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Evaluation of an Outpatient Rehabilitative Program to Address Mobility Limitations Among Older Adults

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Abstract: Live Long Walk Strong is a clinical demonstration program for community-dwelling older patients. It was designed to be consistent with current fall prevention guidelines and reimbursed under the Medicare model. Patients were screened within primary care and referred to a physiatrist followed by systematic assessment and treatment within an outpatient rehabilitative care setting. The treatment included behavioral modification, fall prevention education, community/home exercise integration, and exercise targeting strength, power, flexibility, balance, and endurance. Treatment duration and frequency varied with each patient based on baseline presentation, clinical judgment, and patient preference. Program feasibility and preliminary effectiveness were evaluated by assessing participation and changes in physical performance, respectively. There were 266 patients referred to the program, and 147 were willing to participate. Of these, 116 patients completed all scheduled visits (10.8 ± 3.9 visits). The noncompleters (n = 31) had a higher rate of falls in the previous 6 months and lower baseline Short Physical Performance Battery composite score. At the completion of care, the adjusted mean change in Short Physical Performance Battery was 1.66 units, surpassing a large clinically meaningful threshold (1 unit). The Live Long Walk Strong program appears to be feasible to implement and demonstrates preliminary effectiveness in enhancing mobility among older adults.

Key Words: Exercise, Mobility, Prevention, Rehabilitation, Systematic Interdisciplinary Care Model

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Among community-dwelling older adults, decline in mobility skills leads to significant adverse outcomes including loss of independence, falls, and fall-related injuries. In addition, mobility problems adversely impact care utilization and quality of life.[1,2] Rapid growth of the older adult population is bringing these issues into sharper focus as our overburdened health care system is facing increasing strain.[3–6] For community-dwelling older adults with mobility problems, whereas some evidence exists with regard to the most efficacious means of preventing adverse outcomes,[7–10] there is an absence of reports demonstrating the successful implementation of evidence-based care within the ambulatory care settings. Rehabilitative professionals, working within an ambulatory care setting, are uniquely positioned to care for older adults with mobility problems.[1] However, there is a lack of consensus on how best to treat this heterogeneous population.

The Live Long Walk Strong (LLWS) program is a clinical demonstration project that prioritized the prevention of mobility decline and its consequences (falls and fall-related injuries) among community-dwelling older adults through an innovative care model emphasizing rehabilitative care. It is conceptually based on the *International Classification of Function* (*ICF*).[11] The uniqueness of the LLWS program is reflected in the evidence-based, standardized approach that is conceptually based within a disablement model and uses validated assessments and measures.

The purpose of this clinical demonstration project is to evaluate the feasibility and preliminary effectiveness of the LLWS program among community-dwelling, mobility-limited older adults. First, we will address the feasibility of the LLWS program by reporting on the engagement of eligible patients and identify factors associated with program completion, and second, we will report initial findings on the preliminary effectiveness in enhancing mobility performance after accounting for clinical factors that might impede success. We hypothesize that the LLWS program will improve mobility among older adults and will be feasible to implement in an outpatient care setting.

METHODS

Program Design

This project was initiated to address the needs of community-dwelling older adults under the care of a network of primary

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care physicians working within an independent physician association based in Cambridge, Massachusetts. All referral and assessment strategies were designed to be evidence based, simple, and quick to perform within the context of normal care for busy primary care and outpatient rehabilitation practitioners. This report covers 266 primary care patients referred into the LLWS program from June 2010 through January 2014. The assessment and treatment sessions were conducted at a hospital-based outpatient clinic in Cambridge.

The content of the rehabilitative program was based on the existing scientific evidence regarding exercise for community-dwelling older adults,[12–14] focus groups among older adults, and the collective clinical experience of 2 of the authors (LGB, JFB). Primary care physician groups were educated on program development, content, and referral procedures. The LLWS staff and a representative from the independent physician association held regular monthly meetings and communicated via phone and e-mail regarding issues or concerns.

