3. **Complete Historic Control Data Collection (Aim 2/3):** Finalize data extraction and analysis from historic people with early PD seen in physical therapy, matched to study participants to assess pre-implementation digital health technology and behavioral intervention use by physical therapists.
4. **Final Participant Testing (Aim 3):** Complete 6 month testing (online, in-person, and exit interview) with participants with PD, with a goal of 75% retention.
5. **Aim 2/3 Dissemination:** Submit mixed methods manuscript and presentation abstracts with final analyses.

Section 4: Impact

What was the impact on the development of the principal discipline(s) of the project? The study team is beginning to disseminate knowledge translation tools on their website and through professional groups

that could increase the adoption of digital health technology and behavior change strategies in physical therapy. These will continued to be studied, optimized, and disseminated over the course of the study.

What was the impact on other disciplines? Dissemination activities increasingly target medical professionals, with a long term goal of helping physicians and advanced practice providers to refer more people with PD early after diagnosis to physical therapy, in concordance with clinical practice guidelines.

What was the impact on technology transfer? The data from this project was used in Dr. Rafferty's R01 submission. That submission hopes to use a commercially-available remote therapeutic monitoring platform (Datos). However, the use of data from a 'bring your own device' study creates data sharing and confidentiality concerns as it relies on data from the patients phone or personal activity monitors (e.g. apple watch) that are not approved as medical devices by the FDA. Dr. Rafferty is working with organizational industry research and legal experts to understand how to translate these types of technologies to allow for continuous monitoring rather than only monitoring by the PT during PT appointments.

What was the impact on society beyond science and technology? Nothing to report.

Section 5: Changes and Problems

***Changes in approach and reasons for change*:** Nothing to report.

Actual or anticipated problems or delays and actions or plans to resolve them: Recruitment for Aims 2/3 was slower than anticipated but was completed in June 2022. Actions to resolve recruitment delays included reducing the burden of recruitment efforts on the scheduler, increasing engagement of the participating PTs in enrolling their patients, and transferring more recruitment responsibilities to the research project coordinator. These changes were reviewed and approved by the local IRB and deemed non-substantive by HRPO.

***Changes that had a significant impact on expenditures*:** The project had a slow start due to COVID 19 working restrictions, working on preparatory activities to obtain IRB and HRPO approval, and staffing changes. A new PT facilitator (MH) has completed initial onboarding. The former PT facilitator is continuing on in a reduced role as a contractor to help the new facilitator as she learns her role and to assist with dissemination activities.

Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents: Nothing to report.

- ***Significant changes in use or care of human subjects:*** Nothing to report.
- ***Significant changes in use or care of vertebrate animals:*** N/A
- ***Significant changes in use of biohazards and/or select agents:*** N/A

Section 6: Products

Publications, conference papers, and presentations

***Journal publications**:*

Appendix G includes the full text of this publication:

> **Rafferty, M. R.,** Nettnin, E., Goldman, J. G., & **MacDonald, J.** (2021). Frameworks for Parkinson's Disease Rehabilitation Addressing When, What, and How. *Current neurology and neuroscience reports*, 21(3), 12. https://doi.org/10.1007/s11910-021-01096-0

Appendix H includes the full text of this publication:

> **Rafferty, M. R**., Held Bradford, E. C., Fritz, S., Hutchinson, K. J., Miczak, K., Resnick, A., & Billinger, S. A. (2022). Health Promotion and Wellness in Neurologic Physical Therapy: Strategies to Advance Practice. *Journal of neurologic physical therapy: JNPT, 46*(2), 103–117. https://doi.org/10.1097/NPT.0000000000000376

Books or other non-periodical, one-time publications: Nothing to report.

Other publications, conference papers and presentations: Nothing to report.

Website(s) or other Internet site(s): We have developed a web page for the study through our research lab website. This website provides a brief summary of the study. Knowledge translation tools for people with Parkinson's disease and physical therapists are also shared on this website. As we begin to disseminate results externally, we will also post our dissemination products on this website: https://www.sralab.org/research/labs/kteam/projects/digital-health-technology-physical-therapy

Technologies or techniques: Using stakeholder-identified themes from exploratory interviews, we developed a set of patient education and clinician resources, as well as a one-hour training presentation for participating PTs. The resources are described in *Section 3, Accomplishments*, and attached in Appendices A and B. We are beginning to share these resources on the website above.

Inventions, patent applications, and/or licenses: Nothing to report.

***Other Products*:** Nothing to report.

Section 7: Participants & Other Collaborating Organizations

What individuals have worked on the project?

Name	Miriam Rafferty
Project Role	Primary Investigator
Researcher Identifier	0000 0002 3182 0314
Nearest person month worked	2.60 calendar months
Contribution to project	- Oversaw all study-related activities, including weekly meetings, IRB revisions, promotion and dissemination of the project. - Assisted with development of training resources for facilitation in Aims 2-3 - Planned recruitment and communicated with interdisciplinary team to improve recruitment for Aims 2-3 - Aim 1 qualitative data analyses and presentation.

	- Senior author writing and team member mentoring for manuscript preparation for Aim 1

Name	Dr. Jennifer Goldman
Project Role	Mentor
Nearest person month worked	0 calendar months. Cost Share.
Contribution to project	- Provided Parkinson's disease-specific mentoring - Assisted with overall research professional development, including manuscript and grant writing - Helped Dr. Rafferty to connect with the international PD clinical and research community - Served as physician monitor of the clinical aspects of the program

Name	Arun Jayamaran
Project Role	Mentor
Nearest person month worked	0 calendar months. Cost Share.
Contribution to project	- Provided mentoring, particularly on the use of digital health technology in research and the clinic - Assisted with overall research professional development, including manuscript and grant writing

Name	Bridget Fowler King
Project Role	Research Physical Therapist
Nearest person month worked	1.51 calendar months
Contribution to project	- Assisted with interpretation and dissemination of qualitative data - Presented Aim 1 poster at ANPT - First author of Aim 1 manuscript (currently under review) - Blinded assessor for Aim 2/3 - Conducted quantitative exit interviews for PwP enrolled in Aim 2/3 - Began initial coding of quantitative exit interviews from Aims 2/3

Name	Jillian MacDonald
Project Role	Study Facilitator, Research Physical Therapist
Researcher Identifier	0000 0002 5365 3385
Nearest person month worked	0.80 calendar months
Contribution to project	- Conducted quantitative exit interview for one PT. - Provided interactive training and booster sessions. - Developed and adapted knowledge translation resources with iterative feedback from PTs. - Conducted technology assistance sessions for PwP - Engaged the community in a Parkinson's Foundation even, Moving Day to promote use of digital health technology to monitor activity during a walking even - Provided training for new research physical therapist who will fill facilitator role - Contributed to aim 1 dissemination and manuscript preparation

Name	Sydney Achler
Project Role	Project Coordinator
Research Identifier	0000-0002-8804-3077
Nearest person month worked	2.87 calendar months
Contribution to project	- Managed PwP participants; scheduled blinded assessments - Coordinated scheduling with all clinical sites - Distributed surveys for PwP - Managed transcription agency vendor communications and payment processing - Began initial coding of quantitative exit interviews from Aims 2/3

Name	Kevin Smaller
Project Role	Research Assistance
Nearest person month worked	1.10 calendar months
Contribution to project	- Cleaned, analyzed, and visualized data - Created facilitation report for audit and feedback data management - Created patient and clinician "Report Cards" - Assisted Blind Assessor with preparatory assessment tasks

Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period? N/A

What other organizations were involved as partners?

Organization name	Transcription Star
Location of organization	53 Emerald Rd, Robbinsville NJ, 08691
Contribution to project	Transcription services (the company uses a HIPAA-compliant platform to transcribe interviews for us. We upload interviews as either mp4 or mp3 files onto the secure platform, and they return back to us each transcription in turn.)

Organization name	Northwestern University
Location of organization	259 E Erie St, 19th Floor, Chicago, IL 60611
Contribution to project	In kind support for assistance with recruitment and dissemination activities

Section 8: Special Reporting Requirements

Collaborative Awards: Nothing to Report.

Quad Chart: *See Attached.*

Section 9: Appendices

Appendix A: Resources for people with PD
Appendix B: Resources for clinicians
Appendix C: Digital health technology training for clinicians

Appendix D: Ongoing dynamic training for clinicians (“Booster Sessions”)
Appendix E: Aim 1 Poster, Academy of Neurologic Physical Therapy
Appendix F: Aim 1 Poster, NIA Older Americans Independence Centers Annual Meeting
Appendix G:

Rafferty, M. R., Nettnin, E., Goldman, J. G., & **MacDonald, J.** (2021). Frameworks for Parkinson's Disease Rehabilitation Addressing When, What, and How. *Current neurology and neuroscience reports*, 21(3), 12. https://doi.org/10.1007/s11910-021-01096-0

Appendix H:

Rafferty, M. R., Held Bradford, E. C., Fritz, S., Hutchinson, K. J., Miczak, K., Resnick, A., & Billinger, S. A. (2022). Health Promotion and Wellness in Neurologic Physical Therapy: Strategies to Advance Practice. *Journal of neurologic physical therapy: JNPT, 46*(2), 103–117. https://doi.org/10.1097/NPT.0000000000000376

Appendix A

A(1): Comprehensive list of fitness trackers: Wearables and Apps

Wearables:

Device	Price	Tracker/ Smartwatch	Battery Life	Associated App	Website Link	User Manual	Instructions Video
Fitbit Charge 4	$149	Tracker	7 days	Fitbit	Fitbit	Manual	Video
Fitbit Inspire HR 2	$99	Tracker	10 days	Fitbit	Fitbit	Manual	Video
Fitbit Ace 2	$69	Tracker	5 days	Fitbit	Fitbit	Manual	Video
Fitbit Versa 2	$179	Smartwatch	6 days	Fitbit	Fitbit	Manual	Video
Fitbit Versa 3	$229	Smartwatch with GPS	6 days	Fitbit	Fitbit	Manual	Video
Garmin Vivosmart 4	$129	Tracker	7 days	Garmin Connect	Garmin	Manual	Video
Garmin Vivosport	$169	Tracker	7 days	Garmin Connect	Garmin	Manual	Video
Garmin Vivofit 4	$79	Tracker	1+ year	Garmin Connect	Garmin	Manual	Video
Garmin Vivoactive 3 music	$249	Smartwatch with GPS	7 days	Garmin Connect	Garmin	Manual	Video
Garmin Vivoactive 4	$349	Smartwatch with GPS	7 days	Garmin Connect	Garmin	Manual	Video
Garmin Vivomove 3	$199	Smartwatch with GPS	5 days	Garmin Connect	Garmin	Manual	Video
Garmin Venu Sq	$199	Smartwatch with GPS	6 days	Garmin Connect	Garmin	Manual	Video
Polar Unite	$149	Smartwatch	50 hrs	Polar Flow	Polar	Manual	Video
Polar Vantage M	$279	Smartwatch with GPS	30 hours	Polar Flow	Polar	Manual	Video
Polar Ignite	$229	Smartwatch with GPS	17 hours	Polar Flow	Polar	Manual	Video
Huawei GT	$119	Smartwatch with GPS	14 days	Huawei Health	Huawei	Manual	Video
Honor Band 5	$39	Tracker	20 days	Huawei Health	Amazon	Manual	
Pedometer	$0-15	Tracker	variable	None	many vendors		
amazfit Bip	$60	Smartwatch with GPS	30 days	Amazfit	Amazon	Manual	
Samsung Galaxy Fit 2	$59	Tracker	14 days	Samsung Health Monitor	Samsung	Manual	
Samsung Galaxy Watch Active2	$249	Smartwatch with GPS	43-60 hrs	Samsung Health Monitor	Samsung	Manual	
Apple Watch 3	$199	Smartwatch with GPS	18 hours	Apple Health	Apple	Manual	Video

Apple Watch SE	$279	Smartwatch with GPS	18 hours	Apple Health	Apple	Video
Apple Watch 6	$399	Smartwatch with GPS	18 hours	Apple Health	Apple	Video
Whoop Strap 3.0	Free with $30/month membership	Tracker and app	5 days	Whoop	Whoop	Video
MYZONE® MZ-3 Physical Activity Belt	$149.99	Tracker	6 months	Myzone	Myzone	Video
MYZONE® MZ-1 Physical Activity Belt	$89.99	Tracker	6 months	Myzone	Myzone	Video
MYZONE® MZ-60 Watch	$59.99	Tracker			Myzone	

Apps:

App Name	Cost	Upgrade cost	Device restrictions?	Built in exercise programs	Type of tracking	Social connections	Social connection options	Other comments	Instructions Video
Fitbit	Free	9.99 /month	Yes (Fitbit device)	Free video and audio workouts	Pairs with smartphone to track steps and distance; pairs with Fitbit tracker/smartwatch to track steps, distance, calories burned, floors climbed, and active minutes	Yes	Can connect with friends and start activity challenges		
Garmin Connect	Free		Yes (Garmin device)	Free expert coaching and dynamic training plan	Tracks performance (training status, VO2 max, functional threshold power), activities, health (energy levels, sleep, stress, HR, respiration), women's health (menstrual cycle and pregnancy)	Yes	Easy to share on social media; can create/join challenges to compete with other users; can create groups with friends and compete in step/distance challenges with friends; compare badges with friends; can let friends/family follow your activities in real time (LiveTrack feature)	Can earn badges	Video
Polar Flow	Free		Yes (Polar device)		Tracks active time, burned calories, steps, and distance from steps	Yes	Can follow or check in on friends to view their progress	Receive inactivity alerts encouraging you to get up and move; Give your coach or PT easy access to your training data with the free Polar Flow for Coach service.	Video
Zepp (formerly Amazfit)	Free		Yes (Zepp/Amazfit device)		Records steps taken, sleep hours, heart rate, calories burned, ECG, and SpO2, while also provides you with professional interpretations over these data	No			

Apple Health	Free		Yes (Apple devices)		Tracks workouts, steps, walking, and running distances and all-day activity	No		Video
Samsung Health	Free		Yes (Samsung device)	Videos of expert coaches to teach fitness programs (stretching, endurance training, weight loss, etc.)	Tracks your daily progress on your physical activity, workout intensity, sleep quality, heart rate, stress and blood oxygen levels.	Yes	Samsung Health Together: allows you to challenge yourself against friends/family	Video
Huawei Health	Free		Yes (Huawei device)		Records steps, calories, exercise distance, exercise time, and sleep	No		
Clock Yourself	2.49		No	Has challenges that involve exercises for your body and brain	Activity log counts how many steps you've done with Clock Yourself and how many minutes you exercised for etc.	Yes	Can share sports data with friends	
Noom	Free	9.99	No		Food logging and water tracking feature	No		Video
9zest	21.49 /month		No	Has a library of exercise videos for debilitating conditions like PD, stroke, chronic pain, stress, and anxiety	Tracks completion of workouts	No		Video
Fitness22 (Workout, 5K Runner, 10K Runner, Run Tracker, Sunsa Yoga apps)	Free	Multiple upgrade options	No	Has multiple workouts	Run Tracker: tracks pace, location, distance, elevation, HR, and running splits; 5K & 10K Runner: tracks distance and location	No		
FitNotes	Free	2.99	No		Helps to track weightlifting workouts and cardio exercises	No		
Google Fit	Free		No		HR, speed, pace, route; tracks real-time stats for runs, walks, and bike rides	No	Earn Heart Points for each minute of moderate activity	Video
MedBridge GO for Patients	Free		No	Looping demonstrations of exercises	Allows patients to track activity streaks and completed exercises	No	Enables patients to communicate with healthcare provider	
Strava	Free	7.99	No		Get key stats like distance, pace, speed, elevation gained & calories burned	Yes	Segment leaderboard: compare your performance to other users	Video
Peloton	Free for 30 days	12.99 /month	No	Live and on-demand classes	Tracks HR, pace, splits and elevation metrics	Yes	Work out in real time classes with others; can follow friends on the app to view their progress	
Walkingspree	Free		No	Team Challenges: Virtual Walks, Star Wars Challenge, Olympic-style Challenge, and Team	Track food and calories consumed	Yes	Invite/compare stats with friends; See where you rank among Top Walkers; Participate in team Challenges	

Mapmyrun	Free	5.99 /month	No	Tournament Challenge	Monitor HR zones; audio coach updates, including pace, cadence, distance, duration, calories, and more; log activities	Yes	Use Live Tracking to share real-time running location with friends/family	
JEFIT	Free	6.99 /month	No	Largest exercise database with weight training exercises; workout routine database	Track workouts, cardio and strength training exercises, weight/reps and sets for exercises	Yes	Connect with and add friends; share progress and compare stats with the community; share your workouts on social media	Video
Leap Fitness Step Counter	Free	2.99	Only available through Google Play store?		Counts your steps; tracks burned calories, walking distance and time, etc.	No		
MyFitnessPal	Free	9.99 /month	No		Log food and water, tracks calories, tracks nutrients, log cardio and strength exercises, tracks steps	Yes	Add friends, join community, share accomplishments in news feed	Video
Runkeeper	Free	9.99 /month	No	In-app challenges, virtual running groups	Record activities like running, walking, biking, hiking and more manually or with GPS; Choose the stats you want to hear during your activity like pace, distance, and time	No		
Strong Workout Tracker Gym Log	Free	4.99 /month	No	Range of cardio and strength exercises; library of animated videos	Keep track of your bodyweight, body fat percentage, or any other measurements.	No		Video
Whoop	$30 /month		Yes (WHOOP Strap)		Shows the strain of workouts; tracks running and cycling routes including distance and speed; displays details on sleep (time spent in each sleep stage, time it takes to fall asleep, # of distrubances during the night)	Yes	If you join WHOOP as a team, the WHOOP app allows you to see the Strain and Recovery scores of your teammates.	Video

A(2): Simple table of digital health technology options

Program	Examples of Popular Options	Basic Features
Phone Health App	• Apple Health (iPhone) • Google Fit (Android) • Samsung Health (Galaxy)	Aggregating/visualizing recorded data; tracking type of activity, active time, distance travelled, steps taken, elevation climbed, calories burned; compatible with other exercise apps/devices
Simple wrist activity tracker	• FitBit Charge 4 • FitBit Inspire HR 2 • Garmin Vivosmart 4 • MYZONE® MZ-60 Watch • Samsung Galaxy Fit 2	Tracking a run, monitoring sleep patterns, heart rate monitoring, and step counting
Pedometer	• FitBit Inspire 2 • FitBit Versa 2 • Garmin Vivofit 4 • Xiaomi Mi Band 3	Measuring distance (numbers of steps you take/ miles you travel)
Medbridge Home Exercise Program	N/A	Allows clinicians to build custom plans using library of exercises and educational materials

A(3): Worksheet designed to help patients use digital health technology with a partner

Let's Sync our Tech!

Work with a family member or friend to start using digital health technology together!

Why sync your digital health technology?

Digital health technology is a great tool to use to increase your exercise levels. Using the social connection features of digital health technology can help both you and your loved one work together to be more active and have fun while exercising.

Can you help your loved one set up social connection features on their activity tracker?

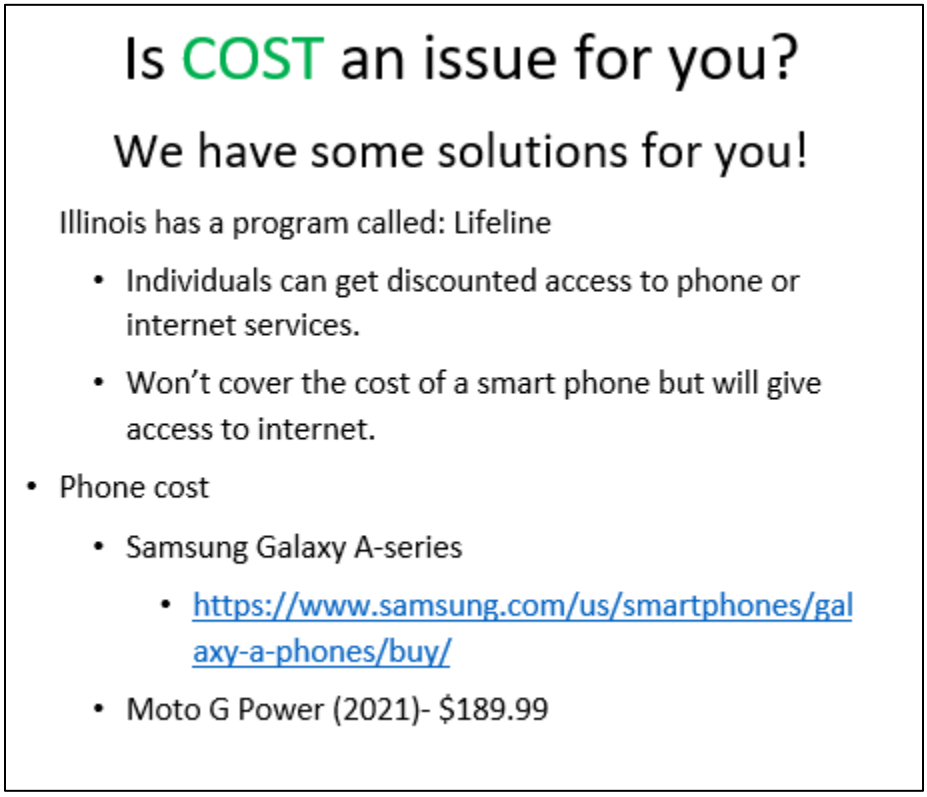
Name your activity trackers*:

Partner 1's activity tracker: _____ Partner 2's activity tracker: _____

General steps for setting up social connections on digital health technology**:	Check off:
Step 1: Turn on all necessary devices. *This includes the activity tracker and any phone/tablet/computer that is needed to run the desired fitness app or program.*	☐ Partner 1 ☐ Partner 2
Step 2: If necessary, download the shared fitness app you will use with your activity tracker. *PAUSE: Check that your fitness tracker/app has social connection features. You and your partners will need to be using the same app. IF your devices don't match, search for an app that allows you to connect with others.* • *You can find these in app store* • *Some free options include: Strava, MyFitnessPal, WalkingSpree, Mapmyrun, and JEFIT*	☐ Partner 1 ☐ Partner 2
Step 3: Open the app and sync the activity tracker with the app. *For example, to sync Fitbit activities to the Strava app, use the following steps: Open the Strava app and go to Settings > Applications, Services, and Devices > Connect a new device to Strava > Fitbit*	☐ Partner 1 ☐ Partner 2
Step 4: Go to the main dashboard of the activity tracker or app you are using to connect with friends. From here, follow device or app-specific steps to add friends. *For example, here are some common pathways to adding friends on a device/app:* • *Fitbit: tap the Today tab> tap your profile picture > tap your name > View All Friends > Add Friends* • *Strava: open the activity you would like to add friends to > Add Friend* • *Myfitnesspal: go to the Friends page > Add Friends*	☐ Partner 1 ☐ Partner 2

*An Activity Tracker is any device you will use to monitor your physical activity, exercise or steps. This might be a watch you wear on your wrist or some other monitoring device.
** Specific steps for connecting will differ based on the device/app being used. These steps provide a general outline of the process.