Screening and Referral

Screening performed in the primary care setting included information highly associated with fall risk such as depression (2-item Patient Health Questionnaire), vision, and current medication use.[15,16] The initial question addressed falls as follows: "Have you had a fall in the past 6 months?" This was followed by 4 questions developed by Fried and colleagues[17] that either designate current or predict future disability with mobility tasks: (1) "For health or physical reasons, do you have difficulty in walking ½ mile (5–6 blocks)"? (2) "If no, have you changed the way you walk ½ mile (5–6 blocks) because of underlying health problems?" (3) "For health or physical reasons, do you have difficulty in climbing 1 flight of stairs (10 steps)?" (4) If no, have you changed the way you climb 1 flight of stairs (10 steps) because of underlying health problems?" Those who reported Task Modification were at 3.8- and 3.9-fold increased risk of developing disability in walking half mile and climbing up 10 stairs, respectively, after 18 months, compared with the high-function group.[17] Patients who were 65 years or older with or without a positive 6-month fall history were designated as appropriate for referral if they answered yes to any the 4 mobility questions. If a patient had a terminal illness, unstable medical condition, acute region-specific injuries, surgeries, or fractures; resided in a nursing home; or demonstrated high levels of untreated chronic pain, they were not considered appropriate for the LLWS program.

Program Management Role

The physical therapist served as the rehabilitation program manager. This is a unique role in that it includes not only typical aspects of outpatient physical therapy (PT) care, such as treating impairments and functional limitations, but also a care coordination and behavioral management role that are less common within outpatient PT care. This role was developed because it was both within the scope of PT practice and also better suited to address the complex needs of this patient population within a continuum of community-based care. The program manager made initial phone contact with the patient, answered questions, identified barriers to access, and encouraged program participation. Throughout the course of care, the program manager coordinated communication between providers and facilitated participation in community-based programs targeting physical activity, exercise, and/or social engagement.

Rehabilitative Assessments

The initial assessment was performed by a physician specialized in physical medicine and rehabilitation. There were a number of reasons for consultation with a physiatrist. First, the physiatry assessment included a thorough screening of functional status including the Short Physical Performance Battery (SPPB).[2,18–20] This information was used to assist in stratifying risk of adverse outcomes and in identifying the need for rehabilitative consultation with occupational therapy, PT, and other services (i.e., orthotist). Second, physical medicine and rehabilitation physicians have expertise in the medical management of musculoskeletal concerns, which are major causes for falls and mobility decline among older adults.[21,22] Third, the physiatrist screened for cognitive impairment using the Mini-Cog and provided associated recommendations to the patient and their caregivers if cognitive impairment was ascertained.[23] Lastly, the physiatrist helped in motivating the patient for engagement with the rehabilitative components of the program and addressed any problems or concerns raised by patients or families with the overall program of care.

The PT assessment included a battery of patient-reported and observed functional measures, as well as a review of relevant chronic conditions related to function.[24] The PT assessment was completed in 60 minutes based on a patient's capabilities. Measurements were chosen for their clinical utility, psychometric properties, and association with falls and mobility decline. Clinical judgment was used to select appropriate measures to yield the most meaningful information to guide clinic care or document change over time. For example, if a patient screened positive for dementia, and there was no available proxy, certain self-report measures might be eliminated because of validity concerns. The full assessment battery consisted of questions and measures that corresponded to each of the domains within the *ICF* model (Table 1). Patients were asked to identify specific, measureable goals and barriers and solutions for attaining the goals. If cognitive impairment was identified, then treatment was provided to the patient with a designated companion or care provider present for all or most treatment sessions. Also, if a patient scored a 0 on the stage of exercise change scale, indicating that he/she did not currently exercise and had no plans to begin an exercise program in the next 6 months, alternative options were discussed. Emphasis was placed on efforts to empower patients and their families to retain and build on gains achieved in skilled care.