A(4): Handout with solutions to address cost as a barrier to using technology



Is COST an issue for you?

We have some solutions for you!

Illinois has a program called: Lifeline

- Individuals can get discounted access to phone or internet services.
- Won't cover the cost of a smart phone but will give access to internet.

- Phone cost
  - Samsung Galaxy A-series
    - https://www.samsung.com/us/smartphones/galaxy-a-phones/buy/
  - Moto G Power (2021)- $189.99

A(5): Goal-setting worksheet designed for patients to use with their PT

(Page 1 of 4)

Technology Goal Setting Worksheet

This worksheet is designed to help you work with your physical therapist to make decisions on how to use technology to track and improve your exercise.

How to use this resource:

Go through this worksheet and questions individually first, and then follow up with your **physical therapist** to make decisions together on what is right for you.

Why is digital health technology useful?

1. Gives you **motivation to exercise**: "The fitness tracker itself is a motivator for me."
2. **Measures your progress:** "That's the key…just knowing where you are and knowing where you're going or having a goal of where you're going. And without the data you'd be kind of flying blind."
3. **Is fun to use**: "It makes it fun! If anything, it can make it fun."
4. Can **share data** with your healthcare team: "There's metrics that I track every couple of months. And then every time I go in with my doctor, I have metrics of where I was a year ago, [or the] last six months."
5. **Automatically records** information like heart rate, sleep, minutes spent exercising and or steps per day.
6. Allows for **competition** with friends or family or yourself!

Important Stuff: We recommended that you consult with your physician or physical therapist about any pain you have before starting a new exercise regime. You should also consult your physician if you have any dizziness, chest pain, difficulty breathing, or if you have noticed changes in your walking or balance that could affect your safety.

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Let's Get Moving with Technology!

1. **Do you use any of the following technology devices? (circle all that apply):**

Computer	Smart phone	Tablet	Fitness tracking watch or pedometer

2. **Do you use an activity tracker (aka fitness tracker)?** **YES** **NO**

IF YES: Do you use your device regularly? **YES** **NO** **SOMETIMES**

IF YES: What type of device you use? (circle all that apply):

Smart watch	Waist tracker	Chest device	Clip-on device

IF YES: What features are most important to you? (circle all that apply):

Battery life	Sharing data	Cost	Heart rate monitor	Step counting	Target zones
Lots of types of exercise	Sleep monitor	Easy to use	Tracking variety day to day	Other:	Other:

IF YOU DON'T USE AN ACTIVITY TRACKER ALREADY: Do you want information on activity trackers that might be beneficial for you? **YES** **NO** **MAYBE**

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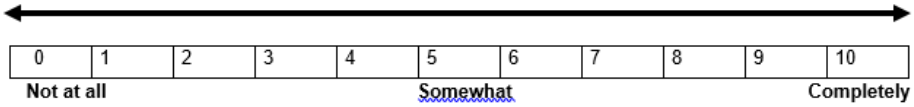
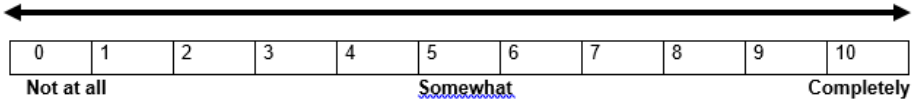
(Page 3 of 4)

3. **How comfortable are you using digital health technology?**



4. **How ready are you to use digital health technology?**



5. **During the past month, to what degree have the following challenges kept you from exercising?**

	Almost never	Moderately	Quite a lot
Physical Problems (fatigue, pain, sleep, fear of falling)	0	1	2
Mood or Motivation Problems (feeling apathetic/depressed)	0	1	2
Lack of Time (time commitments, family, work, appointments)	0	1	2
Environmental Challenges (weather, convenient classes/gym)	0	1	2
Lack of Information about exercise for PD	0	1	2
Lack of Social Support from family, friends, or peers	0	1	2

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If you have strategies or ideas about for using technology, proceed to fill in the details. Otherwise, fill this out with your therapist in the clinic session.

6. With your therapist or independently what strategies might you try to use to address some of your challenges to exercise or using activity tracking devices.

_____

7. What are your goals for physical activity and exercise?

1. _____
2. _____
3. _____

8. How can you use your activity tracking device to reach your goals?

_____

9. What is a good timeline for you to check back in with your therapist regarding your progress toward your goals for exercise?

Plan/Timeline:

_____

_____

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A(6): Step and Intensity Goal-Setting Worksheet

Wearable activity trackers can help with monitoring your health goals and progress

Number of steps

- Taking regular steps is important to leading an active lifestyle.
- Individuals with mild to moderate PD average 4700-4800 steps/day.[1]
- 5000 steps/day is considered a cut-off for identifying a more sedentary lifestyle.[2]
  - 7500 steps/day are associated with a Physically Active Lifestyle
  - Taking greater than 7000 step/day has been linked to longer life![3]
- **Aiming to increase your step count by as little as 1000 steps/day can result in positive health impacts.[4]**

What are your current steps/day? _____

What is your goal for steps/day? _____

Intensity

Science shows its best to exercise for 150m minutes/week at moderate to vigorous intensity.[5] You can monitor your heart rate to determine the intensity.

What is your current heart rate range with exercise? _____

What is your goal heart rate range for exercise? _____

Other Features

Monitors can capture sleep information, provide a place to record water intake, or also help you seek help in an emergency!

Ask your therapist for additional uses and resources about monitoring your health with a wearable activity monitor!

1. Benka Wallén, M, et al. Levels and Patterns of Physical Activity and Sedentary Behavior in Elderly People With Mild to Moderate Parkinson Disease, *Physical Therapy*, Volume 95, Issue 8, 1 August 2015, Pages 1135–1141, https://doi-org.ezproxy.galter.northwestern.edu/10.2522/ptj.20140374
2. Tudor-Locke, C, et al. A step-defined sedentary lifestyle index: <5000 steps/day. *Applied Physiology, Nutrition, and Metabolism*. 38(2): 100-114. https://doi-org.ezproxy.galter.northwestern.edu/10.1139/apnm-2012-0235
3. Paluch, AE, et al. Steps per day and all-cause mortality in middle-aged adults in the coronary artery risk development in young adults study. JAMA Network Open, 4: 1-12.
4. Hall KS, et al. Systematic review of the prospective association of daily step counts with risk of mortality, cardiovascular disease, and dysglycemia. Int J Behav Nutr Phys Act. 2020 Jun 20;17(1):78. doi: 10.1186/s12966-020-00978-9. PMID: 32563261; PMCID: PMC7305604.
5. Penko, AL, et al. Borg scale is valid for ratings of perceived exertion for individuals with Parkinson's disease. Int J Exerc Sci. 2017 Jan 1;10(1):76-86. PMID: 28479949; PMCID: PMC5213192.

A(7): Long-Term Engagement with PT Letter (modified to incorporate DHT language)

Shirley Ryan AbilityLab

355 East Erie Street, Chicago, IL 60611 | 844.355.ABLE (2253) | sralab.org

Participant Name:

Therapist Name:
Therapist Contact:

Dear Participant,

Thank you for attending our therapy program for Parkinson's disease. Together, you and your therapist have decided that you will benefit from a return to PT in __ months to:

- Assess your movement to give insight into your function, mobility & balance.
- Review your exercise and activity.
- Provide you with updates from research regarding PD and exercise.

You may choose to contact your therapist sooner if any of the following occur:

- You notice a change in your function, mobility or balance.
- You notice a decrease in your exercise and/or physical activity habits and need help working through barriers to get back on track.
- You are no longer meeting your goals for steps/day or exercise intensity.
- You experience a setback or injury that requires rehab to restore your previously level of activity.
- You have questions about how to improve or modify your exercise or physical activity routines.

At the Shirley Ryan AbilityLab, we value your health and quality of life. We know that meeting regularly with your team, in a manner much like the dental model, we can ensure that you are feeling well and address any barriers that may limit you.

In order to return to see your therapist, please take the following steps:

1. Contact your physician for a referral to physical therapy that states: "Physical Therapy, Evaluate and Treat" AND have them include the diagnosis of Early Stage- Parkinson's Disease.
2. Contact our team to schedule at: 312-238-PDMD (7363).

If you have any questions or concerns before this time, please reach out to your therapist by phone or through the AbilityLab Portal.

Thank you!
-The team at the Shirley Ryan AbilityLab

Advancing Human Ability.

A(8): Participant 'Report Card' (de-identified sample)

Physical Therapy Exercise Study: Progress Report

Dear [redacted],

Thank you for participating in our study. Below is some of the information we've collected. We've sent this to your physical therapist, [redacted]. If you have any questions about your results, you can give them a call at [redacted]. If you have any questions about the study, you can reach out to Sydney Achler at sachler@sralab.org or (312) 238-7275. This information could be helpful to your other care providers.

Tests & Measures	Visit 1 12/15/2021	Visit 2 6/10/2022	Typical Values (for your age & gender when available)
Self Select Gait Speed Average (meters/second) The speed you can walk at your comfortable pace. A higher score means a faster pace.	0.91	1.02	Average = 1.33 m/s
Fastest Gait Speed Average (meters/second) The speed you can walk at your fastest pace. A higher score means a faster pace.	1.19	1.79	Average = 2.08 m/s
Six Min Walk Test (6MWT) (meters) The distance you can walk over six minutes. The higher your score, the farther you walked.	501.40	554.74	Average = 574 meters
Mini-BEST Total Score A measure of overall balance control. A higher score means better balance. Out of 28 points.	14	21	Fall risk increases if 20 or less
Timed Up and Go Test (seconds) The time is takes you to get up from a chair, walk a short distance, turn and sit down. A lower score means it takes less time to complete the task.	9.41	9.135	Mean time = 8.39
Timed Up and Go Test - Dual Task (seconds) The time it takes you to complete the Timed up and Go Test while performing a math problem. The less time the better.	11.95	21.36	Fall risk increases at 15 seconds or more
Physical Activity (minutes/week) The average amount of time you said you exercise in a week.	30.00	180.00	Goal at least 150 min.
Parkinson's Disease Questionnaire - 39 Score A self-reported measure of PD-related quality of life. A lower score is better. Out of 100 points.	12.29	30.47	In early stages of PD, averages range from 18-32
Self-Efficacy for Exercise Scale A self-reported measure of how barriers affect your likelihood to exercise. A higher score is better. Out of 10 points.	8.22	6.67	Average = 5.5 points
Starkstein Apathy Scale A measure of your feelings of apathy (lack of interest or motivation). A lower score is better. Out of 42 points.	5	5	14 or more suggests follow up is needed
Anxiety - Hospital Anxiety and Depression Score A measure of your feelings of anxiety. A lower score is better. Out of 21 points.	30.47	7.00	More than 8 suggests follow up is needed
Depression - Hospital Anxiety and Depression Score A measure of your feelings of depression. A lower score is better. Out of 21 points.	5.00	10.00	More than 8 suggests follow up is needed
Any other measurements we wanted to direct your attention to:			

Appendix B

B(1): Documentation templates and tips for clinicians

CURRENT PHYSICAL ACTIVITY			
	MODERATE INTENSITY		
		type / kind:	
		minutes per day:	
		times per week:	
		TOTAL mins per week:	0
	VIGOROUS INTENSITY		
		type / kind:	
		minutes per day:	
		times per week:	
		TOTAL mins per week:	0
	STRENGTH		
		type / kind:	
		minutes per day:	
		times per week:	
		intensity:	
		TOTAL mins per week:	0
	FLEXIBILITY		
		type / kind:	
		minutes per day:	
		times per week:	
		TOTAL mins per week:	0
	BALANCE		
		type / kind:	
		minutes per day:	
		times per week:	
		intensity:	
		TOTAL mins per week:	0
	GOALS:		
Barriers to Exercise:			
Facilitators to Exercise:			
DIGITAL HEALTH TECHNOLOGY:			
	Activity Tracker:		
From Device:	Steps/day:		
	Use (min/day):		
	Use (days/week):		
	Intensity range:		
Barriers to digital health technology use:			
Facilitators to digital health technology use:			

B(2): Glossary of digital health terminology

Digital Health Technology Glossary

General Terms:

Digital Health Technology: Any technologies that use computing platforms, connectivity, sensors, and software for healthcare-related purposes.

- *Example(s): Wearable devices, phone and/or computer applications that are used to track exercise*

Activity Tracker/Fitness Tracker: An electronic device that is able to monitor some type of human activity (walking, running, sleep, heart rate, etc.).

- *Example(s): **Wearable sensors** (Sensors located in wearable objects that are able to monitor health and provide data that is clinically relevant)*

Smartwatch: A type of wearable activity tracker that is worn on the wrist and has a touchscreen display.

- *Example(s): Apple Watch, Fitbit, Garmin watches, Samsung Galaxy Watch*

Fitness app: An application that can be downloaded on a mobile device and used for health-related purposes in order to get fit.

- *Example(s): Apple Health, Noom, Strava, Google Fit, Walkingspree, Myfitnesspal, Medbridge, etc.*

Fitness Website: A way to access the activity information through an internet page.

- *Example(s): Fitbit.com*

Fitness app/website-specific features:

Dashboard: The dashboard is a summary page that can be set up for easy reference.

- *Example(s): Summary, Today*

Step Count: Measurement of number of steps taken and/or distance travelled. This is often adjustable based on the individuals' preferences.

Intensity Monitoring: Measurement of the intensity of an exercise using heart rate or one's perceived rate of exertion.

- *Example(s): Heart rate zones, Myzone Effort Points (MEPs)*

Goal Setting: Making a plan for something you want to accomplish and setting measurable goals and timeframes.

- *Example(s): Closing Activity Rings on Apple Watch, Earning badges/points*
- Goals can be self-set or, in some cases, they will be updated by an algorithm in the technology.

Notifications: An announcement or warning given in the form of a message, sound, or symbol on one's device.

- *Example(s): Inactivity alerts*
- Notifications can often be modified in the app OR through the phone "Settings" menu.

Social Connection: Relationships with family, friends, co-workers, and other people around you.

- *Example(s): **Leaderboard** (Compares your performance to other users), Challenges with family/friends, "Together" on Samsung, "Community" on Fitbit.*

Sharing Information: The ability to click an icon and send your activity data to a contact.

- *Example(s): Emailing or sending a notification*

Other Important Terms:

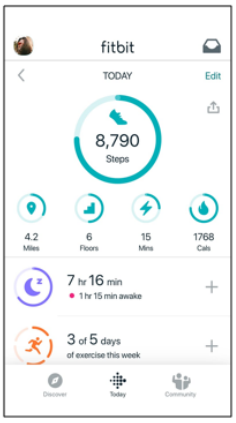
Digital literacy- Life and work skills needed to safely benefit from, participate in and contribute to the digital world of today and the future. Further, digital literacy is an individual's ability to communicate, handle information/content, manage transactions, problem solve, and remain safe and legal when using technology.

Usability- The International Organization for Standardization has defined usability as, "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" .

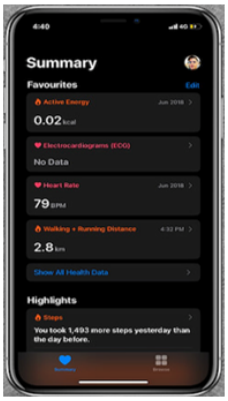
Examples of Terminology

Dashboard:

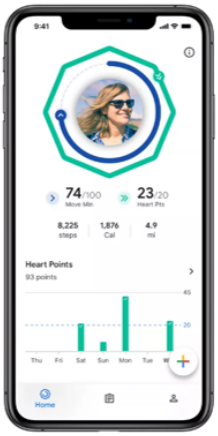
Fitbit



Apple Health

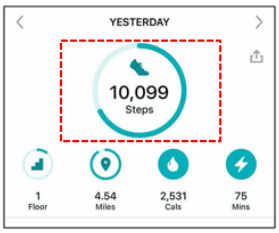


Google Fit

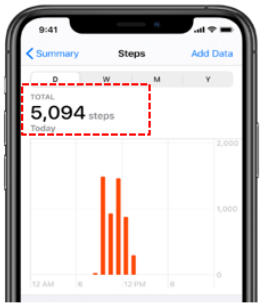


Step Count:

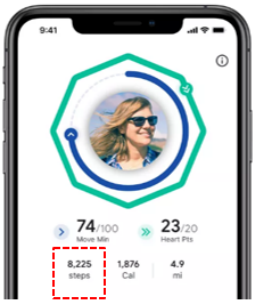
Fitbit



Apple Health



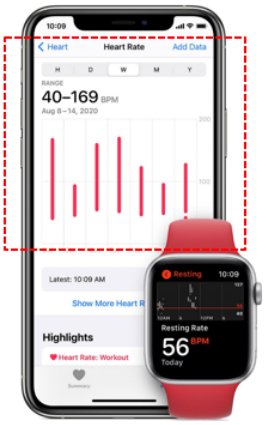
Google Fit



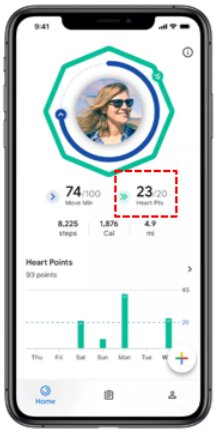
Intensity Monitoring:

Fitbit

Apple Health

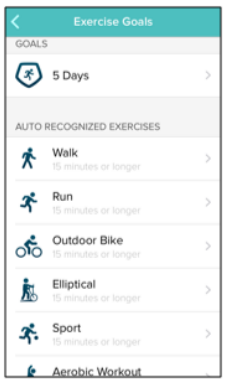


Google Fit

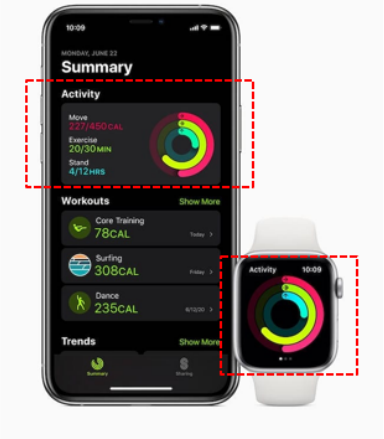


Goal Setting:

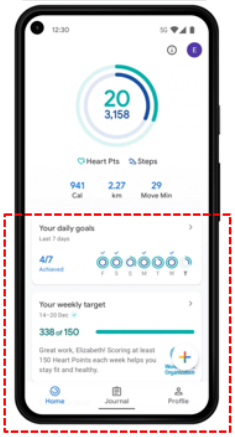
Fitbit



Apple Health (paired with Apple Watch)

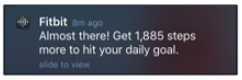


Google Fit

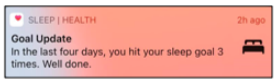


Notifications:

Fitbit



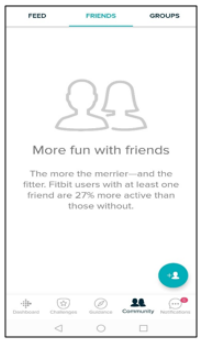
Apple Health



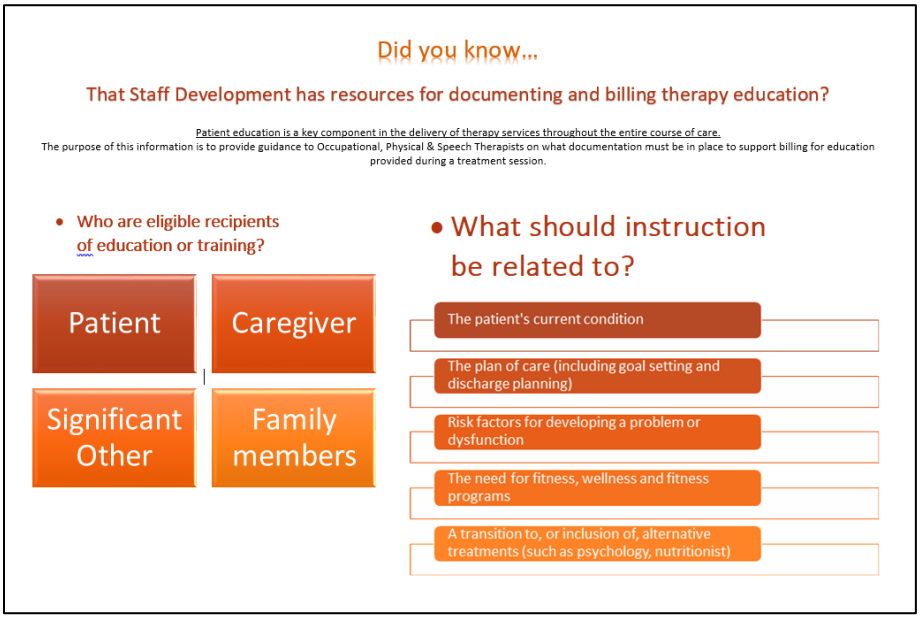
Google Fit

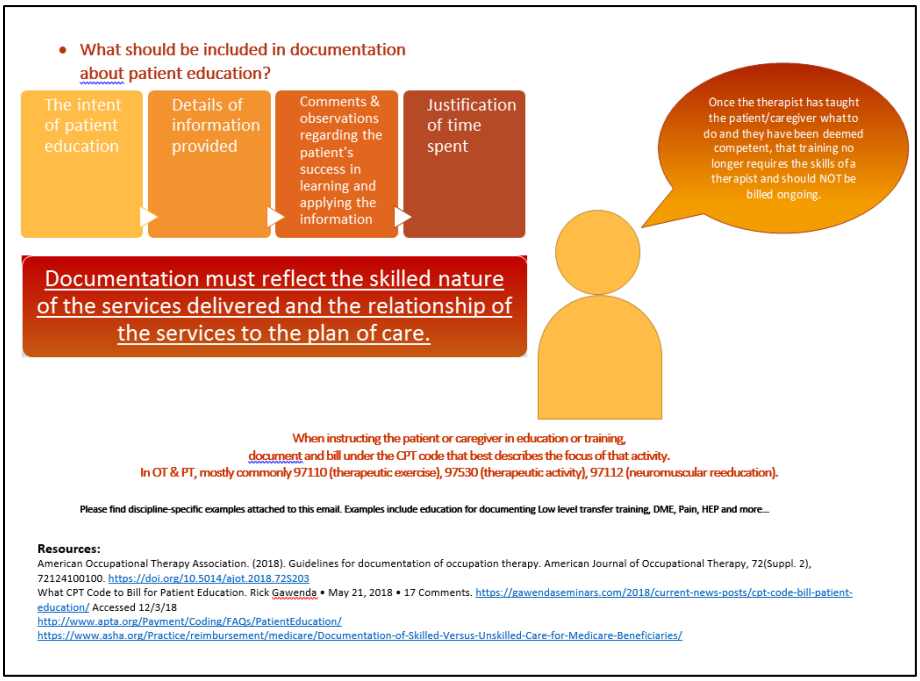
Social Connections:

Fitbit



B(3): Highlighted organizational resources to improve practice





B(4): Informational handout about use of education in therapy sessions

Educated with handouts:
- Excel sheet for digital health technology options
- Technology Goal Setting Worksheet
- PD Shared Decision Ex
- Lets Sync Our Tech Handout
- Cost handout

Other Resources:
- Provided P choice with Cost for purchasing fitness/activity tracker

Barriers and Facilitators addressed:
- Discussed use of ___strategy
- Plan

Home exercise Plan/Recommendations:
- Frequency:
- Intensity:
- Time:
- Type:

B(5): Fidelity Report for clinician documentation (de-identified sample)

	Questions on Exercise and DHT	Proportion of your notes with this topic documented (n=6)
	Any Current Physical Activity	83.33%
DHT	Any Details about DHT	100%
	Steps Per Day (n=2)*	0%
	Intensity (n=6)*	17%
	Exercise Information from DHT	67%
Exercise	Patient-Reported Goals	100%
	Presentation of choice	100%
	Exercise Recommendation	100%
	Patients' Barriers to Exercise	100%
	Patients' Facilitators to Exercise	100%
	Plan for Technology Use	100%
	Shared Decision Making	50%
	Additional Exercise Resources	100%

*Percentages based on only cases where DHT was used to collect health data

Appendix C

Shirley Ryan Abilitylab

Accelerating Physical Therapy Exercise Monitoring

Facilitators, Fidelity & Fitness

PI: Miriam Rafferty, PT, PhD

Objectives

- Examine and apply digital health technology to address barriers to exercise for individuals with PD.
- Apply the developed resources to facilitate digital health technology through behavior change strategies

Digital Health Technology & Exercise in PD

Shirley Ryan Abilitylab

Study Aims

- **Aim 1:** To compare perceived barriers and facilitators to using digital health technology, from the perspectives of PwP and clinicians, before and after they use commercially-available sensors.
- **Aim 2:** To assess fidelity of digital health technology adoption (via activity sensors and exercise tracking) by PwP and their clinicians.
- **Aim 3:** To determine whether greater use of digital health technology and behavior change intervention strategies are associated with changes in fitness and function 6 months after evaluation.

Exercise in Early PD

RESEARCH ARTICLE OPEN ACCESS

Long-term Effect of Regular Physical Activity and Exercise Habits in Patients With Early Parkinson Disease

Kazuto Tsukita, MD, Haruhi Sakamaki-Tsukita, MD, and Ryosuke Takahashi, MD, PhD

Neurology® 2022;98:e859–e871. doi:10.1212/WNL.0000000000013218

Correspondence
Dr. Tsukita
kazuse@kuhp.kyoto-u.ac.jp

Abstract

Background and Objectives

Owing to the lack of long-term observations or comprehensive adjustment for confounding factors, reliable conclusions regarding long-term effects of exercise and regular physical activity in Parkinson disease (PD) have yet to be drawn. Here, using data from the Parkinson's Progression Markers Initiative study that includes longitudinal and comprehensive evaluations of many clinical parameters, we examined the long-term effects of regular physical activity and exercise habits on the course of PD.

RELATED ARTICLE

Editorial

Could Exercise Be the Answer? Disease Modification With Long-term Regular Physical Activity in Parkinson Disease

Discussion

In the long term, the maintenance of high regular physical activity levels and exercise habits was robustly associated with better clinical course of PD, with each type of physical activity having different effects.

Understanding Barriers & Facilitators to exercise

Barriers

Factors related to body structure and function
General health barriers (not related to PD)
Physical discomfort with exercise
PD motor symptoms
PD non-motor symptoms
- Fluctuations in motivation
- Anxiety
- Depression
- Fatigue
- Apathy

Factors related to activities and participation
Low previous physical activity level or sport participation

Personal factors
Low self-efficacy
Reduced balance self-efficacy or fear of falling
Low outcome expectations from exercise
Lack of time

Environmental factors
Lack of social support
Lack of an exercise partner
Discomfort of seeing advancing symptoms of peers when exercising in a group
Poor accessibility of the exercise location and lack of transportation to this location
Bad weather
Cultural challenges
Financial burden of exercise
Wariness of moving in a crowded environment

Motivators

Factors related to body structure and function
Perceived positive effect of exercise on PD motor- and non-motor symptoms once started with exercise

Factors related to activities and participation
Ability to incorporate exercise in daily routine

Personal factors
Sufficient self-efficacy
Belief that
- physical activity is beneficial for health in general
- physical activity can impact disease manifestation
- persons with PD can have control over PD motor- and non-motor symptoms with exercise

Desire to
- maintain independence
- delay progression of PD
- re-frame one's identity as 'active'

Program individually tailored to
- abilities and interest
- personal goals

Perceived positive effect of exercise on health or performance in general once started with exercise
High educational level

Environmental factors
Social support by family or friends
Professional support (e.g., by a trainer for coaching)
Education about benefits of exercise or recommendation of exercise by neurologist
Social interaction with peers during exercise
Drawing strength from comparison to peers with more advanced symptoms during group exercise
Mastery experiences
Feedback on performance
Rewards

Schootemeijer, 2020

Early & Regular Physical Therapy

How can we continue to provide REGULAR Physical Therapy?

- How are you bringing your patients back into therapy?

Epub 2021 Mar 19.

Evidence for Early and Regular Physical Therapy and Exercise in Parkinson's Disease

Terry D Ellis [1], Cristina Colón-Semenza [2], Tamara R DeAngelis [2], Cathi A Thomas [3 4], Marie-Hélène Saint Hilaire [3 5 6], Gammon M Earhart [7], Leland E Dibble [8 9]

Research continues to support our efforts:

To promote an active lifestyle, it is important to enhance sustained exercise and behavioral changes. Recent advances in the use of mobile health applications, personal activity trackers, and wearable sensors allow clinicians to remotely supervise, monitor goal attainment, give feedback, and motivate patients.[8] These technologies also could empower patients to track their own progress and to engage in regular exercise and physical training long term. For patients, this can be a very potent motivator when dealing with a neurodegenerative disease without a cure.

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February 22, 2022; 98 (8) EDITORIAL

Could Exercise Be the Answer?

Disease Modification With Long-term Regular Physical Activity in Parkinson Disease

Margaret K. Y. Mak, Heidi Beck Schwarz

Benefits of incorporating technology for PA

- Digital Health- Supported Exercise
- mHealth appears to impact
  - Tracking change in disease symptoms over time, tremor, gait, physical activity etc.
  - Wearables provide passive data collection on PA and sleep
  - Wearables are better measuring PA objectively than patient reports
  - Self tracking for medication management, on/off times

These authors suggest…

- An individually tailored physical activity and exercise program is the best option.
- Individuals participating in research trials report that having someone monitoring them is motivating.
- Technology offers a great option for helping people adhere to exercise in daily life.
  YET ACCESS TO TECHNOLOGY does not = adherence to use or exercise!
- Use a "motivational app" to monitor and provide feedback on exercise.

What people with PD are saying about the tech….

- Gives you **motivation to exercise.**
- **Is fun to use**.
- Can **share data** with your healthcare team.
- **Automatically records** information (such as your heart rate, sleep, minutes spent exercising and or steps per day)
- Allows for **competition** (with friends or family or yourself!)

Accelerating Physical Therapy Exercise Monitoring

Shirley Ryan Abilitylab

Now, for the STUDY

- Patients are encouraged to **"bring their own device"**.
- Clinicians have access to **resources & tools** for facilitating digital health technology use.
  - This is a dynamic process. We are learning together!
- **Use documentation** to facilitate the future plan of care & aid in understanding program fidelity.

Lets talk the same talk! (definitions)
Glossary of Digital Health Technology

- Digital Health Technology
- Activity Tracker/Fitness Tracker
- Wearable Sensors
- Smart Watch
- Fitness App
- Fitness Website
- On the App or Browser
  - Dashboard
  - Step Count
    - Consider day-to-day variation
    - Within day variation
  - Intensity Monitoring
  - Goal Setting

Let's talk the same talk- Other features

- **Notifications**
  - Reminders to keep moving
  - Rewards for meeting goals
- **Social Connection**
  - Social contacts help with accountability
- **Share information**
  - Some patients may want to share

Other considerations that may impact use:

- **Digital literacy-** Life and work skills needed to safely benefit from, participate in and contribute to the digital world of today and the future. Further, digital literacy is an individual's ability to communicate, handle information/content, manage transactions, problem solve, and remain safe and legal when using technology.
- **Usability-** The International Organization for Standardization has defined usability as, "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use"

What we learned in the interviews

Barriers
- Low Digital Literacy
  - Patient OR clinician
- Non-motor symptoms
- Cost
- Low motivation
- Limitations in the device
- Lack of PD programs
- Lack of support to use

Facilitators
- High Digital Literacy
  - Patient OR clinician
- High usability
- Other members of the team
- Having partner support
- Fun
- Technology is a motivator
- Seeing day-to-day variation
- Allows for competition
- High self efficacy

Resources to facilitate technology use

- Technology Goal Setting Worksheet
  - CLINICIAN Technology Goal Setting Worksheet
- Excel sheet with Fitness tracker & app options
- Other tools
  - Partner tech "Lets Sync our Tech!"
  - Addressing Cost
  - Simple Tech Table
  - Exercise sustainment tools

Updated & Adapted Strategies

- Updated Aerobic, Strength and Balance Handout
- Updated letter for discharge
- Technical Support

- Anything else you wish you had?

Excel file Filtering

- Lets practice how to use this!

App Name	Cost	Upgrade cost	Device restrictions?	Built in exercise programs	Type of tracking	Social c
Fitbit	Free	9.99/month	Yes (Fitbit device)	Free video and audio workou	Pairs with smartphone to track ste	Yes
Garmin Connect	Free		Yes (Garmin device)	Free expert coaching and dyn	Tracks performance (training stat	Yes
Polar Flow	Free		Yes (Polar device)		Tracks active time, burned calorie	Yes
Zepp (formerly A	Free		Yes (Zepp/Amazfit device)		Records steps taken, sleep hours,	No
Apple Health	Free		Yes (Apple devices)		Tracks workouts, steps, walking, a	No
Samsung Health	Free		Yes (Samsung device)	Videos of expert coaches to t	Tracks your daily progress on your	Yes
Huawei Health	Free		Yes (Huawei device)		Records steps, calories, exercise d	No
Clock Yourself	2.49		No	Has challenges that involve e	Activity log counts how many step	Yes
Noom	Free	9.99	No		Food logging and water tracking fe	No
9zest	21.49/month		No	Has a library of exercise videc	Tracks completion of workouts	No
Fitness22 (Work	Free	Multiple upgr	No	Has multiple workouts	Run Tracker: tracks pace, location,	No
FitNotes	Free	2.99	No		Helps to track weightlifting worko	No
Google Fit	Free		No		HR, speed, pace, route; tracks real	No
MedBridge GO fr	Free		No	Looping demonstrations of ex	Allows patients to track activity sti	No
Strava	Free	7.99	No		Get key stats like distance, pace, s	Yes
Peloton	Free for 30 days	12.99/month	No	Live and on-demand classes	Tracks HR, pace, splits and elevati	Yes
Walkingspree	Free		No	Team Challenges: Virtual Wal	Track food and calories consumed	Yes
Mapmyrun	Free	5.99/month	No		Monitor HR zones; audio coach up	Yes
JEFIT	Free	6.99/month	No	Largest exercise database wit	Track workouts, cardio and strengt	Yes
Leap Fitness Ste	Free	2.99	Only available through Google	Play store?	Counts your steps; tracks burned c	No
MyFitnessPal	Free	9.99/month	No		Log food and water, tracks calorie	Yes
Runkeeper	Free	9.99/month	No	In-app challenges, virtual run	Record activities like running, wal	No
Strong Workout	Free	4.99/month	No	Range of cardio and strength	Keep track of your bodyweight, bc	No
Whoop	$30/month		Yes (WHOOP Strap)		Shows the strain of workouts; trac	Yes

Common uses that patients report

- Used it the "check" intensity & goals.
- Use it to monitor exercise intensity & steps
- Notifications on exercise throughout the day.
- Others?

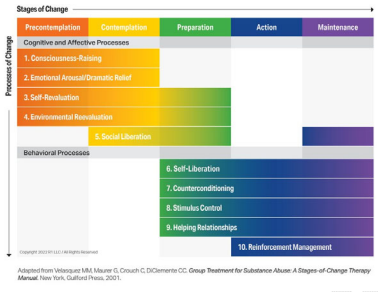
Common Problems & Solutions

- Technical Issues
  - Short Battery Life-
    - Most watches have a pre-set mode you can chose.
  - Too many notifications
    - Change in settings
- How to set goals on the watch/phone

- Jillian's solution= YouTube videos!
- Other problems? Solutions?

Common Problems & Solutions

- In the contemplation or preparation stage.



Adapted from Velasquez MM, Maurer G, Crouch C, DiClemente CC. *Group Treatment for Substance Abuse: A Stages-of-Change Therapy Manual*. New York, Guilford Press; 2001.

Behavior Change

Standardizing Documentation

Shirley Ryan Abilitylab

Exercise & technology history

- **Subjective** Report:
  - PA & Exercise- (NO CHANGE)

Reminder

FITT
- Frequency
- Intensity
- Time
- Type

- **Subjective** Report:
  - Document their Activity tracker
  - Preferred fitness app/website
  - Activity tracker usage (min/day, steps/day, number days used/week)

Exercise Type

Provide Education

- **Education Section**
  - Home Exercise program (free text and additional information section)
  - Presentation of choice (excel sheet discussed, pros/cons etc.)
  - Recommendation for technology
  - Barriers/Facilitators discussed
  - Plan for Technology use (readiness to use)
  - Resources given
    - Shared decision handout, Technology Goal Setting Worksheet

Documentation

- **Goal Setting**
  - Match a goal to the patient's reported goals.
  - Include technology for activity monitoring.
  - Goals that include Physical Activity & Exercise.

- **Plan**
  - Documentation of behavior change intervention
    - Choice of technology
    - Recommendation of technology use
    - Barriers & facilitators for technology, physical activity &/or exercise listed
    - Stage of readiness

Evidence of shared decision making box

- Use **Technology Goal Setting Worksheet** ✓
  - Document use, scan in result
- Address barriers & facilitators
- Give & document choice

Documenting Behavior Change

- Part of your "Intervention"
  - Document preferred in Education to help or over flow in additional information
  - Include: choice, recommendations & barriers & facilitators, readiness
  - Why?
  - This is will help in 6 months

Case Examples

Shirley Ryan Abilitylab

Case 1- Patient with High Digital Literacy

- A 77 yo female with dx of PD
- Owns a smartwatch, smart phone and uses video chat her grandchildren.
- Currently walks with a friend 1x/week and monitors steps on her watch.
- Has done cardio & weight lifting in the past, and feels motivated to get started again.
- Occasionally looks at the goals on the phone but doesn't have formal goals.
- Feels discouraged by fatigue and feelings of apathy.

- What questions might you ask?
- What barriers and motivators do you see?
- How would you help her develop an action plan?

Documentation Example 1

Subjective Statement

Calibri 8

Activity Tracker: Apple Smartwatch, iPhone
Fitness Apps- Apple Health App, Uses Strava with friend.
Steps/day: average ~3,000/day, ~500 step variably on "non-walking days", ~6,000 when walks with friend.
Barriers to exercise: apathy, fatigue

Facilitators to exercise: history of exercise, uses her smartwatch to look at steps, reports feeling motivated

CURRENT PHYSICAL ACTIVITY:
MODERATE INTENSITY type / kind: walking; minutes per day: 60; times per week: 1; TOTAL mins per week: 60.

SUBJECTIVE

Prosthetics
DME PT
Lower Extremi

Topics	Individuals Taught	Barriers to Learning	Teaching Method	Teaching Evaluation	Education Referral Made To	Comment
Equipment/Device use,Goals reviewed,Home exercise program	Patient	None evident	Demonstration,Explanation,Participation,Printed materials	Encourage continued participation,Needs practice/supervision	<MultiAlpha>	Educated with handouts: - PD Shared Decision Ex - Technology worksheet - Aerobic exercise

Comment
Patient educated in additional options for monitoring variability throughout the week & day.
Encouraged to perform additional walks & monitor heart rate to assess intensity. Recommend patient continue with current tracker & app.
Discussed use of activity tracker and fitness app to monitor and increase steps. Patient agrees to use goals for motivation.
Patient set personal goals for reaching 5,000 steps/day. Patient will also invite her adult children to share exercise data.

EDUCATION

GOALS

Patient/Caregiver Goals

Patient wants to increase fitness level, wants to build strength & cardio.

Right click below for sample goals

Bed Mobility	Home Exercise Program	Lymphedema	Mobility

Posture	Pregnancy Pain	Range of Motion	Strength

	Goal	Status
Goal # 1	By time of discharge, patient will use her activity tracker to show at least 150 minutes/week of moderate to vigorous intensity exercise (HR= 102-135 bpm) for benefit of neuroprotective effects context progressive neurodegenerative disease process.	Initial assessment
Goal # 2	By time of discharge, patient will show evidence on their fitness tracker or fitness app of strength, balance and flexibility exercises for HEP at least 2 days/week in relation to management of PD, a progressive neurodegenerative disease process.	Initial assessment

PLAN

Treatment Plan/Goals Established with Patient/Caregiver

Yes
No

Technology Goal Setting Worksheet

Case 2- Lower Digital Literacy- Session 1

- 77 yo female with a dx of PD
- She is doing some walking, has exercised in the past and is "contemplating" doing more
- Session 1: She is *interested* in getting something to monitor activity but doesn't want something "flashy". She asks you "What should I get?"