Intervention

Treatment strategies were chosen based on current effective rehabilitative strategies in this patient population.[13,15,25,26] The general principles of the treatment included (1) behavioral change methods to help the patient build upon and retain gains made in the skilled setting[27]; (2) adoption of independent exercise programs to be performed at home or in community-based settings that were accessible and acceptable to the patient; and (3) exercise training at moderate to high intensity addressing

TABLE 1. ICF categories of assessment and corresponding assessments and treatments

Domain	Assessment	Treatment
Comorbidity	Review of chronic illness	Education regarding impact of conditions on prognosis
Polypharmacy	Evaluate for problem medications or medication combinations	Recommendations to referring physician
Depression	2-Item Patient Health Questionnaire depression screen	Recommendations to referring physician
Activity		
Gait performance	4-m HGS; gait Assessment	Treadmill training with emphasis on speed and form; conversing while treadmill walking
Static/dynamic postural stability	SPPB	Postural stability training with a focus on movement in upright, weight-bearing positions with gradual reduction of upper extremity support
Body Functions and Structure		
Leg strength and power	Stair-climb power; 5× chair stand	Incorporation of strength and speed into all functional training exercises; progressive resistance functional training using weighted vests and Theraband
Endurance	6-MWT	Treadmill with progressive speed and distance within treatment time constraints; continuous circuit training
Trunk extensor muscle endurance	Extensor endurance test	Training for both static and dynamic posterior chain endurance/activation
Pain	BPI scale score	Introduction of specific pain reduction strategies to address pain symptoms
Posture	Occipital wall distance	Ongoing cues for optimal posture during all exercises; trunk extensor muscle endurance training
Vision	Question regarding yearly vision check	Recommendation for vision check if overdue
Cognition	Mini-Cog	Incorporation of the patient dyad; referral to speech therapist for cognitive training and compensatory strategies
Participation		
Disability/activity restriction	Questions related to current functional activity restrictions and specific functional goals	Functional training behavioral change strategies addressing physical and behavioral barriers to participation
Personal Factors		
Physical activity behavior	SEC scale; structured behavioral agreement addressing: goals, accountability, support, and community resources; family/friend support agreement; checklist for patient/provider assignments	Health behavior contract with establishment of patient specific goals/barriers/benefits; family and friend support agreement; accountability/community integration agreement with an associated action plan to establish links to community programs/activities; independent exercise instruction with the use of an exercise calendar reviewed for adherence at each session; use of a checklist of recommended activities reviewed for completion at each exercise session; education, evaluation, and problem solving for achievement of patient-identified goals
Fear of Falling	Falls Efficacy Scale International–SF	Functional mobility training with an emphasis on positive reinforcement regarding capabilities
Environmental Factors		
Home and community	Transportation; Lifeline services; availability/accessibility of community resources	Ongoing education/recommendations and community integration

body system impairments recognized as relevant to mobility and falls. These included endurance,[8,28] leg strength, leg speed of movement,[13,29–32] postural stability,[15] limb flexibility,[33,34] and dual tasking.[35,36] All training was based predominately on functional movement patterns.[37] The program manager completed all assessment and treatment sessions at the outpatient clinic. The length of each treatment session was 45 to 60 minutes based on a patient's capabilities. The intervention type, frequency, and duration varied, depending on patient presentation at baseline, clinical judgment, and patient preference (see Supplement, http://links.lww.com/PHM/A375).