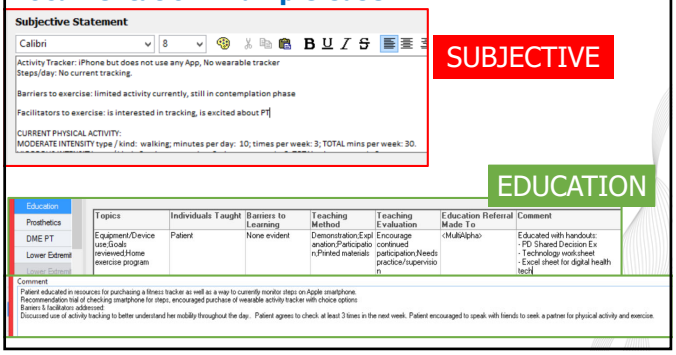
- What questions will you ask to help her make a decision?
- What resources can you share?
- What do you recommend?

Case 2

- She purchased a simple monitor and came to her second session wearing it.
  - She says "I don't know what to do but I can see my steps."
  - She asks "How many steps should I be getting?"

- How do you answer question?
- How do you help her with an action plan?
- What resources can you share?

Documentation Example Case 2



How can we support you during the study?

- Training
- Accessible facilitation
  - In-person at 355 on Mondays & Friday
  - Through WebEx, email or by phone Tuesday-Thursday
- Audit & Feedback on documentation
- Mentoring sessions
- Support reminders
- Research data from assessments if helpful

Questions?

Thank You

Appendix D

Shirley Ryan Abilitylab

Training #2: Accelerating Physical Therapy Exercise Monitoring

Facilitators, Fidelity & Fitness

PI: Miriam Rafferty, PT, PhD

Objectives

- Review the recommendations for using & documenting digital health technology & behavior change strategies.
- Consider and evaluate the strategies & resources for using digital health technology to facilitate physical activity and exercise
- Share & problem solve any common experiences & issues with technology.

Introductions

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Study Aims

- **Aim 1:** To compare perceived barriers and facilitators to using digital health technology, from the perspectives of PwP and clinicians, before and after they use commercially-available sensors.
- **Aim 2:** To assess fidelity of digital health technology adoption (via activity sensors and exercise tracking) by PwP and their clinicians.
- **Aim 3:** To determine whether greater use of digital health technology and behavior change intervention strategies are associated with changes in fitness and function 6 months after evaluation.

STUDY INFO

- Patients are encouraged to **"bring their own device"**.
- Clinicians engage & support patients with use of this technology
- Clinicians have access to **resources & tools** for facilitating digital health technology use.
  - This is a dynamic process. We are learning together!
- **Use documentation** to facilitate the future plan of care & aid in understanding program fidelity.

Recommendations

Use & documentation

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Recommendations in PT

Discussion

- Ask your patient about using digital health technology.
  - How are they using it? Can they show you?
  - How confident are they in using it?
  - What are the barriers and facilitators to using it?
- Encourage the use of digital health technology and behavior change strategies to improve ADHERENCE to your recommended plan.
- Document: Subjective report, Education, Goal Setting & Plan
  - Is there value in documenting the absence of exercise or DHT use?

Exercise & technology history

- **Subjective** Report:
  - PA & Exercise- (NO CHANGE)

Reminder

FITT
- Frequency
- Intensity
- Time
- Type

- **Subjective** Report:
  - Document their Activity tracker
  - Preferred fitness app/website
  - Activity tracker usage (steps/day, heart rate, time use)

Exercise Type
- Aerobic
- Strength
- Flexibility
- Neuromuscular Control, Balance & Agility
- Walking

Provide Education

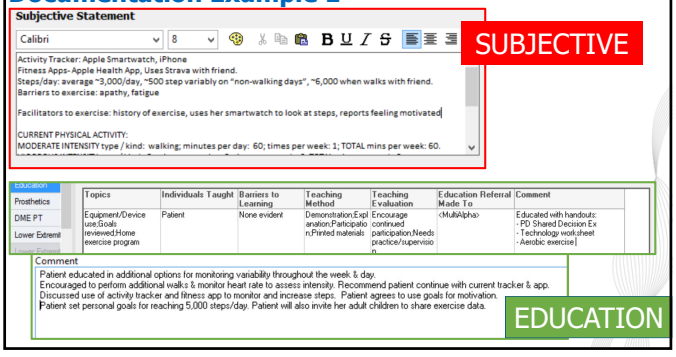
- **Education Section**
  - Home Exercise program (free text and additional information section)
  - Presentation of choice (excel sheet discussed, pros/cons etc.)
  - Recommendation for technology
  - Barriers/Facilitators discussed
  - Plan for Technology use (readiness to use)
  - Resources given
    - Shared decision handout

Documentation

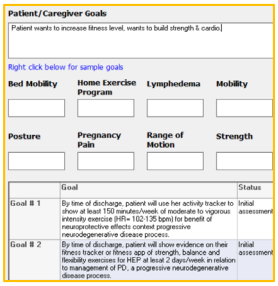
- **Goal Setting**
  - Match a goal to the patient's reported goals.
  - Include technology for activity monitoring.
  - Goals that include Physical Activity & Exercise.

- **Plan**
  - Documentation of behavior change intervention
    - Choice of technology
    - Recommendation of technology use
    - Barriers & facilitators for technology, physical activity &/or exercise listed
    - Stage of readiness
    - Check the Shared Decision Box

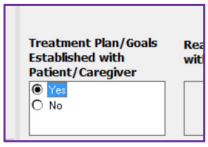
Documentation Example 1



GOALS



PLAN



Technology Goal Setting Worksheet

Audit Report

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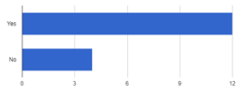
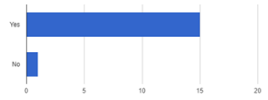
Audit Results

- Documenting Digital Health Technology:



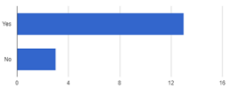
- Documenting Physical Activity & Exercise:



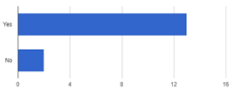
- In 4 evaluations, steps were noted.
- In 3 evaluations, some other info was noted about physical activity.

Audit Results

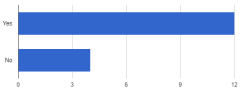
- Documenting Presentation of Choice for Tech, PA & ex:



- Documenting Recommendations:



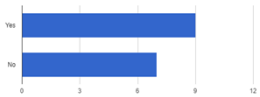
- Documenting Barriers:



- Documenting Facilitators:

Audit Results

- Documenting Patient-Reported Goals:



Discussion

Strategies & Resources

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How can we support you during the study?

Discussion

- Training
- Accessible facilitation
  - In-person at 355 on Mondays & Friday
  - Through WebEx, email or by phone Tuesday-Thursday
- Audit & Feedback on documentation
- Mentoring as needed
- Support reminders
- Research data from assessments if helpful

Resources to facilitate technology use

- Technology Goal Setting Worksheet
  - CLINICIAN Technology Goal Setting Worksheet
- Excel sheet with Fitness tracker & app options
- Patient Education Tools
  - Partner tech "Lets Sync our Tech!"
  - Addressing Cost
  - Simple Tech Table
  - Exercise sustainment tools
  - GOALS Use of trackers

Common Errors with Tech

- Problems with measurement
  - Steps
    - Step count can be measured through the phone and/or the wearable device.
    - Check on the app, where data is coming from.
    - Some devices can be validated.
  - Heart Rate
    - The devices read heart rate through either light sensors or electric sensors
      - Error may occur with each type
  - Other?

Sensor Considerations

- How do the sensors work?
  - Use of light technology
    - Green light (most watches), red light (pulse ox)
    - Concern for measurement error
      - Skin tone & tatoo
      - Ambient light
    - May warrant your validation
      - Fitbit, Apple, Garmin have done additional work to account for these errors
  - Electric sensors (on the exercise equipment)
    - Require more power

Factilitators for technology

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What people with PD are saying about the tech....

Discussion

- Gives you **motivation to exercise.**
- **Is fun to use**.
- Can **share data** with your healthcare team.
- **Automatically records** information (such as your heart rate, sleep, minutes spent exercising and or steps per day)
- Allows for **competition** (with friends or family or yourself!)

Other thoughts?

Discussion

Thank You

Accelerating Physical Therapy Exercise Monitoring

Shirley Ryan Abilitylab

Lets talk the same talk! (definitions)
Glossary of Digital Health Technology

- Digital Health Technology
- Activity Tracker/Fitness Tracker
- Wearable Sensors
- Smart Watch
- Fitness App
- Fitness Website
- On the App or Browser
  - Dashboard
  - Step Count
    - Consider day-to-day variation
    - Within day variation
  - Intensity Monitoring
  - Goal Setting

Let's talk the same talk- Other features

- **Notifications**
  - Reminders to keep moving
  - Rewards for meeting goals
- **Social Connection**
  - Social contacts help with accountability
- **Share information**
  - Some patients may want to share

Other considerations that may impact use:

- **Digital literacy-** Life and work skills needed to safely benefit from, participate in and contribute to the digital world of today and the future. Further, digital literacy is an individual's ability to communicate, handle information/content, manage transactions, problem solve, and remain safe and legal when using technology.
- **Usability-** The International Organization for Standardization has defined usability as, "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use"

What we learned in the interviews

Barriers

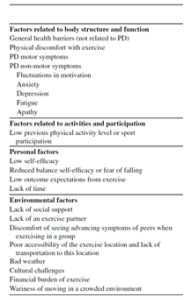
- Low Digital Literacy
  - Patient OR clinician
- Non-motor symptoms
- Cost
- Low motivation
- Limitations in the device
- Lack of PD programs
- Lack of support to use

Facilitators

- High Digital Literacy
  - Patient OR clinician
- High usability
- Other members of the team
- Having partner support
- Fun
- Technology is a motivator
- Seeing day-to-day variation
- Allows for competition
- High self efficacy

Understanding Barriers & Facilitators to exercise

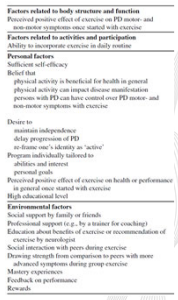
Barriers



Factors related to body structure and function
General health barriers (not related to PD)
Physical discomfort with exercise
PD motor symptoms
PD non-motor symptoms
Fluctuations in motivation
Anxiety
Depression
Fatigue
Apathy
Factors related to activities and participation
Low previous physical activity level or sport participation
Personal factors
Low self-efficacy
Reduced balance self-efficacy or fear of falling
Low outcome expectations from exercise
Lack of time
Environmental factors
Lack of social support
Lack of an exercise partner
Discomfort of seeing advancing symptoms of peers when exercising in a group
Poor accessibility of the exercise location and lack of transportation to this location
Bad weather
Cultural challenges
Financial burden of exercise
Wariness of moving in a crowded environment

Schootemeijer, 2020

Motivators



Factors related to body structure and function
Perceived positive effect of exercise on PD motor- and non-motor symptoms once started with exercise
Factors related to activities and participation
Ability to incorporate exercise in daily routine
Personal factors
Sufficient self-efficacy
Belief that physical activity is beneficial for health in general
physical activity can impact disease manifestation
persons with PD can have control over PD motor- and non-motor symptoms with exercise
Desire to maintain independence
delay progression of PD
re-frame one's identity as 'active'
Program individually tailored to abilities and interest
personal goals
Perceived positive effect of exercise on health or performance in general once started with exercise
High educational level
Environmental factors
Social support by family or friends
Professional support (e.g., by a trainer for coaching)
Education about benefits of exercise or recommendation of exercise by neurologist
Social interaction with peers during exercise
Drawing strength from comparison to peers with more advanced symptoms during group exercise
Mastery experiences
Feedback on performance
Rewards

Benefits of incorporating technology for PA

- Digital Health- Supported Exercise
- mHealth appears to impact
  - Tracking change in disease symptoms over time, tremor, gait, physical activity etc.
  - Wearables provide passive data collection on PA and sleep
  - Wearables are better measuring PA objectively than patient reports
  - Self tracking for medication management, on/off times


Original Research

Comparative Effectiveness of mHealth-Supported Exercise Compared With Exe... People With Parkins... Randomized Contro...

HHS Public Access

Author manuscript

Mov Disord. Author manuscript; available in PMC 2020 May 01.

A Roadmap for Implementation of Patient-Centered Digital Outcome Measures in Parkinson's disease Obtained Using Mobile Health Technologies

Digital Technology in Movement Disorders: Updates, Applications, and Challenges

These authors suggest…

- An individually tailored physical activity and exercise program is the best option.
- Individuals participating in research trials report that having someone monitoring them is motivating.
- Technology offers a great option for helping people adhere to exercise in daily life.
  YET ACCESS TO TECHNOLOGY does not = adherence to use or exercise!
- Use a "motivational app" to monitor and provide feedback on exercise.

Shirley Ryan Abilitylab

Accelerating Physical Therapy Exercise Monitoring

Facilitators, Fidelity & Fitness

PI: Miriam Rafferty, PT, PhD

Facilitator: Jillian MacDonald, PT, DPT

Objectives

- Review evidence for physical activity and exercise in early PD.
- Examine and apply digital health technology to address barriers to exercise for individuals with PD.
- Apply the developed resources to facilitate digital health technology through behavior change strategies

Exercise & Physical Therapy in PD

Shirley Ryan Abilitylab

Exercise in Early PD

RESEARCH ARTICLE OPEN ACCESS

Long-term Effect of Regular Physical Activity and Exercise Habits in Patients With Early Parkinson Disease

Kazuto Tsukita, MD, Haruhi Sakamaki-Tsukita, MD, and Ryosuke Takahashi, MD, PhD

Neurology® 2022;98:e859-e871. doi:10.1212/WNL.0000000000013218

Correspondence
Dr. Tsukita
kazuzam@kuhp.kyoto-u.ac.jp

Abstract

Background and Objectives

Owing to the lack of long-term observations or comprehensive adjustment for confounding factors, reliable conclusions regarding long-term effects of exercise and regular physical activity in Parkinson disease (PD) have yet to be drawn. Here, using data from the Parkinson's Progression Markers Initiative study that includes longitudinal and comprehensive evaluations of many clinical parameters, we examined the long-term effects of regular physical activity and exercise habits on the course of PD.

RELATED ARTICLE

Editorial

Could Exercise Be the Answer? Disease Modification With Long-term Regular Physical Activity in Parkinson Disease

Discussion

In the long term, the maintenance of high regular physical activity levels and exercise habits was robustly associated with better clinical course of PD, with each type of physical activity having different effects.

Research continues to support our efforts:

To promote an active lifestyle, it is important to enhance sustained exercise and behavioral changes. Recent advances in the use of mobile health applications, personal activity trackers, and wearable sensors allow clinicians to remotely supervise, monitor goal attainment, give feedback, and motivate patients.[3] These technologies also could empower patients to track their own progress and to engage in regular exercise and physical training long term. For patients, this can be a very potent motivator when dealing with a neurodegenerative disease without a cure.

Neurology® The most widely read and highly cited peer-reviewed neurology journal

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SHARE February 22, 2022; 98 (8) EDITORIAL

Could Exercise Be the Answer?

Disease Modification With Long-term Regular Physical Activity in Parkinson Disease

Margaret K. Y. Mak, Heidi Beck Schwarz

Early & Regular Physical Therapy

How can we continue to provide REGULAR Physical Therapy?

- How are you bringing your patients back into therapy?

Epub 2021 Mar 19.

Evidence for Early and Regular Physical Therapy and Exercise in Parkinson's Disease

Terry D Ellis [1], Cristina Colón-Semenza [2], Tamara R DeAngelis [2], Cathi A Thomas [3 4], Marie-Hélène Saint Hilaire [3 5 6], Gammon M Earhart [7], Leland E Dibble [8 9]

Accelerating Physical Therapy Exercise Monitoring

Shirley Ryan Abilitylab

Reminders…

- Patients are encouraged to **"bring their own device"**.
- Clinicians have access to **resources & tools** for facilitating digital health technology use.
  - This is a dynamic process. We are learning together!
- **Use documentation** to facilitate the future plan of care & aid in understanding program fidelity.

Original resources to facilitate technology use

- Technology Goal Setting Worksheet
  - CLINICIAN Technology Goal Setting Worksheet
- Excel sheet with Fitness tracker & app options
- Other tools
  - Partner tech "Lets Sync our Tech!"
  - Addressing Cost
  - Simple Tech Table
  - Exercise sustainment tools

Updated & Adapted Strategies

- Updated Aerobic, Strength and Balance Handout
- Updated letter for discharge
- Technical Support
- Office Hours on Tuesdays! Where: Jillian's Zoom

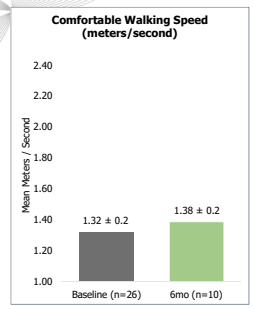
- Anything else you wish you had?

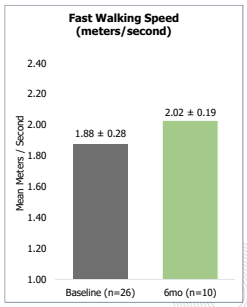
Sharing preliminary results- Quantitative

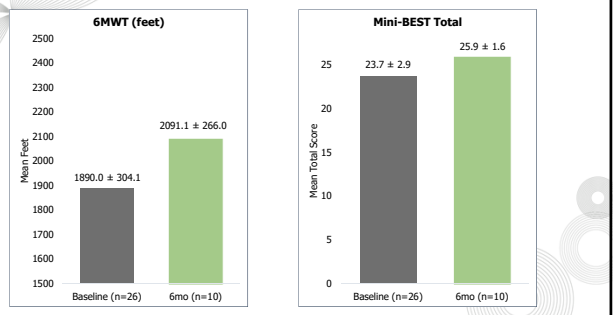
Graphs depict aggregate scores (mean ± standard deviation)

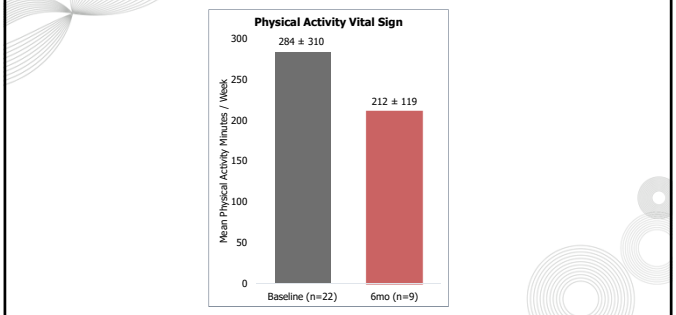
scores improved from baseline to 6mo

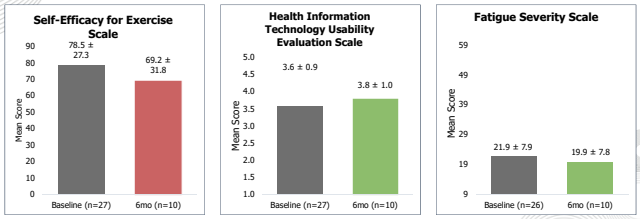
scores worsened from baseline to 6mo









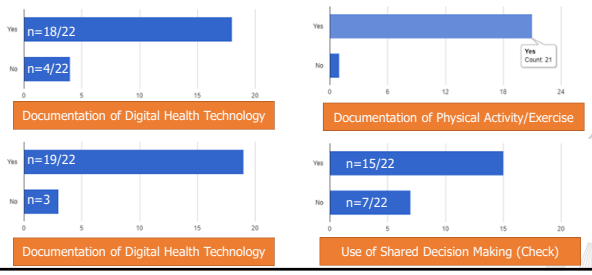


Range: 0-90
Better Scores: High

Range: 1-5
Better Scores: High

Range: 9-63
Better Scores: Low

Documentation Audit

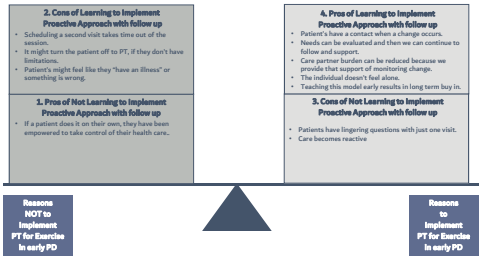


Proactive PT- Promoting Sustained Exercise

- We are finding people have lingering questions about exercise.
- Change can occur within 6 months
- Do our patients know when to return to PT?

How can we promote the 6-12 month follow up?

Group Decisional Balance Activity: Learning to Implementing Proactive Approach in PD (2-4 visits).



How can technology help them (and US)?

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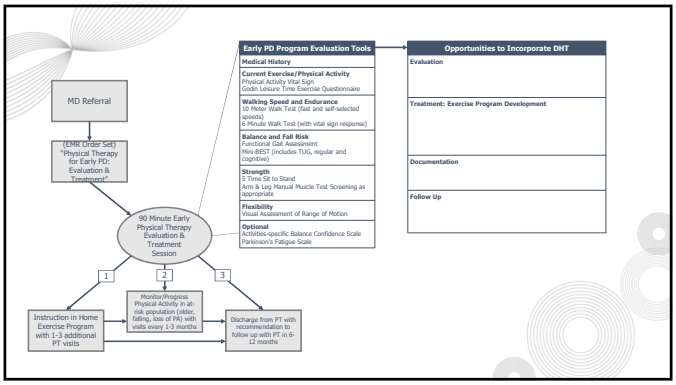
Common uses that patients report

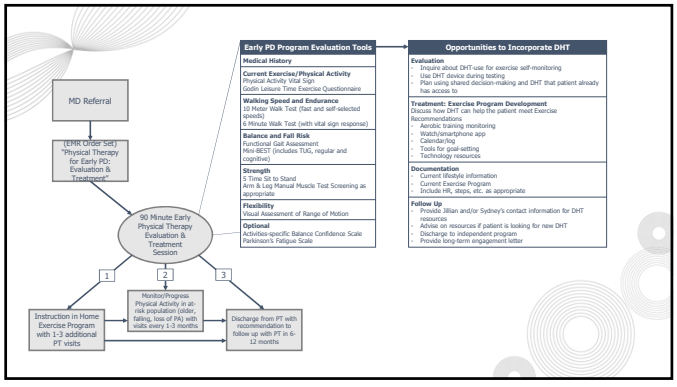
- Used it the "check" intensity & goals.
- Use it to monitor exercise intensity & steps
- Notifications on exercise throughout the day.
- Weekly email updates- minutes in zone
  - Not having to add it up. (maybe Garmin)
- Medbridge as combined HIIT workout
- Others?

Common Problems & Solutions- Technology

- Technical Issues
  - Short Battery Life-
    - Most watches have a pre-set mode you can chose.
    - Behavior change- set the watch & charge by the phone when you charge
  - Too many notifications
    - Change in settings
- How to set goals on the watch/phone

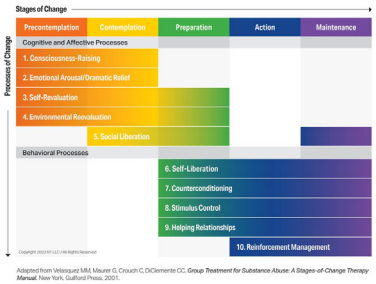
- Jillian's solution= YouTube videos!
- Other problems? Solutions?





Common Problems & Solutions- Readiness

- In the contemplation or preparation stage.



Adapted from Velasquez MM, Maurer G, Crouch C, DiClemente CC. *Group Treatment for Substance Abuse: A Stages-of-Change Therapy Manual*. New York, Guilford Press, 2001.

Behavior Change

Consciousness-Raising	• Build Awareness, Education
Emotional Arousal/Dramatic Relief	• Pay attention to emotions & feelings
Self-Re-evaluation	• Create a positive new self image
Environmental Reevaluation	• Notice Impact on others
Social Liberation	• Notice public support and gain alternatives
Self-Liberation	• Make choices and Commitments
Counterconditioning	• Use substitutes
Stimulus Control	• Stimulus Control
Helping Relationships	• Get help & Support
Reinforcement Management	• Use Rewards

Understanding Barriers & Facilitators to exercise

Barriers

Factors related to body structure and function
General health barriers (not related to PD)
Physical discomfort with exercise
PD motor symptoms
PD non-motor symptoms
- Fluctuations in motivation
- Anxiety
- Depression
- Fatigue
- Apathy

Factors related to activities and participation
Low previous physical activity level or sport participation

Personal factors
Low self-efficacy
Reduced balance self-efficacy or fear of falling
Low outcome expectations from exercise
Lack of time

Environmental factors
Lack of social support
Lack of an exercise partner
Discomfort of seeing advancing symptoms of peers when exercising in a group
Poor accessibility of the exercise location and lack of transportation to this location
Bad weather
Cultural challenges
Financial burden of exercise
Wariness of moving in a crowded environment

Motivators

Factors related to body structure and function
Perceived positive effect of exercise on PD motor- and non-motor symptoms once started with exercise

Factors related to activities and participation
Ability to incorporate exercise in daily routine

Personal factors
Sufficient self-efficacy
Belief that
- physical activity is beneficial for health in general
- physical activity can impact disease manifestation
- persons with PD can have control over PD motor- and non-motor symptoms with exercise

Desire to
- maintain independence
- delay progression of PD
- re-frame one's identity as 'active'

Program individually tailored to
- abilities and interest
- personal goals

Perceived positive effect of exercise on health or performance in general once started with exercise
High educational level

Environmental factors
Social support by family or friends
Professional support (e.g., by a trainer for coaching)
Education about benefits of exercise or recommendation of exercise by neurologist
Social interaction with peers during exercise
Drawing strength form comparison to peers with more advanced symptoms during group exercise
Mastery experiences
Feedback on performance
Rewards

Schootemeijer, 2020

Resources to facilitate technology use

- Technology Goal Setting Worksheet
  - CLINICIAN Technology Goal Setting Worksheet
- Excel sheet with Fitness tracker & app options
- Other tools
  - Partner tech "Lets Sync our Tech!"
  - Addressing Cost
  - Simple Tech Table
  - Exercise sustainment tools

Updated Strategies

- Updated Aerobic, Strength and Balance Handout
- Updated letter for discharge
- Technical Support
- Office Hours on Tuesdays! Where: Jillian's Zoom

- Anything else you wish you had?
  - Education to referrers or the PDMD clinician team

Preliminary Qualitative Results

- Everyone is Exercising!
- Most are prioritizing heart rate and intensity and 150 minutes/week
- Variable use of Digital Health Technology continues to be the norm
- Participants not sure when to come back to PT
- Feel their PT services have been timely and efficient
- Participants feel DHT helps them stay motivated keeps them accountable and better able to track their goals (steps, heart rate intensity, minutes/week)
- Exercise sustainment barriers still affect exercise fluctuations even with DHT use (work/retirement, weather, time, life events-loss, moving, caring for loved one).

Preliminary Qualitative Results

- High technology users vs Low technology users
- **Low user** "For me I think if somebody like would actually sit down and teach you how to do some of this stuff… Especially now it seems like you know, like something new is a little bit harder for me. So it just seems like it's overwhelming. So I'm trying to keep it simple."
- **Low user** "When you're not seeing somebody all the time, it's different… Just to stay motivated. And for me, it works better… [To see them more often]."
- **High User** "I had been using technology to monitor my workouts. And I was just interested to see further research, what the findings are. I like the quantitative, being able to work out and see what I did and see where I can improve"
- **High User** "I said, Oh, I have this app that I use" And the PT said, "That's perfect, this is what you want to do, you want to do this-." And so right from the start, we worked on this together. Because I was already using an app. I was already using technology… my PT show me specifically how I needed to [use DHT]."

Our Suggestions

- Keep doing your thing!
- Continue to promote digital health technology as a useful tool for our patients.
- Follow up with folks, schedule a visit so it can be billable.

Questions?

Thank You

Study Aims

- **Aim 1:** To compare perceived barriers and facilitators to using digital health technology, from the perspectives of PwP and clinicians, before and after they use commercially-available sensors.
- **Aim 2:** To assess fidelity of digital health technology adoption (via activity sensors and exercise tracking) by PwP and their clinicians.
- **Aim 3:** To determine whether greater use of digital health technology and behavior change intervention strategies are associated with changes in fitness and function 6 months after evaluation.

Standardizing Documentation

Shirley Ryan Abilitylab

Exercise & technology history

- **Subjective** Report:
  - PA & Exercise- (NO CHANGE)

Reminder

FITT
- Frequency
- Intensity
- Time
- Type

- **Subjective** Report:
  - Document their Activity tracker
  - Preferred fitness app/website
  - Activity tracker usage (min/day, steps/day, number days used/week)

Exercise Type

Provide Education

- **Education Section**
  - Home Exercise program (free text and additional information section)
  - Presentation of choice (excel sheet discussed, pros/cons etc.)
  - Recommendation for technology
  - Barriers/Facilitators discussed
  - Plan for Technology use (readiness to use)
  - Resources given
    - Shared decision handout, Technology Goal Setting Worksheet

Documentation

Goal Setting
- Match a goal to the patient's reported goals.
- Include technology for activity monitoring.
- Goals that include Physical Activity & Exercise.

Plan
- Documentation of behavior change intervention
  - Choice of technology
  - Recommendation of technology use
  - Barriers & facilitators for technology, physical activity &/or exercise listed
  - Stage of readiness

Evidence of shared decision making box

- Use **Technology Goal Setting Worksheet** ✓
  - Document use, scan in result
- Address barriers & facilitators
- Give & document choice

Documenting Behavior Change

- Part of your "Intervention"
  - Document preferred in Education to help or over flow in additional information
  - Include: choice, recommendations & barriers & facilitators, readiness
  - Why?
  - This is will help in 6 months

PURPOSE

To **describe barriers & facilitators** to using digital health technology.

INTERVIEW PARTICIPANTS

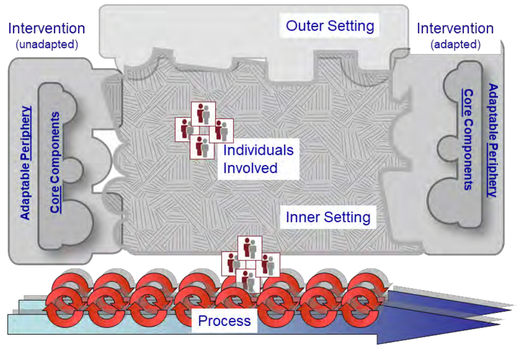
- People with Parkinson's disease (PwPD)
- Physical therapists (PT)
- Technology stakeholders (Tech)

Age years (mean ± SD)	65.31 ± 8.67	37.00 ± 6.35	47.38 ± 11.25
Characteristics	46% of PwPD were within 3 years of diagnosis	Average 11 ± 7 years in practice	Average 14 ± 11 years in field
Confidence with Using Technology (scale of 1-10)	8.8 ± 2.8 (10 highest)	7.3 ± 1.8 (10 highest)	N/A

ANALYSIS

Coded barriers and facilitators using **Consolidated Framework for Implementation Research (CFIR)**

https://cfirguide.org



technology in PT to increase use by people with PD.

"If it frustrates me, I don't use it. I don't do things that frustrate me anymore. **And so it needs to be simple. It needs to be accurate**

"**Give me some recommendations** … It wou be easier if someone else had put the information in a concise [package] for me …

"Technology … is **already being developed** i a way that **they can use it easily** … at the en of the day, clinicians are very busy … "

Contact us for study info: **bfowler@sralab.org**

BACKGROUND

Evidence shows that **digital health technology can aid in adherence to exercise** for people with Parkinson's disease (PD), but it is **used infrequently in clinical practice.**

PURPOSE

To **describe barriers & facilitators** to using digital health technology, and how these are different after individuals use technology.

METHODS

- Individual zoom or in-person interviews.
- Sample multi-stakeholders before study implementation to inform resource development.
- Exit interviews with participants and clinicians after study completion.

PARTICIPANTS

PRE-IMPLEMENTATION INTERVIEWS

- People with Parkinson's disease (PwPD) n=13
- Physical therapists (PT) n=12
- Technology stakeholders (Tech) n=13

Age years (mean ± SD)	65.31 ± 8.67	37.00 ± 6.35	47.38 ± 11.25
Characteristics	46% of PwPD were within 3 years of diagnosis	Average 11 ± 7 years in practice	Average 14 ± 11 years in field
Confidence with Using Technology (scale of 1-10)	8.8 ± 2.8 (10 highest)	7.3 ± 1.8 (10 highest)	N/A

PRELIMINARY POST-IMPLEMENTATION INTERVIEWS

- Different PwPD (n=6 of 32 so far)
  - 60.86 ± 7.17 years old
  - 83% within 3 years of PD diagnosis
- Mixture of same & different PTs (n=1 of 7 so far has completed)

ANALYSIS

Deductive coding of determinants using **Consolidated Framework for Implementation Research (CFIR)**

https://cfirguide.org

Before Intervention:

Clinicians should create resources to make it easier for patients, including:

- Technologically savvy patients
- Patients who need simplification due to low technology literacy.

People with PD Exit Interviews:

Technologically savvy patients want more specific information on tracking different types of exercise goals with technology.

Low technology users want more opportunities for technical assistance and accountability.

"If it frustrates me, I don't use it. **I don't do things that frustrate me** anymore**.** And so it needs to be simple. It needs to be accurate."

"**Give me some recommendations** … It would be easier if someone else had put the information in a concise [package] for me … "

"Technology … is **already being developed** in a way that **they can use it easily** … at the end of the day, clinicians are very busy … "

PT Exit Interview:

Patient-level barriers related to readiness and interest in technology seemed to be greater barriers to use than the technology itself.

Scan for study info

Appendix G

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MOVEMENT DISORDERS (T. SIMUNI, SECTION EDITOR)

Frameworks for Parkinson's Disease Rehabilitation Addressing When, What, and How

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Abstract

Purpose of Review This review summarizes the evidence on rehabilitation for people with Parkinson's disease, including when to refer, what rehabilitation professionals should address, and how to deliver rehabilitation care.

Recent Findings Clinical practice guidelines support physical therapy, occupational therapy, and speech-language pathology for Parkinson's disease. However, integrating guidelines into practice may be difficult. Implementation studies take into account patient and clinician perspectives. Synthesizing guidelines with implementation research can improve local delivery.

Summary There is moderate to strong evidence supporting physical therapy, occupational therapy, and speech-language pathology soon after diagnosis and in response to functional deficits. We propose a framework of three pathways for rehabilitation care: (1) consultative proactive rehabilitation soon after diagnosis for assessment, treatment of early deficits, and promotion meaningful activities; (2) restorative rehabilitation to promote functional improvements; and (3) skilled maintenance rehabilitation for long-term monitoring of exercise, meaningful activities, safety, contractures, skin integrity, positioning, swallowing, and communication.

Keywords Parkinson's disease · Physical therapy · Occupational therapy · Speech-language pathology · Rehabilitation · Healthcare delivery models

Introduction

Interdisciplinary rehabilitation is an integral part of evidence-based care for people with Parkinson's disease (PwP). The traditional rehabilitation team consists of physical therapy (PT) [1•], occupational therapy (OT) [2•], and speech-language pathology (SLP) [3•]. Strong evidence has been summarized in clinical practice guidelines (CPGs) describing the evaluations and interventions delivered by these professionals [1•, 2•, 3•, 4•, 5•]. CPGs are forms of knowledge synthesis that grade the evidence and provide recommendations based on the strength of the literature, expert perspectives, and patient input [6]. They are considered Level I evidence; the highest form of evidence informing practice.

Despite the presence of CPGs supporting rehabilitation, rehabilitation for PwP is underutilized [7–9]. Barriers to implementing evidence-based rehabilitation for PwP exist at the individual, team, organization, and systems levels [10, 11]. Rehabilitation delivery can be facilitated by addressing barriers identified by clinical teams and patients. The clinician and patient perspectives are an essential part of evidence-based practice [12]. Synthesizing clinician and patient perspectives from qualitative studies and mixed methods evaluations of local quality improvement projects will improve real-world implementation of CPGs related to interdisciplinary rehabilitation in Parkinson's disease (PD).

The purpose of this review is to summarize evidence-based PT, OT, and SLP for PwP, including when individuals should be referred to rehabilitation therapies, what should be done, and how rehabilitation care should be delivered. This overview of rehabilitation for PwP blends the highest level of

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evidence with practical perspectives for how to implement best practices. We propose that identifying common pathways for care based on the stages of PD and goals of therapy can improve rehabilitation delivery. The role of rehabilitation across the stages of PD is described for an interdisciplinary audience. This knowledge is necessary to communicate appropriate expectations for rehabilitation. Discipline-specific readers should seek additional guidance directly from the CPGs for more specific delivery instruction.

Methods

This narrative review synthesizes international CPGs that have been published in Europe [1•, 2•, 3•], the UK [5•], and Canada [4•] addressing rehabilitation for PwP. These guidelines summarize the strength of the evidence related rehabilitation assessments and treatments. Grade A or strong recommendation means that the supporting body of evidence includes strong studies that directly apply to the target population and are overall consistent in terms of results [4•]. Moderate strength recommendations, graded as B or C, mean the body of evidence includes moderately strong evidence that is directly applicable to the topic or moderate to strong studies that require extrapolation [4•]. Weak evidence supporting a recommendation, also referred to as Grade D, indicates a low quality of evidence or studies with small effect sizes or large confidence intervals [1•]. Finally, CPGs can include recommendations based on the expert opinions of the guideline development group [4•, 5•].

Clinical practice guidelines may include some input from expert clinician and patient stakeholders, but can lack information on practice-based evidence and real-world delivery. Evidence-based practice should take into account three sources of evidence: research, expert clinical perspectives, and patient values [12]. Therefore, this review also incorporates additional expert clinical consensus statements and review articles, qualitative research studies on patient perspectives, published examples of real-world implementation, and our expert clinical experience discussing patient values and care pathways. These supplemental data sources are particularly important in the section on *how* to deliver rehabilitation, but are incorporated throughout.

When: Rehabilitation Referral Timing

In the United States, the American Academy of Neurology has quality indicators stating that neurologists should discuss rehabilitation at least yearly for PwP [13]. The European CPG for PT adds detail suggesting that rehabilitation referrals should be triggered for at least three reasons: soon after diagnosis, when experiencing functional deficits due to motor or nonmotor symptoms, and during hospitalizations for reduction of adverse events [1•]. The European OT CPG, UK CPG, and Canadian CPG also emphasize proactive treatment soon after diagnosis, as well as treatment in response to functional deficits [1•, 2•, 3•, 4•, 5•]. Expert opinions published separately from these CPGs include suggestions that rehabilitation could be effective earlier in prodromal stages of PD, such as in people with Rapid Eye Movement Sleep Behavior Disorder [14]. Few research studies specifically address advanced stages of PD, rehabilitation during hospital, or skilled nursing facility stays [15, 16]. However, functional declines in advanced PD indicate a rationale for rehabilitation to improve or compensate for the losses. This section of the review summarizes evidence supporting the timing of rehabilitation.

Consultative and Proactive Rehabilitation in Early Parkinson's

Early after diagnosis, CPGs in the UK and Canada state that physicians should consider referrals to PT, OT, and SLP with experienced clinicians soon after diagnosis [4•, 5•]. Two key words in this recommendation are *consider* and *experienced*. The UK guidelines clarify that "consider" indicates the guideline developers' confidence that an intervention will do more good than harm for most patients and is likely to be cost effective. However, they recognize that other options may be similarly cost effective; therefore, selecting the intervention should depend on the patient's values and preferences [5•]. There is evidence supporting that specialty-trained *experienced* PD rehabilitation providers may reduce costs, reduce hip fractures, and be associated with fewer inpatient admissions [17]. Recommendations to consider early rehabilitation were rated as grade B [4•].

All currently published guidelines and an expert clinical perspective support evaluation, education, and advice by PT, OT, and SLP soon after diagnosis [1•, 2•, 3•, 4•, 5•, 18•]. The recommendations for early PT include education and advice specifically about promoting physical activity, empowering self-management, preventing inactivity, reducing fear of falling, improving physical capacity, addressing pain, and delaying the onset of activity limitations [1•, 4•, 5•]. Early OT includes providing education and advice on ways to train or maintain high quality daily occupational performance related to the motor and nonmotor symptoms of PD [2•, 4•, 5•]. Occupational performance involves choosing, planning, and performing activities that are particularly meaningful for an individual in the context of living, working, and leisure [2•]. For example, the OT can address work-related activities by providing advice about ways to improve or maintain hand function for writing, computer use, or adaptive technology [2•, 4•]. In early SLP, advice and education should specifically target potential problems with speech, swallowing, saliva control, and cognition [3•]. SLP can screen for voice problems that could interfere with work and personal relationships

through the early use of education related to speaking with intensity. In addition, they can assess for and treat weakness in the orolingual muscles or executive function deficits. People with early PD have reported that a proactive rehabilitation approach benefited them both physically and emotionally [19•].

Restorative Rehabilitation for Functional Improvements in Any Stage of Parkinson's

In all stages of PD, rehabilitation should address patient-reported and clinically observed functional deficits. These deficits can be addressed in any setting, including outpatient, acute care, inpatient interdisciplinary rehabilitation facilities, home care, and skilled nursing rehabilitation units. Each discipline of rehabilitation has literature supporting some interventions with Grade A or strong evidence, and make other recommendations with lower levels of evidence.

There are strong recommendations supporting the use of PT to improve limitations in walking, balance, muscle strength, and motor functions [1•, 4•, 5•]. PT can address these problems through task-specific training and exercise. There is a strong recommendation supporting the use of OT to address limitations in the areas of instrumental activities of daily living, basic activities of daily living, work, and leisure, as well as concerns about the patient's safety and self-reliance when carrying out daily activities [2•, 4•, 5•]. They primarily address these limitations through training adaptive techniques, exercise, or task-specific practice to restore functions. There is also a strong recommendation supporting the use of SLP to address impairments such as swallowing, voice and communication, and cognition [3•, 4•, 5•]. Swallowing problems may be evidenced by problems eating, drinking, or drooling [3•]. SLP can address these problems by providing exercises for, and teaching compensatory strategies related to speaking with intensity, preventing choking, and avoiding the accumulation of saliva [3•].