Outcome

The SPPB was the primary outcome for evaluating preliminary effectiveness of the program. The SPPB is a composite measure of 3 tasks, habitual gait speed (HGS) over 4 m, standing balance, and chair-rise time.[18] Performance on each subcomponent is scored between 0 and 4 and added to yield a composite score ranging from 0 to 12, with higher scores indicating better performance. The SPPB is a reliable and valid measure of lower-extremity performance and predictive of adverse outcomes.[18,38] Secondary outcomes for evaluating preliminary effectiveness included the 6-minute walk test (6-MWT), and the 4-m HGS component of the SPPB. The 6-MWT is a safe and well-tolerated test and has ben used clinically to measure mobility among patients with a variety of chronic conditions.[39] This measure was not added to the assessment battery until after the program was initiated, so values are missing on 29 patients. The 4-m HGS is derived from the subcomponent of SPPB, in which participants were instructed to walk at their usual pace over a distance of 4 m and was calculated as calculated as 4 / (time in seconds). This measure is predictive of disability and mortality among older adults.[18]

Data Analysis

Patient data were obtained under an internal review board–approved health and medical records review. The number of referrals, number of those who initiated care, and number of those who completed full treatment were derived to evaluate feasibility. Lack of completion was defined as failure to complete the number of visits projected to complete the course of care by the physical therapist and the patient/family.

Statistical analyses were performed using SPSS software version 22 (IBM Corp., Chicago, Illinois). The assumption of normality and homogeneity of variance were tested. Differences between patients who completed and who did not complete treatment at baseline were analyzed using independent *t* tests for continuous variables and χ^2 or Fisher exact test for categorical variables. Mann-Whitney *U* test was used to evaluate the group difference for non–normally distributed variables. Change in the performance on SPPB, 6-MWT, and 4-m HGS for patients who completed the program were examined using repeated-measures analysis of variance, controlling for age, gender, fall history, cognitive status, comorbidity, pain, and stage of exercise change. As part of a sensitivity analysis, separate multivariable linear regression models were constructed for categories of important adjustment variables that are recognized to have potential for influencing the impact of treatment. These adjustment variables were age, gender, fall history, cognitive status, comorbidity, pain, and stage of exercise change. Age was categorized into 3 subgroups, 65 to 74, 75 to 84, and 85 years or older.[40] Fall history was categorized into 2 subgroups, 0 and 1 or more falls.[41] Cognitive status was categorized into 2 levels, dementia (Mini-Cog <3) and normal (Mini-Cog ≥3).[23] Comorbidity was categorized into 2 levels, less than 3 and 3 or more.[42] Pain interference with daily activities was categorized into 2 subgroups according to Brief Pain Inventory (BPI) scale cutoff points from a previous population-based study of community-dwelling older adults, no and mild pain, less than 2.57, and moderate to severe pain, 2.57 or greater.[21] The Stage of Exercise Change (SEC) scale was categorized into 3 subgroups, low (SEC = 0–1), moderate (SEC = 2), and high (SEC = 3–4).[43] The resulting adjusted mean change in SPPB for each model was evaluated in reference to the previously defined large clinically meaningful differences for the SPPB (1.0 unit). Statistical significance was determined at $P < 0.05$. Bonferroni adjustment was conducted to reduce the likelihood of type 1 error for the pre/post comparison for SPPB, HGS, and 6-MWT among those who completed the treatment sessions.

RESULTS

A total of 266 patients were referred to the program between July 2010 and January 2014. Fifty-five percent (n = 147) of patients participated in the program. Of those, 31 (21%) did not complete the full program of care (Fig. 1). We were