Skilled Maintenance for Long-Term Monitoring in Advanced Parkinson's Disease

Patients in late stages of PD are more limited in their movements, basic and instrumental activities of daily living, and cognition. Rehabilitation in the late stages of PD is frequently delivered in the home, skilled nursing facilities, during acute hospitalizations, or in inpatient rehabilitation facilities due to difficulty traveling for outpatient appointments [20]. Depending on the settings, goals of care, and the characteristics of the individual with PD and their carepartner, rehabilitation may be focused on improving function, addressing quality of life, or palliative approaches [1•, 21]. There are strong recommendations supporting that the interprofessional care team in advanced PD should also include nursing personnel and carepartners [1•, 2•, 3•]. One approach includes skilled maintenance rehabilitation to help maintain individuals maintain or slow declines in function for as long as possible, which has recently been approved by the United States Medicare insurance company [22]. Skilled maintenance therapy is the delivery of "skilled therapy services" when there is a demonstration of the need for "specialized judgment, knowledge and skills of a qualified therapist" to effectively execute a maintenance program [23].

Across PT, OT, and SLP, rehabilitation in the later stages requires a greater need for the use of compensatory strategies, assistive devices, environmental adaptations, and family or paid carepartners [2•, 16]. PT can improve functional mobility through the use of compensatory strategies, task-specific training, and assistive devices; however cognitive deficits can decrease carry-over of learning and implementing new skills [24]. PT also supports adapted physical activity to reduce losses of physical capacity [1•]. Skilled PT and OT can address the maintenance of vital functions, prevention of pressure sores and contractures, and optimize body positioning in wheelchair or bed using a skilled maintenance approach [1•, 25, 22]. There are moderately strong recommendations for OT on providing advice for environmental adaptations and training carepartners to supervise the patient during daily activities [2•, 26]. Moderately strong recommendations for SLP include addressing dysphagia, cognition and word finding problems, drooling, particularly by teaching modifications and cues [3•]. An example of inpatient rehabilitation program for people with advanced PD found physical function improvements occurred in individuals with Hoehn and Yahr stages 3 and 4 PD, but not in individuals with stage 5 PD [15]. In this study, interdisciplinary rehabilitation consisted of PT, OT, and SLP for 2 h of individual therapy, 6–7 days each week for 1 month [15]. Studies have found that improvements in cognitive function can be more difficult to achieve in advanced PD [15, 16].

What: Rehabilitation Assessment and Treatment in Physical Therapy, Occupational Therapy, and Speech-Language Pathology

This section will assist interdisciplinary team members in understanding what PT, OT, and SLP assessments and treatments are likely to be performed during rehabilitation care. Treatments supported in the CPGs are summarized in Table 1 by the carepath and stage of PD. Readers seeking detailed discipline-specific guidance should seek additional training from the discipline-specific professional resources, reputable national or international provider organizations, and PD advocacy organizations. We recommend that each team member develop knowledge and expertise through continuing education and self-study [27].

In some cases, multiple members of the rehabilitation team can address the activity or participation limitations in an

Table 1 Rehabilitation care path framework for Parkinson's disease. Summarized rehabilitation assessments and interventions from clinical practice guidelines, with dosing suggestions based on expert opinions (*Abbreviations*: *OT*, occupational therapy; *PA*, physical activity; *PT*, physical therapy; *SLP*, speech-language pathology; *PwP*, people with Parkinson's; *PLVT*, Pitch Limiting Voice Treatment; *LSVT*, Lee Silverman Voice Treatment)

Consultative and proactive rehabilitation in early Parkinson's			**Restorative rehabilitation for functional improvement (any stage)**			**Skilled maintenance for long-term monitoring, particularly in advanced PD**		
Assessment, education about the disease, and advice on recommended activities and self-management.			Address impairments and limitations function that effect activities and participation through any stage of PD			Maintain vital functions; prevent complications such as pressure sores and contractures; support caregivers/nurses.		
PT	**OT**	**SLP**	**PT**	**OT**	**SLP**	**PT**	**OT**	**SLP**
• Assess baseline functional measures • Prevent inactivity through individually tailored exercise advice, prescription, and coaching • Address and prevent fear of movement or falling • Improve of physical capacity • Address pain • Delay onset of activity limitations	• Assess, educate, and advise on motor and nonmotor symptoms • Provide information and advice to prevent prematurely dropping meaningful activities and occupations • Increase knowledge to deal with current and future limitations with work, leisure, or household daily activities	• Assess, educate, and advise on voice, swallowing, and cognition • Advise on speaking with more intensity • Possibly short, intensive treatment with PLVT or LSVT if there is mild to moderate hypokinetic dysarthria	• Assess functional measures • Prescribe exercise to address impairments • Address walking, balance, transfers, manual activities, and motor function problems • Train Movement strategies	• Ass0065ss motor and nonmotor symptoms • Improve/maintain skills during the performance of activities • Address difficulties with activities of daily living using PD-specific strategies • Modify activities and environment to improve occupational performance	• Assess and treat speech, swallowing, saliva control, and cognitive limitations • Improve vocal pitch and range with intensive treatment • Instruct conversational partners • Explain importance of swallowing in time and teach compensation strategies and cues	• Assess function as needed • Support exercise to minimize reduction in physical capacity • Correct body posture in bed/wheelchair • Support periodic changes in position • Involve and coach the caregivers/nursing staff in the interventions • Maintain vital functions; prevent complications such as pressure sores and contractures; support carers/nurses	• Assess symptoms as appropriate • Modify activities and environment to improve occupational performance • Use adaptations • Support caregivers	• Assess speech, swallowing, saliva control, and cognition • Advise/support the use of alternative communication for severe dysarthria • Instruct conversation partners in cues or strategies • Modify food consistency and educate on cues and safety with moderate to severe dysphagia

interdisciplinary or transdisciplinary manner [28]. For example, each rehabilitation discipline can address cognitive function in some manner, from dual task training in PT, executive function training in OT, and communication and cognitive strategies in SLP. A broader team approach to treating cognition involves the medical providers (neurology and/or movement disorders specialists), psychology or neuropsychology, social work, and psychiatry. Each discipline also assesses and monitors safety for the PwP and provides training for carepartners who are experiencing problems supervising or supporting the PwP. In some way, each discipline can assist the patient in optimizing their quality of life, self-management, and functional independence, while addressing their discipline-specific goals.

Physical Therapy Assessment and Treatments

In all stages of PD, PT should address individual goals of the patient and carepartner, as well as assess fall history [1•]. In addition, PT should evaluate the need for restorative therapy by measuring potential deficits in gait, static and dynamic balance, agility, posture, dual tasking, pain, fatigue, transitional movements, overall functional mobility, safety, and regular physical activity or exercise participation [1•, 29]. In the initial evaluation of PwP in the early stages, these measures can provide a baseline of functional performance. Complete lists of standardized outcome measure recommendations to assess these deficits can be found in the European PT guidelines and resources developed by the Academy of Neurologic PT [1•, 30, 31] .

Restorative PT assessments and treatments depend on the stage of PD and the goals of therapy. Approaches may include task-specific walking and balance practice, treadmill training, moderate and vigorous aerobic exercise, strengthening, stretching, dance, tai chi, and complex movement strategies including amplitude-based training [1•]. PT frequently introduces PD-specific mobility strategies including cueing and compensatory strategies [1•]. These strategies may be introduced in early PD using motor learning principles when cognitive function is intact or only mildly affected. They are essential in the moderate to advanced stages of PD when restorative treatments cannot help the individual achieve age-matched healthy performance. When indicated, PT should address freezing of gait through the use of cues, task-specific practice, and compensatory strategies. Appropriate assistive devices for safe mobility can be identified and trained. PT may also assess for orthostatic hypotension and fine motor function, although other members of the interdisciplinary care team should be consulted to address these impairments. In advanced PD, PT may also work to prevent pressure sores and contractures.

Across all stages of PD, PT can also address exercise prescription and participation. The physical therapist's role is to educate, recommend, instruct, monitor, and progress recommendations over time [32, 33]. This should be done in accordance with the latest exercise guidelines for PwP combined with a personalized approach based on the individual's history, comorbidities, barriers, and preferences [32, 33]. By enabling the PwP to share decision-making on the frequency, intensity, and type of exercise, the physical therapist fosters intrinsic motivation and supports long-term adherence [1•].

Occupational Therapy Assessments and Treatments

In all stages of PD, OT addresses meaningful occupational performance. Occupational performance includes activities and roles in the domains of instrumental activities of daily living, basic activities of daily living, work, leisure, health management, hand function and coordination, fine motor, dexterity, coordination, safety, self-reliance when carrying out daily activities, and driving [2•]. Evaluation of safe driving may occur in both contextual and non-contextual environments with assessment of visual, motor and cognitive impairments [2•, 34]. Recommended standardized outcome measure for occupational therapists can be found in the European OT guidelines [2•]. It is optimal that evaluations be performed in the context of the occupational performance problem such as, for example, in the home or in the appropriate medication state.

Treatment plans in OT may include formalizing daily structure with meaningful work and leisure activities, self-management, energy conservation, addressing hand impairments and function, driving, community and home living environment, basic and instrumental activities of daily living, dual task training, posture, positioning, and carepartner support [2•, 35]. OT interventions target changing aspects of the individual, activity, and/or environment. At the individual level, OT focuses on skill improvement or maintenance, compensatory strategies, self-management, schedule and routine development and behavior change [35]. At the activity level, OT can assist the PwP to organize and simplify their tasks, or to apply external cues or devices to make the task easier. At the environmental level, OT promotes modifying the environment to ensure safety, effectiveness, and efficiency when performing activities [2•]. Treatment strategies commonly include exercises, cueing, and self-management strategies [36].

Speech-Language Pathology Assessments and Treatments

In all stages of PD, SLP assess three primary domains: speech, swallowing, and communication-cognition. SLP assessment should include spontaneous and standardized speech measures including volume and evaluation of other motor aspects of speech and breath support, swallow function including video fluoroscopic swallowing studies (VFSS) or fiberoptic endoscopic evaluation of swallowing studies (FEES) studies when possible, and cognition [3•, 37]. While formal, comprehensive cognitive assessments are typically completed by a

neuropsychologist [38], SLPs also assess and treat the functional impact of cognitive impairment. In addition, other discipline, such as PT and OT, can assess cognition within their discipline-specific domains as it influences motor learning and as a determinant of a rehabilitation outcomes and home safety [5•].

Related to speech, the primary voice impairments in PD are typically hypokinetic dysarthria and hypophonia, causing a mumbling or softer voice. PD-related impairments can affect articulation, phonation, prosody, and respiration, all of which are required motor activities for normal speech production [39]. Treatment for dysarthria can compensate for impairments or modify the communication environment to improve understanding between the speaker and listener [40]. Treatment approaches include amplitude-based training with regular re-checks, other therapies focused on cues for attention to effort, posture, pacing, carepartner training, and compensatory strategies such as amplification, nonverbal communication, or *augmentative* and alternative *communication* technology [3•, 40–44].

When addressing swallowing, the SLP works with the patient and carepartner on strengthening orolingual muscles, expiratory muscle strength training, task-specific swallowing practice with or without FEES biofeedback, adapting diet consistency, drooling, and developing appropriate cueing for posture and safety [4•, 5•, 45]. Dysphagia can occur even in early PD [46]. The speech-language pathologist teaches compensation strategies to prevent choking, particularly in relation to swallowing oral medications [3•, 4•, 5•]. Carepartner training can also include external cueing for swallowing and drooling.

Related to cognition, PwP can experience a range of cognitive changes from bradyphrenia to mild cognitive impairment or dementia, which can influence rehabilitation strategies [47]. SLP can address working and short-term memory, as well as executive function domains including attention, set-shifting, inhibition, self-monitoring, planning and organization, goal-directed behaviors, and visuospatial function [2•, 3•]. Cognition is addressed in the context of how it affects comprehension, communication, and social pragmatics. Communication and cognitive rehabilitation and compensation may be explored by both SLP and OT. Cognition can also be addressed in an interdisciplinary context based on their influence on mobility, motor learning, occupational performance, and safety. Although restoration of specific cognitive deficits may not be feasible, SLP can provide valuable tools to train the patient and carepartner on beneficial cues, compensatory communication strategies, and education to improve acceptance of the changes [3•].

How: Rehabilitation Care Paths and Delivery Models

Clinician and patient stakeholders provide input into CPGs, but the guidelines provide little information on how to implement the guidelines in the real world. This section describes how rehabilitation can be implemented using a novel care delivery framework. In addition, we consider dosing of interventions and implementation of team-based care.

Care Delivery Framework

We propose a framework of care delivery that acknowledges the different stages of PD. The goals of care may differ for someone who is newly diagnosed or in the advanced stages of PD, although at all stages of the disease there can be goals to improve function. Fig 1 outlines this framework of a (1) consultative, proactive rehabilitation approach in early PD, (2) a traditional restorative approach addressing functional improvements, and (3) a skilled maintenance approach for long-term monitoring in advanced PD. The consultative, proactive approach is a form of secondary prevention. There are many mild motor, occupational performance, voice, and cognitive changes that can be measured and treated even in newly diagnosed PD. A consultative approach in newly diagnosed PD can provide support and knowledge related to exercise participation [19•, 48]. This consultative approach can also introduce PwP to the rehabilitation team, minimizing the overwhelming commitment of comprehensive restorative therapy. A restorative approach is appropriate in any stage, but particularly in moderate stage PD. It is the traditional approach to rehabilitation that is focused on improving function. It requires a greater dose (number and frequency of visits) of rehabilitation for effectiveness. Finally, a skilled maintenance approach is an approach taken to allow rehabilitation providers to monitor people with a disorder that can cause a high likelihood of decline in function. It can be more useful in advanced PD or in PwP who receive home health services or rehabilitation in a skilled nursing facility [22, 25].

Dosing of Rehabilitation

It is important to consider dosing of rehabilitation at multiple levels: frequency of visits within an episode of care, duration of episode of care, and frequency of episodes of care. The requirements for frequency of visits and duration of episode of care are different when focused on restoring function than in early PD, when the focus is primarily on baseline assessment, education, and exercise prescription. Consultative, proactive rehabilitation in early PD, when deficits are mild, can often be accomplished in four visits or less spread over a couple months [19•, 49]. However, most traditional restorative rehabilitation trials that seek to improve a functional task provide 2–4 sessions per week for 4–12 weeks [1•, 50–53]. Functional improvements can occur with individual, group, and community-based exercise approaches, although it is important to consider potential reimbursement concerns and an individual's resources available for self-pay community

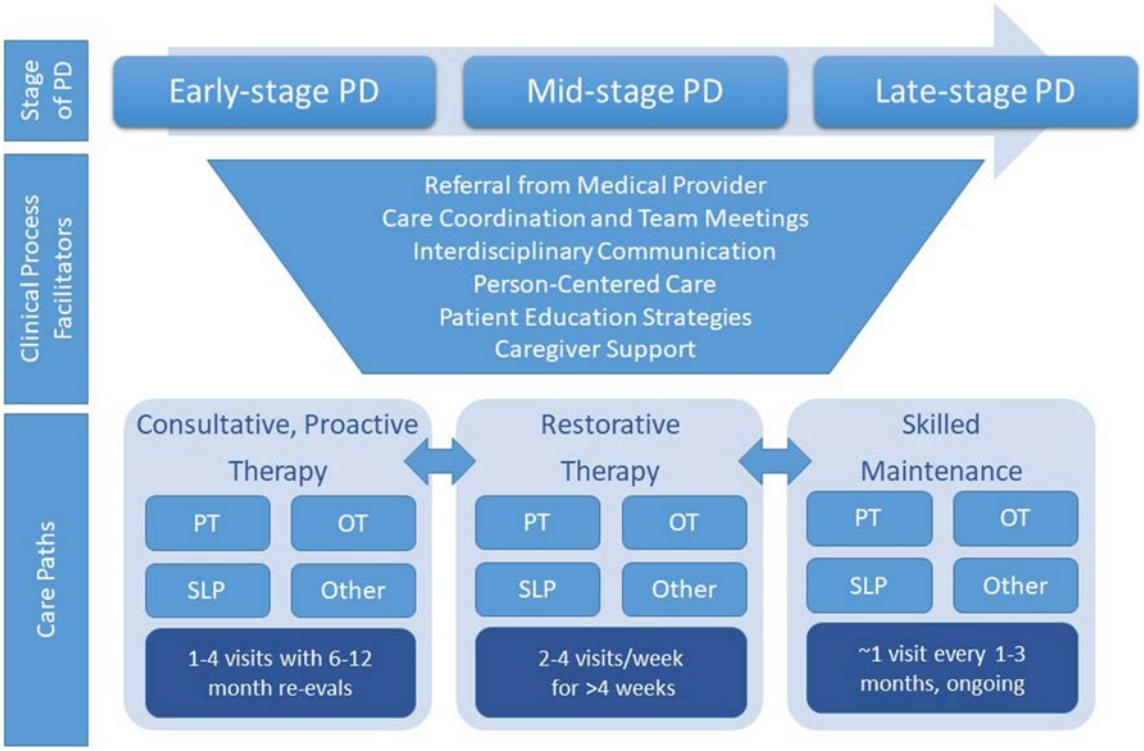

Fig. 1 Process model for team-based rehabilitation care paths across the stages of Parkinson's disease

services such as exercise groups [1•]. More progressive models of care include recommending regular re-assessment every 3–6 months, as proposed in the Korean rehabilitation consensus statement [37]. Regular rehabilitation re-checks can be considered a "dental model" of rehabilitation care [48]. Approximately 50% of adults report visiting the dentist every 6 months, but there is much lower utilization of rehabilitation services by PwP [8, 54]. In the United States, the Centers for Medicare and Medicaid Services recently supported a model called skilled maintenance rehabilitation that may be an acceptable way to help people in the advanced stages of PD when functional improvements more difficult to achieve [22, 25]. We propose that the skilled maintenance model may be effective with visits every 1–3 months for PwP, although this may need to be adjusted based on the individual's needs and insurance coverage.

Person-Centered Team-Based Care

A team-based approach can improve quality of life and motor symptoms in PwP more than care by a general neurologist alone [11, 18•, 55]. Interdisciplinary and multidisciplinary are two terms that are often used interchangeably, but interdisciplinary implies greater synthesis of team goals and relies on the use of regular team meetings. In contrast, multidisciplinary care includes many team members who may work more independently or between organizations. Taking either an interdisciplinary or multidisciplinary approach can assist PwP in addressing their multi-faceted concerns, particularly considering the constrained time of any one care provider and the evolution of PD motor and nonmotor symptoms [56–58]. Delivery of rehabilitation team-based care can occur in traditional outpatient, day rehabilitation, home health, and inpatient rehabilitation settings [16, 59–63•]. Telehealth may also be an appropriate delivery model for rehabilitation care, depending on circumstances such as living distance to the clinic, time constraints due to employment or transportation burden, or safety to attend the clinic as well as access, availability, and ease of technology [18•].

Physical therapy, OT, and SLP deliver person-centered care, which includes helping the PwP to identify goals for rehabilitation, personal determinants of success, and sources of motivation [64, 37, 18•, 65, 66]. Interactions with the rehabilitation team should promote active participation, shared decision-making, and autonomy, and empowerment [29, 67]. Other team members may include, but are not limited, to the following: clinical coordinator, nursing, social work, licensed counselors, neuropsychologist, vocational rehabilitation counselors (employment), dieticians, recreation therapists, and dentists, along with physicians with specialties such as movement disorders, general neurology, primary care, physical medicine and rehabilitation (physiatry), pain, geriatrics, psychiatry, neuro-ophthalmology, gastroenterology, urology, sleep, vascular medicine, and palliative care [18•, 68, 69]. Due to the potential sizes of the teams, having

mechanisms for care coordination, team meetings, and communication are essential [18•].

Conclusions and Future Directions

Clinical practice guidelines describe best practices for the traditional rehabilitation therapies of PT, OT, and SLP for PwP. To improve the delivery of evidence-based rehabilitation, we propose a framework for care delivery that takes into account how treatment goals can differ across the stage of Parkinson's. Future research can empirically test these delivery models in pragmatic trials and explore how they relate to outcomes, quality of life, and integration with other disciplines. In particular, there is a need for additional research studying the role of rehabilitation soon after diagnosis and in advanced PD.

Code Availability Not applicable

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Declarations

Conflict of Interest Dr. Rafferty reports grants from United States Department of Defense, during the conduct of the study. She reports grants from National Institute on Disability, Independent Living, and Rehabilitation Research; Parkinson's Foundation; Academy of Neurologic Physical Therapy; Foundation for Physical Therapy; Agency for Healthcare Research and Quality; Davis Phinney Foundation, other from Parkinson's Foundation, other from Academy of Neurologic Physical Therapy, outside the submitted work. Ella Nettnin has nothing to disclose. Dr. Goldman reports grants from NINDS, MJFF, Parkinson's Foundation, other from Acadia, Aptinyx, Sunovion, Worldwide Med, grants from CHDI, Biotie, during the conduct of the study. Dr. MacDonald reports grants from Parkinson's Foundation, grants from Academy of Neurologic Physical Therapy, grants from Department of Defense, outside the submitted work.