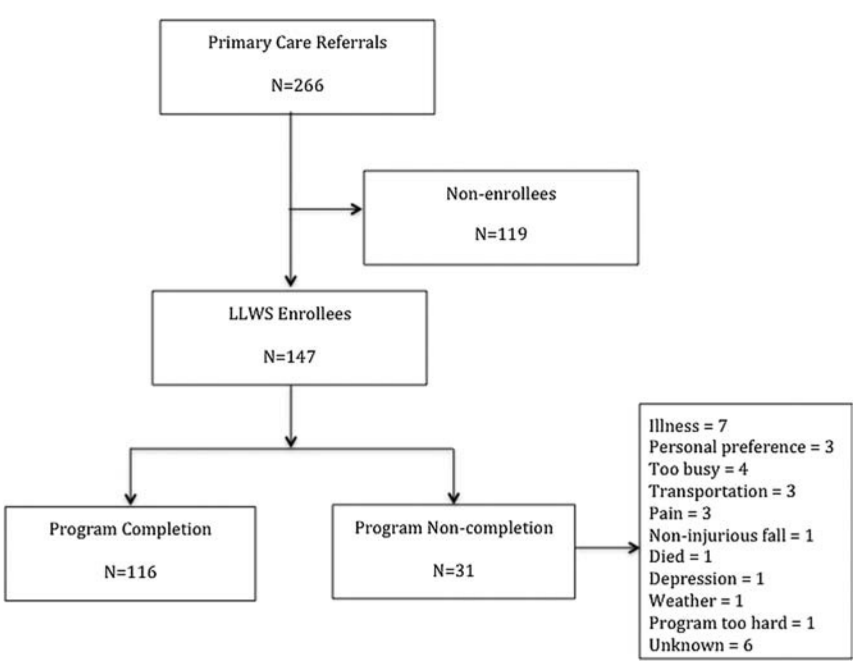

FIGURE 1. Study flow.

unsuccessful in engaging 119 (45%) of these patients referred by their primary care providers to the program. Of the 119 patients who we were unable to engage in treatment, 24% (n = 29) declined participation with no reason given. We were unable to contact 19% (n = 23) of them, and 10% (n = 12) declined because of transportation or financial (copay) concerns. Of the remaining 47% (n = 55) who refused, the reasons included illness, time constraints, hospitalization, current home health services, medical procedure pending, or weather concerns.

As of January 2014, 116 (78.9%) of 147 patients completed the treatment sessions. For those who completed the treatment, the mean PT visit frequency was 1 visit every 3.7 treatment days. The highest frequency was 1 visit every 2 treatment days, with the lowest visit frequency of 1 treatment visit for every 10 days. Mean total number of PT visits for patients who completed the program (n = 116) was 10.8 ± 3.9 visits (4–24 visits), and for patients who did not complete the program (n = 31), 3.6 ± 2.4 visits (1–11 visits).

Baseline characteristics of LLWS patients are listed in Table 2 according to program status as complete or incomplete treatment. No differences were observed between patients in these 2 categories for age, gender, body mass index, comorbidity, Mini-Cog status, BPI scale score, and SEC. Significant differences were observed between the 2 groups in the 6-month fall history (P = 0.021), baseline SPPB composite score (P = 0.001), and 4-m HGS (P = 0.006) and 6-MWT (P < 0.001).

TABLE 2. Baseline characteristics of patients who received care in the LLWS program from June 2010 to January 2014

Characteristics	n	Program Completion	n	Noncompletion	*P*
Age (y)	116	81.6 (7.6)	31	82.2 (6.0)	0.61
% Female	116	74 (64%)	31	15 (48%)	0.12
BMI, kg/m^2	82[a]	26.7 (4.4)	28	26.9 (5.2)	0.82
<25		35 (43%)		10 (36%)	
25.0–29.9		30 (37%)		13 (46%)	
>30		17 (20%)		5 (18%)	
Comorbidities	116	4.11 (1.8)	31	4.35 (2.0)	0.51
Mini-Cog <3	108	25 (23%)	30	10 (33%)	0.26
BPI scale score	107	2.32 (1.7)	27	2.80 (1.9)	0.19
6-mo fall history	116		31		0.021
0		43 (37%)		6 (19%)	
1		54 (47%)		13 (42%)	
Multiple		19 (17%)		12 (39%)	
SEC	115		30		0.211
0 = Precontemplation		8 (7%)		5 (17%)	
1 = Contemplation		46 (40%)		13 (43%)	
2 = Preparation		29 (25%)		6 (20%)	
3 = Action		3 (3%)		2 (7%)	
4 = Maintenance		29 (25%)		4 (13%)	
SPPB	116	6.7 (2.7)	31	4.9 (2.5)	0.001
4-m HGS	116	0.72 (0.25)	31	0.59 (0.17)	0.006
6-MWT	87[b]	1032.8 (406.0)	25	719.8 (314.7)	<0.001

Values are mean (SD) or n (%).

[a]Missing numbers are elevated because of missing height measurements.

[b]Missing numbers are elevated because this measure was added after the program started.

BMI, body mass index.

The adjusted mean changes in SPPB score for each covariate among patients who completed the program are presented in Figure 2. No statistically significant impact was observed for each covariate on the SPPB change score. The mean change scores for patients who completed the program were as follows: SPPB (n = 116), 1.66 ± 1.83 (P < 0.001); 4-m HGS in meters per second (n = 116), 0.09 ± 0.17 (P = 0.006); and 6-MWT in feet (n = 83), 121.63 ± 166.10 (P < 0.001).

DISCUSSION

The LLWS program demonstrates both feasibility and preliminary clinical effectiveness. The assessment tools used were simple and practical for use in outpatient rehabilitative care settings (Table 1). Analyses among those who completed the program reveal improvements in mobility as measured by the SPPB, 4-m HGS, and 6-MWT. In addition, this multifactorial program addressing strength, power, flexibility, and postural stability was well tolerated among older adults with a broad range of mobility limitation severity.

Patients who did not complete the treatment program exhibited poorer baseline physical function and a history of more falls before program initiation compared with those who completed training (Table 2). Thus, these individuals still manifested problems that should be targeted by prevention programs, but had barriers limiting program engagement. It may suggest that integration with enhanced case management or home-based modes of rehabilitative care may be important to better address these individuals' needs. For patients with cognitive impairment, we attempted to impact function by engaging the active participation and support of family members and friends in activities and exercises both during and after the conclusion of outpatient care. Importantly, we observed meaningful improvements regardless if cognitive impairment was present. We also observed robust changes after considering other potentially influential factors such as high levels of comorbidity and poor readiness for exercise. However, while we observed robust changes in function, these results must be interpreted with caution, given we had no control group as a comparator. This was not a research study, but rather a clinical demonstration project, and inclusion of a nontreatment control group was not clinically or ethically feasible. In addition, we do not yet know the longer-term benefits beyond the conclusion of outpatient care.

Among all patients who completed the LLWS, the mean differences in the SPPB (1.66 units; 95% confidence interval, 1.30–2.01 units), HGS (0.09 m/s), and 6-MWT (124 ft) exceeded established clinically meaningful differences for these outcomes (SPPB: 1 unit, HGS: 0.05 m/s, 6-MWT: 66–164 ft).[44,45] Within randomized controlled studies evaluating these outcomes among similar populations, 1 meta-analysis reported a mean change in SPPB of 1.87 units (95% confidence interval, 1.17–2.57 units) as a result of exercise in comparison to control subjects.[14] Other more recent randomized controlled trials evaluating the effect of physical activity interventions among community-dwelling, mobility-limited older adults report a mean change in SPPB ranging from 0.7 to 1.75 units.[12,46] Our finding of a mean adjusted change of 1.66 units with LLWS is consistent with the effect size observed within these