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Health Promotion and Wellness in Neurologic Physical Therapy: Strategies to Advance Practice

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Presentations related to this work include the following:

1. ANPT Synapse Center Online continuing education course "Health Promotion & Wellness Strategies Applied to Neurorehabilitation."
2. Two-day preconference course at the *Combined Sections Meeting of the American Physical Therapy Association.* January 2019 titled "Health Promotion and Wellness Strategies Applied to Neurorehabilitation."
3. Related resources are shared on the ANPT HPW webpage (https://www.neuropt.org/practice-resources/health-promotion-and-wellness).

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Background and Purpose: Neurologic physical therapy (PT) can assist people with neurologic conditions and injuries to optimize their health and well-being by addressing barriers at the individual, relationship, community, and societal levels. The purpose of this special interest article is to provide consensus-driven strategies to address barriers to implementing health promotion and wellness (HPW)-related neurologic PT practice.

Summary of Key Points: Environmental scan, literature review, and expert input were used to determine barriers and develop strategies. Barriers include lack of time; low knowledge, self-efficacy, and awareness; client complexity; and lack of HPW resources; as well as concerns regarding payment and scope of practice. Four key strategies emerged: (1) develop and disseminate a consensus-based scope of practice for HPW in neurologic PT; (2) increase knowledge of resources related to HPW; (3) promote delivery models for HPW-related neurologic PT; and (4) encourage advocacy, community building and partnership along the continuum of care.

Recommendations for Clinical Practice: Clinicians should practice to their full scope of HPW-related PT practice. This includes optimizing movement, including physical activity and fitness, as well as reinforcing the importance of healthy sleep, nutrition, stress, and smoking cessation. These activities address primary, secondary, and tertiary prevention. Clinicians are encouraged to report their experiences with HPW-focused delivery models and outcomes. Additional research is needed to understand the full impact of HPW on PT practice (see the Video, Supplemental Digital Content 1, available at: http://links.lww.com/JNPT/A364).

Key words: *delivery model, fitness, health promotion, knowledge translation, physical activity*

(*JNPT* 2022;46: 103–117)

Health promotion and wellness (HPW) are critical to participation in valued activities and life roles.[1,2] Neurologic physical therapy (PT) is a health care delivery mechanism that is ideally placed to assist people with life-changing neurologic conditions and injuries to optimize their health and wellness despite their condition.[3,4] While there are various definitions, health promotion supports individuals, groups, or communities to enable the pursuit of and control over health improvements, prevention, and wellness.[1,5] Wellness incorporates all dimensions of individual and group existence, including optimal physical and emotional health, spirituality, social connectivity, psychological, and intellectual

well-being.[1,5,6] Furthermore, health is inclusive of quality of life and well-being, not merely the absence of disease.[1,5-7]

Recent national and international efforts have called on PT to screen and address 5 core HPW components of healthy lifestyle behaviors: (1) physical activity, including lifestyle physical activity, structured exercise, and sedentarism; (2) sleep; (3) stress; (4) nutrition; and (5) smoking.[6,8,9] Physical activity is "any bodily movement produced by skeletal muscles that results in energy expenditure."[10] It can include basic activities of daily living or exercise, which is defined as "a subset of physical activity that is planned, structured, and repetitive" with an objective to improve or maintain physical fitness.[10] Physical activity is the HPW component most often addressed by PT, and its benefits are well-documented.[11,12] However, the 4 other health behaviors also represent critical modifiable risk factors for the onset of noncommunicable diseases (NCDs) such as heart disease and diabetes, which are important considerations in HPW neurologic PT practice.[13] Although underexplored in PT literature and practice, these 5 health behaviors are modifiable risk factors that have been associated with the onset or worsening of neurologic conditions and injuries such as stroke,[12,14-22] spinal cord injury (SCI),[23-29] traumatic brain injury (TBI),[30-34] multiple sclerosis (MS),[35-38] and Parkinson disease (PD).[39-44] PT screening and health promotion activities targeting all 5 of these health behaviors may reduce risk of NCD and improve the health, wellness, as well as disease-specific and functional outcomes, of clients with neurologic conditions and injuries. Table 1 provides examples of the interactions between modifiable risk factors related to health behaviors, NCDs, and neurologic conditions.

Since 2016, the Academy of Neurologic Physical Therapy (ANPT) has addressed HPW through several initiatives: the HPW Task Force, the IV Step Conference,[3,4] and the 2018 strategic plan, which identified the development of HPW resources as an action step "to advance practice, policy, research and education for those impacted by neurologic conditions."[45] Numerous additional sources have supported the importance of changing the current PT paradigm from a reactive system focused primarily on "sick care" to more proactive health-focused care.[6,8,9,46]

Although critically important, there are many unaddressed barriers to practicing HPW-related PT. The barriers are organized here through the social-ecological model at the individual (client), relationship (clinician-client dyad), community (facilities, organizations), and societal (payment, social determinants of health) levels.[47] Barriers related to clients include lack of interest or awareness that PTs provide

Table 1. Example Relationships Between Neurologic Conditions, Noncommunicable Diseases, and Modifiable Risk Factors Related to Health Behaviors That Can be Influenced by Physical Therapy[a]

Condition	Prevalence of Noncommunicable Disease or Modifiable Risk Factors Related to Health Behaviors in Neurologic Condition or Injury	Modifiable Risk Factors or Health Behavior Associated With Increased Risk of Developing Neurologic Condition or Injury (Incidence)	Modifiable Risk Factors or Health Behavior Associated With Worse Outcomes When One Has the Neurologic Condition
Stroke	Stroke doubles the risk of having dementia[21] 50% prevalence of sleep disorders after stroke[14]	Sleep impairment (insomnia) increases risk by 54%[18] High amounts of physical activity reduces risk by 20%-25%[12] High cholesterol is associated with increased risk[19]	Sedentary lifestyle may aggravate poststroke fatigue[22] Smoking increases risk of second stroke, MI, or death[17,20]
SCI	55%-68% of population is overweight or obese[23] Increased risk of cardiovascular disease based on blood cholesterol values and hypertension[25] Poor sleep and sleep-related breathing disorders are greater in SCI than the general population[29]	Number of new SCI caused by falls is increasing, along with increased average age of new SCI[24]	Obesity may be associated with the development of upper extremity overuse injuries[26] Nutritional status influences pressure ulcer closure[27] Pain and anxiety increase risk of developing chronic health conditions[28]
PD	One-third less active than older adults[42] Sleep disorders, particularly REM behavior disorder, are common[43]	People who are less physically active have a greater incidence of developing PD[41]	More exercise is associated with slower decline in QOL and mobility[40] Poor nutritional status is associated with poorer functional gains during rehabilitation[44]
MS	Prevalence of cardiovascular disease in patients older than 60 y is more than 40%[36]	Smoking may be associated with a 50% increase in MS risk compared with nonsmoking[37]	Relapse rates 2.6 times higher in patients with MS with obesity, hypertension, and diabetes[36] Higher accrual of lesions in those with poor diets[36] Smoking contributes to an 80% increase in secondary-progressive MS risk[37]
TBI	Sports-related concussions increase risk of sleep distubance[32] Elderly individuals with a history of cancer may have worse outcomes of subsequent TBI[31]	Complex relationships exist between TBI incidence/prevalence with substance abuse, family violence, and social determinants of health[33,34]	Chronic smoking impairs post-TBI recovery[30]

Abbreviations: MI, myocardial infarction; MS, multiple sclerosis; PD, Parkinson disease; QOL, quality of life; SCI, spinal cord injury; REM, rapid eye movement; TBI, traumatic brain injury.

[a]This is a nonexhaustive review of the topic.

HPW services, as well as condition complexity (ie, comorbidities and cognition).[6,46,48] At the level of the clinician-client dyad, barriers include lack of clinician time and added burden of addressing HPW,[6,46,48] lack of physical therapist and referral source knowledge of the role of PT in HPW, and low clinician self-efficacy in specific HPW skills (ie, motivational interviewing).[6,46] Community-level barriers include lack of accessible facilities and trained exercise professionals within local community networks,[6,49,50] as well as fragmented HPW education resources across consumer and professional organizations.[6,46] Societal-level barriers include payment concerns due to the misperception that the scope of PT practice does not include HPW due to traditional foci on restoration of function[6,46,48] and the social determinants of health (SDOH).[51] While the SDOH can contribute to barriers across all levels of the social ecological model, they are most notable at the societal level. The SDOH include the domains of economic stability; education access and quality; health care access and quality; neighborhood and built environment; and social and community context. These domains can become barriers to the success of PT, as well as physical activity and HPW, and increase health disparities.[51] The relative importance of these barriers may differ between clinicians, populations, and neurologic rehabilitation settings; thus, individually tailored barriers assessments should be considered.[52]

Despite the importance of HPW, barriers have slowed implementation of HPW-focused care. The purpose of this special interest article is to provide expert consensus-driven strategies to address the barriers to implementing HPW-related neurologic PT practice. These strategies sought to (1) develop and disseminate a consensus-based scope of practice for HPW practice in neurologic PT; (2) increase knowledge of resources related to HPW; (3) promote delivery models for HPW-related neurologic PT; and (4) encourage advocacy, community building, and partnership along the continuum of care. Further, next steps are provided for clinicians and researchers to advance practice and address remaining knowledge gaps.

METHODS

This article represents the work of the ANPT HPW Task Force, which served under the Practice Committee beginning in 2016. The ANPT Board of Directors selected Task Force members after a call for applications sent to all ANPT members. The Task Force consisted of 7 individuals (clinicians, researchers, and educators), with an average 18 ± 8 years of experience in the field and expertise across neurologic PT diagnoses, practice settings, classroom and clinical education, and HPW-related research areas (Table 2).

The HPW Task Force examined previously reported HPW priorities within general and neurologic PT practice, identified barriers, and executed an action plan. An environmental scan of existing literature and resources was conducted alongside consensus building with expert stakeholders. The environmental scan focused on investigating definitions of HPW, existing and needed resources related to HPW, the role of contemporary neurologic PT in HPW practice, barriers to HPW practice, and strategies to overcome these barriers.

Table 2. Characteristics of Health Promotion and Wellness Task Force Members (N = 7)

Characteristics	n (%)
Credentials	
DPT	3 (43)
NCS	4 (57)
PhD	5 (71)
CEEAA	2 (29)
Professional area of expertise	
Research	3 (43)
Entry-level DPT teaching	5 (71)
Postprofessional teaching	3 (43)
Residency director/mentor	2 (29)
Clinical instructor	1 (14)
Expert clinician	4 (57)
Diagnostic expertise	
Stroke	4 (57)
Spinal cord injury	1 (14)
Brain injury	3 (43)
Parkinson disease	1 (14)
Multiple sclerosis	1 (14)
Other Neurodegenerative	1 (14)
HPW-related expertise	
Research	5 (71)
Entry-level DPT teaching	6 (86)
Postprofessional teaching	5 (71)
Practice	5 (71)

Abbreviations: CEEAA, certified exercise experts for aging adults; DPT, doctor of physical therapy; HPW, health promotion and wellness; NCS, Board-Certified Clinical Specialist in Neurologic Physical Therapy; PhD, doctor of philosophy.

The environmental scan was conducted initially from 2016 to 2017, but remained iterative through 2020 as new information arose. Information gathered included international definitions,[1,5,7] position statements from national and international PT organizations,[3,4,8,9,53,54] peer-reviewed literature on HPW practice and barriers,[2,3,6,8,9,46,48] and existing client-focused community resources available on the Internet related to neurologic HPW.

Consensus building on the 4 strategies to address barriers to HPW practice included review, discussion, and debate on the results of the environmental scan by HPW Task Force members and consultation with other subject matter experts, including APTA leadership, ANPT leadership, and the APTA HPW Council. The APTA HPW Council is a networking and APTA-advising body who educates and advises health colleagues on the roles of PTs in health promotion, wellness, and prevention. The HPW Task Force synthesized this information, discussed, and resolved any discrepancies through discussion at monthly meetings, a 2-day working meeting, and email communication. Ultimately, a map of the 4 strategies to address the barriers identified was developed. The Figure illustrates this map depicting the relationship between the barriers and strategies, organized by the social ecological model.

Develop and Disseminate a Consensus-Based Scope of Practice for HPW Practice in Neurologic PT

A clear consensus statement on HPW neurologic PT practice addresses barriers related to a lack of public

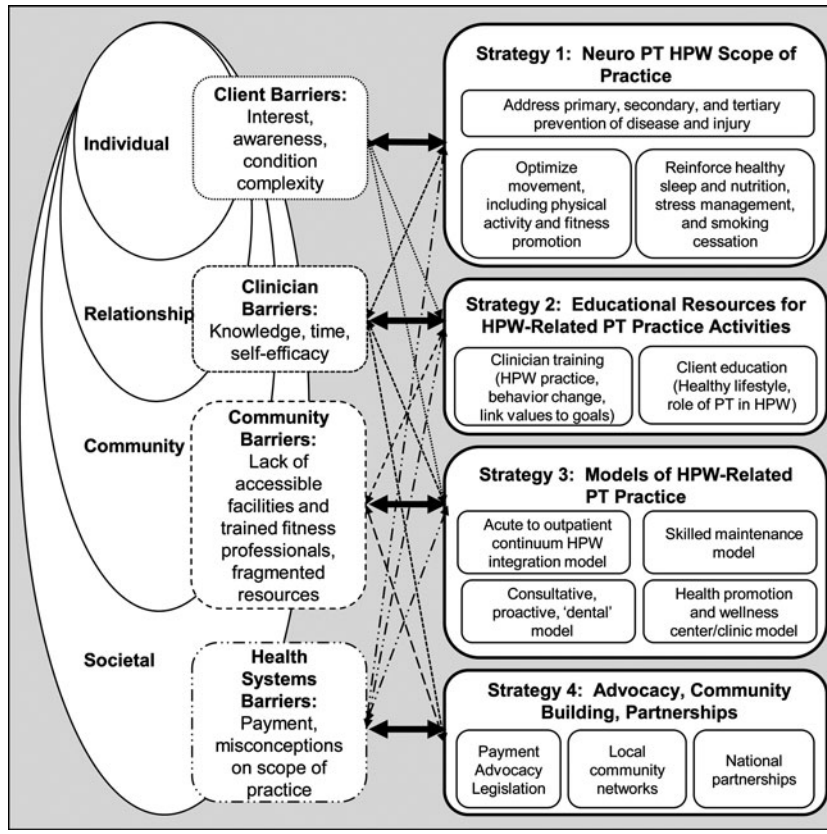

Figure. Map connecting barriers to strategies promoting HPW in neurologic physical therapy. Barriers identified in the literature were organized using the social ecological model (left). Strategies identified by the ANPT HPW Task Force are summarized (right). Each strategy targets barriers at a specific level of the social ecological model; however, each barrier is addressed by multiple strategies, and multiple strategies address each barrier (center bidirectional arrows). ANPT, Academy of Neurologic Physical Therapy; HPW, health promotion and wellness.

awareness regarding the role of PT in HPW, as well as a lack of knowledge or interest in HPW-related PT practice by neurologic physical therapists, referrers, and clients (Figure). A clear scope of practice also assists legislative advocacy and payment efforts. The scope of HPW-related neurologic PT includes addressing primary, secondary, and tertiary prevention of disease and injuries by: (1) optimizing movement, including the promotion of physical activity and fitness and (2) reinforcing the importance of healthy sleep and nutrition, stress management, and smoking cessation. Resources supporting this scope were the APTA Guide to Physical Therapy Practice 3.0,[5] the World Health Organization,[7] the Ottawa Charter for Health Promotion,[1] APTA House of Delegate (HOD) position statements,[53,54] articles outlining consensus work from the World Confederation for Physical Therapy,[8,9] and prior articles addressing HPW in neurologic PT practice.[3,4]

Determining and disseminating expert consensus on HPW neurologic PT scope of practice helps to clarify controversial areas related to HPW in neurologic PT practice, without attempting to extend practice. The first area of controversy is the role of PT in screening and addressing health behaviors beyond physical activity and fitness. The APTA HOD position statements are clear that nutrition, sleep, stress, and smoking are within PT scope of practice, as long as all local state licensing laws and regulations are followed and the clinician is acting within their own personal scope of practice based on training and expertise.

Another controversial area of HPW in neurologic PT is the understanding of the PT role in primary, secondary, and tertiary prevention. Traditional PT falls under the scope of tertiary prevention, or reducing the negative impact of ongoing illness or injury to improve function and quality of life.[55] The role of neurologic PT in secondary prevention, or reducing the impact of disease and injury through screening and early intervention to prevent long-term problems, has also been well-defined.[3,55] Secondary prevention is particularly important based on the role of physical activity in maintaining function, promoting quality of life, and decreasing risk of cardiovascular complications and NCDs in people with neurologic diseases. The role of PT in primary prevention, or the prevention of a disease or injury from occurring, is less prevalent, but growing.[3,6,55] The most common examples of primary prevention in neurologic PT are the role of physical activity in cardiovascular and brain health, as well as community-based fall screenings for older adults, which could prevent traumatic spinal cord and brain injuries.

The APTA has been advancing the role of PT in primary prevention through position statements,[53,54] the Guide to PT Practice,[5] the development of the Annual PT Visit and its associated training tools,[56] and support of APTA HPW Council. Clinicians who work in community wellness settings, cash-based PT settings, or who consult on population-level initiatives are at the leading edge of primary prevention efforts. However, current advocacy work by the APTA for payment of PT services as part of wellness and prevention programs will advance primary prevention in more traditional health care settings.[57] In addition to legislative advocacy, the APTA shares implementation plans for an Annual PT Visit across the lifespan, even in individuals with no known health conditions.[56] Within traditional neurologic PT settings, clinicians can schedule an Annual PT Visit to address secondary and tertiary prevention within the context of their neurologic condition. During those annual visits, screening for health behaviors will also address primary prevention of NCDs. For example, screening for and addressing nutrition and smoking in an individual with MS may be associated with reduced signs of disease progression,[36,37] as well as primary prevention of NCDs such as obesity and lung disease. Although each payer is different, the initiation of direct access and reimbursable skilled maintenance therapy (see strategy 3) support neurologic physical therapists to address prevention in traditional health care settings. This article addresses ongoing barriers to HPW and prevention practice through the provision of implementation strategies and education. Physical therapists can then advocate to their health care administrators, referrers, and communities about their role in HPW and prevention.

Increase Knowledge of Resources Related to HPW

Barriers related to low clinician knowledge, time, and self-efficacy are addressed by investigating and compiling existing clinician training and client education HPW resources (Figure) and addressing gaps in resources as identified. Compiling the existing resources also addresses barriers related to client knowledge and complexity, as well as the fragmented information available on community resources.

There are a growing number of high-quality HPW education resources available for the general public and some for people with neurologic conditions. Reputable client-focused education resources include national and international professional organizations, consumer organizations, and government initiatives, as well as a variety of reputable disability advocacy and condition-specific organizations. The lack of awareness of these resources and spread of these resources across various organizations makes it difficult for practicing clinicians to find appropriate information quickly and may lead to duplicating work. Furthermore, many of the resources do not include the role of PT in HPW-related topics.

Existing educational resources that can facilitate HPW practice in neurologic PT are shared on the ANPT HPW webpage and summarized in Table 3. Increasing awareness of existing client-focused resources may reduce duplication of efforts by clinicians. Resources include education sheets,

Table 3. Sources of Educational Resources to Facilitate Physical Therapy Delivery of Health Promotion and Wellness Content to People With Neurologic Disorders[a]

Resource Source	Types of Resources Provided	Example Organizations
National and international organizations	Summary of state policies Clinician networking groups Clinician education (fact sheets, presentations, tool boxes, knowledge synthesis) National initiatives including "Exercise is Medicine" Consumer education	APTA World Confederation for Physical Therapy American College of Sports Medicine Preventive Cardiovascular Nurses Association National Physical Activity Plan World Health Organization Center for Medicare Advocacy
Clinical practice guidelines repositories	Condition-specific guidelines may include information on physical activity US nutrition and physical activity guidelines	APTA Evidence-Based Practice Resources National Institute for Health and Care Excellence (UK) ParkinsonNet US Office of Disease Prevention and Health Promotion
Consumer organizations	Consumer education (Web sites, webinars, fact sheets, exercise programs) Evidence-based health programs	National Multiple Sclerosis Society Parkinson's Foundation American Stroke Association United Spinal Association Brain Injury Association Evidence-based health programs at the Y (YMCA) National Center on Health, Physical Activity and Disability by Centers for Disease Control and Prevention (NCHPAD) National Sleep Foundation
Government initiatives (United States)	Consumer education (Web sites, fact sheets, videos) Information for health care providers and exercise professionals Virtual training programs Activity tracking programs	National Institute on Aging Move Your Way by Office of Disease Prevention and Health Promotion Centers for Disease Control and Prevention Programs for Addressing Social Determinants of Health MyPlate by US Department of Agriculture

[a] Please see the ANPT HPW Web site for updated links to these resources.[60]

booklets, and videos developed by professional groups such as the APTA; the National Center on Health, Physical Activity and Disability (NCHPAD); and the Exercise is Medicine (EIM) Campaign by the American College of Sports Medicine (ACSM). The ANPT HPW webpage includes up-to-date resources on each of the HPW topics, including examples from government initiatives and client-focused resources, such as nutrition materials provided by the US Department of Agriculture, and healthy sleep information from the National Sleep Foundation. Using existing resources to support client education can benefit both clinicians and clients. They facilitate comprehensive rehabilitation and wellness programs and serve to link individuals to appropriate community organizations enhancing support and self-advocacy.