	N	SPPB change score (95% CI)	p
Age, y			
65-74	25	2.32 (1.70 - 2.94)	.234
75-84	42	1.45 (.80 - 2.11)	
≥85	49	1.51 (1.04 – 1.98)	
Gender			
Female	74	1.80 (1.36 - 2.23)	.672
Male	42	1.43 (.90 - 1.96)	
Fall history			
0 fall	43	1.51 (.97 - 2.05)	.361
≥ 1 falls	73	1.75 (1.32 - 2.19)	
Cognition			
Normal	83	1.70 (1.31 - 2.09)	.431
Dementia	25	1.40 (.69 - 2.11)	
Co-morbidity			
< 3	19	2.00 (1.26 - 2.74)	.491
≥ 3	97	1.60 (1.22 - 1.97)	
BPI			
< 2.57	40	1.76 (1.34 - 2.18)	.314
≥ 2.57	67	1.53 (.89 - 2.16)	
SEC			
Low: 0-1	54	1.72 (1.21 - 2.23)	.507
Moderate: 2	29	1.76 (1.06 - 2.46)	
High: 3-4	32	1.50 (.87 - 2.13)	
Adjusted total	99	1.66 (1.30 - 2.01)	.563

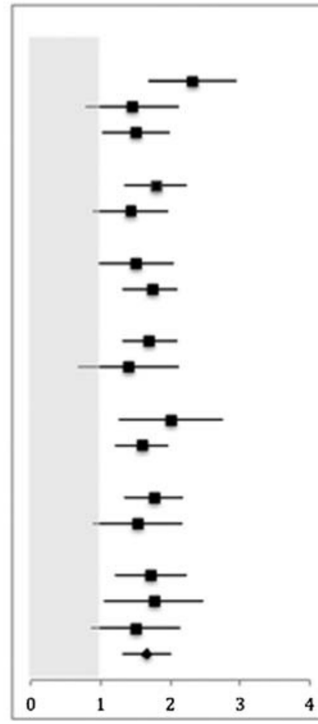

FIGURE 2. Stratified analyses of change in SPPB score for clinically relevant adjustment variables and adjusted mean SPPB score. Grey area reflects a 1 unit change, which is characterized as a large clinically meaningful difference in SPPB score.[44]

well-controlled clinical trials. Also, these improvements in mobility function exceeded large clinically meaningful differences in the SPPB independent of a large number of clinical factors, which might have been theorized to impede clinical effectiveness (Fig. 2). Thus, taken together, these points support the preliminary effectiveness of the LLWS program.

The strength of this work is the demonstration of feasibility in implementing the LLWS program in clinical settings and its potential clinical effectiveness among a varied sample of mobility-limited older adults. We included patients who are commonly excluded from clinical trials (i.e., cognitive impairment) and therefore for whom there is limited evidence guiding care. While long-term benefits were not evaluated, it should be noted that the SPPB scores and its components are predictive of subsequent disability, hospitalization, and fall-related injuries.[18,47,48] Another unique aspect of the LLWS program is the program manager role fulfilled by the physical therapist. This role not only included the typical aspects of outpatient rehabilitative care, but also focused on care coordination and behavioral management. These are roles that are less commonly utilized by outpatient physical therapists, but increasingly recognized as important components of PT care.[49]

Limitations

We acknowledge other potential limitations in interpreting the findings of this clinical demonstration project. One unblinded physical therapist provided all of the clinical care and assessments. While this mirrors true clinical care, the potential for assessment bias still exists. Also, at this time, we do not know the long-term duration of treatment effects or whether the program impacted other relevant outcomes such as incident fall rates, incident fall-related injuries, or the onset of disability. Certain aspects of the program may not be feasible to replicate in all clinical settings such as the duration of PT sessions, the availability of a physiatrist, or equipment limitations. Another important consideration is program engagement. The range of treatment duration includes those who dropped out early during the course of treatment, as well as other whose course was more complex. This range of visits is not unexpected, given the heterogeneity of health and functional status among the patients. Finally, a substantial number of individuals (45%) referred to LLWS never enrolled with treatment. This may highlight that the provision of transportation services, home-based programs, or telehealth strategies will be necessary to better serve such individuals.

CONCLUSIONS

Overall, LLWS is feasible to implement in busy outpatient rehabilitative settings and well tolerated and resulted in meaningful gains in observed performance measures. The program requires further investigation to examine true efficacy and effectiveness.

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