While we encourage the use of existing reputable HPW education resources (Table 3), many of these resources target clients rather than physical therapists. They often do not clearly address the role of PT in HPW-related topics (eg, when, where, and how to intervene). Several clinician training tools have been developed by and for physical therapists, which are now available online through the ANPT. These tools can help address clinician barriers related to lack of knowledge and time by providing information about HPW screening and assessment tools, as well as behavior change strategies. These tools include: (1) the ANPT HPW webpage,[58] (2) the ANPT Synapse Education Platform course, "Health Promotion and Wellness Strategies Applied in NeuroRehabilitation," and (3) the "Bridging the Gap between PT and Lifelong Physical Activity and Exercise in People with Neurological Conditions Toolkit."[59] Any new resources developed should build upon existing resources, ensure accessibility, and address health literacy.

The ANPT HPW webpage (https://www.neuropt.org/practice-resources/health-promotion-and-wellness)[60] was launched in 2019. It provides a platform for sharing reputable educational resources curated for physical therapists. Resources are organized as (1) clinician resources and tools, (2) client/patient resources and tools, (3) translation to practice setting tools, (4) foundational learning and key articles, and (5) links to information from the condition-specific ANPT Special Interest Groups on HPW topics. The HPW webpage is open to the public and updated regularly to share the most accurate and evidence-based information.

The ANPT Synapse Education Platform includes an online continuing education course titled "Health Promotion and Wellness Strategies Applied in NeuroRehabilitation." This course provides education on foundational HPW topics based on the US National Prevention Strategy health priorities as described by the APTA[54] and international peer-reviewed literature in PT education.[8] These concepts include the HPW domains of physical activity[3,4] (structured exercise, sedentarism, and lifestyle physical activity), nutrition,[23,36,61] sleep health,[14,35,62] stress management,[15,39,63,64] depression,[35,65-67] smoking cessation,[16,46,68,69] polypharmacy,[70,71] and violence prevention.[72,73] Additionally, the course provides clinical tools, including education on the role and scope of neurologic PT in HPW,[8,53,54,74,75] as well as outcome measurement and screening tools for HPW and physical activity.[76-79] The Synapse education course also includes information on health behavior change models and motivational interviewing-informed practice.[50,80-84]

The "Bridging the Gap between PT and Lifelong Physical Activity and Exercise in People with Neurological Conditions" document was developed originally by the ANPT Spinal Cord Injury Special Interest Group.[85] With author permission, it was adapted for general neurologic PT audiences with additional resource material. This toolkit now provides detailed objectives and rationale for promoting lifelong physical activity, how to assist clients in connecting back to PT after an episode of care, and multiple appendices that serve as educational materials, worksheets, and references. The aim of this toolkit is to facilitate PT-client dialogue and shared decision-making around values, goals, barriers, and action planning to promote healthy physical activity and exercise habits for individuals living with a neurologic condition or injury.

Knowledge and dissemination of HPW principles and practice is also growing in entry-level DPT education, although more work is needed. Magnusson et al[86] provide core competencies for population health, prevention, and HPW in PT, which can guide and enhance education of new clinicians and help programs address HPW-related Commission on Accreditation in Physical Therapy Education (CAPTE) standards (7D11, 7D14, 7D19h, 7D20, 7D23, 7D34, 7D39, 7D40, and 7D41). Rethorn et al's survey[87] of DPT programs highlights the need for continued support of and resources for faculty to teach HPW.

Promote Delivery Models for HPW-Related Neurologic PT

The environmental scan and consensus building process led to identifying the importance of developing and disseminating delivery models for HPW-related PT practice to address barriers across all levels of the social-ecological model. Sharing practical delivery models addresses barriers related to clinician time and knowledge; interest and awareness of clients and referrers; community exercise and education resources; and the understanding of the general public and third-party payers on how PT can address HPW (Figure). Four delivery models revealed in the environmental scan include: (1) acute to outpatient rehabilitation continuum model,[49] (2) proactive consultative "dental" model,[88] (3) skilled maintenance model,[89] and (4) HPW center/clinic model.[90,91] Each model is defined, with delivery and documentation considerations in Table 4. Models may involve partnerships with evidence-based community programs, exercise professionals, caregivers (formal and informal), research studies, and community organizations.[92,93] All models should include screening for lifestyle health behaviors, including physical activity (eg, structured exercise, sedentarism, and lifestyle physical activity), nutrition, smoking, sleep, and stress management. Clinicians should also consider how the SDOH can influence successful outcomes. Interventions should be delivered as appropriate per PT scope of practice, noting potential differences between practice settings, state regulations, and need for additional clinician training.

Table 5 summarizes examples of how each delivery model can be applied, with a focus on physical activity. The models are applicable across various neurologic conditions

Table 4. Physical Therapy Delivery Models Incorporating Health Promotion and Wellness[a]

Model[b]	Model 1 = Acute to Outpatient Continuum HPW Integration Model	Model 2 = Consultative, Proactive, "Dental" Model	Model 3 = Skilled Maintenance Model	Model 4 = Health Promotion and Wellness Center/Clinic Model
Operational definition	Introduce adapted lifestyle physical activity in acute rehab Foster independent community physical activity and enhance fitness in outpatient rehab Transition to semi-supervised or independent exercise through continuum of care[49]	Provide expertly tailored exercise prescription, monitoring, and progression Goals to restore, improve, or maintain function and to optimize movement Use proactively after diagnosis or for long-term monitoring in chronic disease[88]	Medicare coverage of SNF, HH, and OP services for *skilled care* to improve, maintain or prevent or slow further deterioration[89] Functional gains not required Must be reasonable, necessary care that cannot be delivered by nonskilled personnel	Exercise programs are completed with assist and progressed with PT monitoring or supervision as needed Part of a traditional rehab center, a standalone nonprofit organization, or a community center Services provided by licensed or nonlicensed professionals[90,91]
Delivery considerations[b]	Gradually fade visit frequency following restorative care to monitor transition to community exercise Consider transitioning to models 2-4, as needed Traditional payment model	Brief episode of care (~1-4 visits) Follow-up episodes recommended every 3-12 mo, depending on self-efficacy, independence, or risk of functional decline Traditional payment model	Bimonthly or monthly visits to monitor and modify optimizing movement programs[133] Weekly visits if patient is at high risk for rapid change Medicare-specific model definition may not apply to all private insurers	Transition outpatient visits to community center outside health care delivery system Common barriers include accessibility and affordability Commonly cash or philanthropy-funded
Documentation considerations[c]	Document prior level of physical activity Create transition plans through continuum Document education and stage of change	Document medical need for regular exercise and skilled exercise prescription Evaluate and document physical activity and exercise FITT-VP	Justify *skilled* care clearly (ie, medical need for exercise monitoring and adjustments due to complex and/or changing medical and functional needs)	Vary depending on state practice act and individual center/clinic policies Evaluate and document physical activity and exercise FITT-VP

Abbreviations: FITT-VP, frequency intensity time-type volume and progression; HH, home health; HPW, health promotion and wellness; OP, outpatient; rehab, rehabilitation; SNF, skilled nursing facility.

[a]These delivery models may be modified with health policy changes over time.

[b]Common delivery considerations: All models should include screening for physical activity (structured exercise, sedentarism, and lifestyle physical activity, as well as nutrition, smoking, sleep, and stress management). Delivery should include HPW outcome measures, facilitating behavior change, and training caregiver and or extenders (eg, PTA and nonlicensed exercise professionals) as needed.

[c]Common documentation considerations: All models should document physical activity and exercise assessments, as well as the need for skilled PT to assess, prescribe, monitor, and progress exercise in clients with neurologic conditions.

Table 5. Application Examples of Health Promotion and Wellness Delivery Models

Model	Model 1 = Acute to Outpatient Continuum HPW Integration Model	Model 2 = Consultative, Proactive, "Dental" Model	Model 3 = Skilled Maintenance Model	Model 4 = Health Promotion and Wellness Center/Clinic
Client examples (nonexhaustive)	Individual with new injury (eg, stroke, TBI, and SCI) or illness in acute inpatient rehabilitation	Individual newly diagnosed with neurodegenerative condition (eg, PD and MS) or individual with chronic condition (stroke)	Individual with significant impairment or chronic condition at high risk of functional decline (eg, ALS, advanced PD, and MS)	Individual with subacute injury or illness requiring significant community support (eg, subacute SCI and stroke)
Physical activity and exercise promotion within PT delivery model	Educate on the importance of lifestyle physical activity. Facilitate peer mentor visit describing active lifestyle. In OP PT, introduce to progressive walking programs and adaptive exercise equipment. Fade frequency of visits while investigating community-based physical activity resources. Transition to model 4.	Baseline evaluation of walking, balance, physical activity, and exercise participation. Three additional visits every 2-4 wk to increase duration and intensity of structured exercise program in community gym with trainer. Condition-specific exercise programs. Recheck in 6 mo.	OP or HH PT 1-2/wk. Transitioned to 1-2x/mo during periods of stability, to provide *skilled* care to monitor for changes in functional status. Problem-solve, modify, and progress exercise, recommend equipment. Family/client education and training.	Refer to a specialized medical fitness center for postrehabilitation exercise. Center is staffed by PT, OT, and exercise physiologists who provide a fitness evaluation, and design and assist as needed in an individualized exercise plan. Center is accessible and has condition-specific equipment (eg, standing frame, body weight support, FES cycle, and wheelchair treadmill).
Cost of physical activity plan of care within PT delivery model	Insurance co-pays, followed by model 4 costs	Insurance copays, community exercise expenses (gym, trainers, PD-specific exercise class)	Insurance co-pay	Monthly gym membership (Medicare Silver Sneakers coverage), cash pay for additional services with scholarships available (personal training/exercise therapy)
Example of physical activity measures	Prior activity level with PA measure	• Physical Activity Vital Sign[110,111] • Godin Leisure Time Exercise Questionnaire[79] • Exercise Self-Efficacy[114,115] • Accelerometry-based measure[108,109]	• International Physical Activity Questionnaire-Long form[112,113] • Accelerometry-based measures[108,109]	• Physical Activity Vital Sign[110,111] • Godin Leisure Time Exercise Questionnaire[79] • Exercise Self-Efficacy Scale[114,115] • Accelerometry-based measures[108,109]

(*continues*)

Table 5. Application Examples of Health Promotion and Wellness Delivery Models (*Continued*)

Model	Model 1 = Acute to Outpatient Continuum HPW Integration Model	Model 2 = Consultative, Proactive, "Dental" Model	Model 3 = Skilled Maintenance Model	Model 4 = Health Promotion and Wellness Center/Clinic
Example additional HPW measures and/or screening questions[a] can be used in any model[b]	Nutrition • How many fruits and vegetables do you eat per day? • Starting the conversation tool[117] • Readiness to change[116] Sleep • How many hours of sleep do you regularly get? Do you feel well rested when you wake up? • Pittsburgh quality sleep index[119] • Stop-Bang Questionnaire for Sleep Apnea[120] Stress • How is your stress level? • Perceived stress scale-14[121] • Brief-COPE[122] Smoking • Do you smoke (nonsmoker, current smoker, stopped smoking in the past 6 mo)? • Readiness to change[116]			
Additional HPW Education component examples can be used in any model.[b] See Table 3 for educational resource materials.	Nutrition • Recommend well-balanced diet and dietician consult • Educate on how diet impacts energy and activity Sleep • Educate on sleep hygiene • Educate on reducing sedentarism and increasing lifestyle PA • Recommend peer and caregiver support groups. Caregiver respite services if needed. Stress • Educate on stress management, possibly including meditation and mindfulness. • Recommend counseling or peer support groups Smoking • Use MI-informed communication strategies • Use the 5A's and 5R's model for smoking cessation education and support[8,118] • Educate on importance of smoking cessation • Recommend peer support groups			

Abbreviations: ALS, amyotrophic lateral sclerosis; FES, functional electrical Stimulation; HH, home health; HPW, health promotion and wellness; MI, myocardial infarction; MS, multiple sclerosis; OP, outpatient; OT, occupational therapy; PA, physical activity; PD, Parkinson disease; PT, physical therapy; SCI, spinal cord injury; TBI, traumatic brain injury.

[a]See Bezner[6] and APTA Annual PT Visit for additional tools and questions.[56]

[b]The additional HPW measures, screening questions, and education should be applied across all the delivery models as needed for their clients. Education should begin with assessment or screening questions, dialogue to understand readiness to change, and should proceed using principles of shared decision-making.

and injuries where documented evidence for the benefits of healthy lifestyle behaviors exists, including SCI,[94,95] TBI,[96,97] stroke,[90,98-100] MS,[101-104] and PD.[105-107] With each delivery model, clinicians should measure and track physical activity outcomes appropriate to the setting. Measures may include aerobic fitness, accelerometer or pedometer-measured step counts (or wheelchair push counts),[108,109] brief patient-reported outcome measures such as the Physical Activity Vital Sign,[110,111] the Godin Leisure Time Exercise Questionnaire,[79] or the longer International Physical Activity Questionnaire to assess sedentary time.[112,113] Physical therapists should also facilitate healthy behavior change[9,46,50,114,115] using the readiness to change questionnaire[116] and exercise self-efficacy scales.[114,115] If a client cannot be independent with their exercise maintenance and progression despite behavior change strategies, clinicians should train and utilize caregivers and/or extenders (eg, physical therapist assistants or nonlicensed exercise professionals as appropriate). In addition to physical activity, Table 5 includes screening tools and education regarding nutrition,[117] smoking,[8,118] sleep,[119,120] and stress management.[56,121,122] Screening and education should ensure client health literacy[123] and advocacy for connection to environmental and personal supports in the community and health care system.[56]

One healthy lifestyle behavior is presented in each model in Table 5, but these examples can be applied across all models due to similarities in screening and educational approaches. The following example highlights the similarities and differences for one HPW area, nutrition, in 2 delivery models. In an acute care setting, the physical therapist may ask informal screening questions regarding nutrition, and refer to an inpatient registered dietician for full assessment and intervention. The informal screen may be completed by asking "How many servings of fruit and vegetables do you typically eat per day?" to gauge overall healthy eating habits; "Have you had any changes in your diet since entering the hospital?" to assess changes and current intake; and "How much water have you drunk today?" to determine hydration and potential impact on PT.[6,56] The physical therapist then provides education on the importance of nutrition to PT, physical activity, function, and overall well-being, and requests a referral to a dietician as appropriate.[6] In contrast, in an outpatient proactive consultative dental model, nutrition may be assessed formally through a screening tool such as the "Starting the Conversation" Tool or using similar informal screening questions as in acute care.[117] Depending on the results of the nutrition screening, the physical therapist may further explore readiness to change nutritional habits and provide general healthy eating resources from the US Department of Agriculture consumer-facing nutrition Web site. The physical therapist can also request a referral to a registered dietician for further assessment and intervention if needed. Current payment limitations on dietary services in outpatient settings highlight the importance of screening for HPW topics and providing appropriate referrals during acute rehabilitation when the service is more accessible. Screening resources, including interview questions, standardized tools, and frameworks, for assessing lifestyle health behaviors and readiness to change are available through several resources including the newly updated Annual PT Visit available through the APTA.[6,8,46,56]

One common feature across all 4 delivery models is the need to approach PT with a strong foundation in behavior change techniques. Incorporating behavior change strategies into PT requires knowledge of theories and models, as well as the ability to apply that knowledge in practice. Knowledge of the behavior change theories has been well summarized by Bezner and colleagues.[50] They have also been summarized in the ANPT HPW Synapse Education series. Theories addressed include the transtheoretical model,[124] which includes aspects of readiness to change[125] and self-efficacy.[126] It is recommended that readers interested in health behavior change consider both self-study using seminal texts, such as that by Glanz and colleagues[127] and continuing education courses.

Encourage Advocacy, Community Building, and Partnership Along the Continuum of Care

The final strategy to improve delivery of HPW-related neurologic PT practice is through advocacy, community building, and establishing partnerships along the continuum of care. This strategy addresses barriers related to payment, public interest, and awareness on the importance of HPW and accessibility, as well as time and efficiency of the clinician related to ease of community referrals (Figure). Physical therapists are advancing the role of HPW in legislative efforts and partnerships with outside organizations. Additionally, physical therapists may help drive change to address SDOH through advocacy and population health initiatives. These relationships at the national and local level may be through governmental organizations, nonprofit organizations, or community wellness centers.

At the national level, the APTA has partnerships with ACSM's EIM campaign and the Academy of Geriatric Physical Therapy (AGPT) has a collaboration with National Council on Aging (NCOA). Additionally, the APTA is a partner of the Physical Activity Plan Alliance committed to implementing the National Physical Activity Plan. Other national PT groups addressing the need for advocacy include the APTA's HPW Council, the ANPT Advocacy and Consumer Affairs Committee, the ANPT Membership and Public Relations Committee, and the HPW Special Interest Group of the AGPT. Because important HPW partnerships can span neurologic and nonneurologic populations, the APTA's HPW Council is an ideal avenue to facilitate communication of national and international efforts between groups.

One example highlighting the importance of cross-group communication is the recently developed population health, prevention, and HPW competencies for entry-level DPT practice.[86] The APTAs HPW Council sponsored the development of this document and communicated it to PT educators across specialty areas.[86]

At the local levels, clinicians may need to advocate with clinic administration and payers to set up processes to integrate HPW delivery models. For example, they should consider appropriate referrals, electronic documentation, and communication between providers. Further, they can enhance engagement and ease transitions to lifelong physical activity and exercise by connecting clients with local adaptive exercise

trainers and evidence-based programs in their communities. There are at least 10 professional organizations that train exercise professionals to work with people with disabilities and medical conditions. Examples of these organizations include the ACSM, American Council on Exercise, and NCHPAD. It is also important for clinicians to be aware of evidence-based exercise programs in their local communities. As part of the AGPT/NCOA partnership, tools were developed to help therapists understand and connect clients to evidence-based programs such as a Matter of Balance (Moving for Better Balance), Enhance Fitness, and NeuroFit.[128-130] Standardized implementation and training procedures ensure consistent delivery to maximize outcomes. Therapists are encouraged to follow the joint work of the AGPT/NCOA to disseminate these evidence-based programs.[131]

NEXT STEPS TO ADVANCE HPW PRACTICE AND ADDRESS KNOWLEDGE GAPS

To advance HPW-related neurologic PT practice, clinicians should practice to the full scope of PT practice within the various HPW delivery models presented, while being aware of state and local policies and personal expertise that could influence their care. They should use existing resources and develop partnerships with wellness organizations in their community. Additionally, the ANPT may consider national partnership development with consumer advocacy organizations to promote the role of PT in physical activity promotion. Clinicians are encouraged to document outcomes and share experiences through local and national education programs, case study manuscripts, communication with peers via the ANPT neuro listserv, and legislative advocacy through APTA's Legislative Action Center. Measuring outcomes and sharing knowledge are essential components of evidence-based practice. Barriers to HPW practice have been well-documented,[6,46,48] and thus sharing successful practical examples of implementation strategies and outcomes could enhance delivery worldwide.

Additional research is needed to address knowledge gaps related to HPW neurologic PT practice. The first recommendation for researchers is to develop, refine, and synthesize knowledge related to clinically feasible, valid patient-reported, and accelerometer-based measures of physical activity.[78,79,108,109] These measures will have improved utility with a better understanding of their psychometric properties across populations. Publishing knowledge translation tools to facilitate real-world implementation of these measures could enhance the likelihood of success. Second, researchers studying traditional restorative PT interventions are encouraged to consider the impact of nutrition, sleep, smoking cessation, stress management, lifestyle physical activity, and sedentarism, as potentially impactful covariates in the study design. Knowledge translation research should examine the impact of PT-led HPW interventions on client-specific barriers, including readiness to change and self-efficacy. Additionally, research is needed to explore the role of the SDOH on PT outcomes, particularly environmental factors such as safe places for physical activity and healthy food.[132] Large-scale clinical trials on the role of neurologic PT in improving physical activity and other lifestyle behaviors should measure outcomes related to the development of NCDs, hospitalization rates, quality of life, and participation. Finally, PT health services researchers may want to partner with payers to conduct demonstration projects related to PT for HPW.

LIMITATIONS

While this article identifies and compiles important strategies to address barriers to HPW practice, limitations should be considered. The suggested strategies primarily target clinicians. The resources provided may not address problems experienced by clients in underserved communities or specific geographic areas. Additionally, limited information is included on how to change processes and policies at the level of the health systems or payers. Future work in these areas could ease the burden placed on clients, as well as the burdens on physical therapists delivering primary prevention or addressing population health. Finally, methodologic limitations include lack of a systematic review and lack of a formal Delphi process. Rather, environmental scan, narrative review, expert opinion, and informal expert consensus were used. Future work should develop systematic reviews and clinical practice guidelines as more evidence becomes available.

CONCLUSION

Shifting from a reactive care model to a proactive model of PT that includes HPW will take individual and collective efforts. Implementing the strategies identified here clarifies the role of PT to all stakeholders and addresses previously reported barriers to HPW practice. Physical therapists can help people be well despite living with a neurologic condition or injury. Individuals living with neurologic conditions need experienced and knowledgeable clinicians to optimize movement, health, and well-being.

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