OPEN

Assessment of Walking Speed and Distance Post-Stroke Increases After Providing a Theory-Based Toolkit

Nancy M. Salbach, PT, PhD, Marilyn MacKay-Lyons, PT, PhD, Jo-Anne Howe, PT, Alison McDonald, PT, Patricia Solomon, PT, PhD, Mark T. Bayley, MD, Sara McEwen, PT, PhD, Michelle Nelson, PhD, Beverly Bulmer, PT, MScCH, and Gina S. Lovasi, PhD

Background and Purpose: While underutilized, poststroke administration of the 10-m walk test (10mWT) and 6-minute walk test (6MWT) can improve care and is considered best practice. We aimed to evaluate provision of a toolkit designed to increase use of these tests by physical therapists (PTs).

Methods: In a before-and-after study, 54 PTs and professional leaders in 9 hospitals were provided a toolkit and access to a clinical expert over a 5-month period. The toolkit comprised a guide, smartphone app, and video, and described how to set up walkways, implement learning sessions, administer walk tests, and interpret and apply test results clinically. The proportion of hospital visits for which each walk test score was documented at least once (based on abstracted health records of ambulatory patients) were compared over 8-month periods pre- and post-intervention using generalized mixed models.

Results: Data from 347 and 375 pre- and postintervention hospital visits, respectively, were analyzed. Compared with preintervention, the odds of implementing the 10mWT were 12 times greater (odds ratio [OR] = 12.4, 95% confidence interval [CI] 5.8, 26.3), and of implementing the 6MWT were approximately 4 times greater (OR = 3.9, 95% CI 2.3, 6.7), post-intervention, after adjusting for hospital setting, ambulation ability, presence of aphasia and cognitive impairment, and provider-level clustering. Unadjusted change in the percentage of visits for which the 10mWT/6MWT was documented at least once was smallest in acute care settings (2.0/3.8%), and largest in inpatient and outpatient rehabilitation settings (28.0/19.9% and 29.4/23.4%, respectively).

Discussion and Conclusions: Providing a comprehensive toolkit to hospitals with professional leaders likely contributed to increasing 10mWT and 6MWT administration during inpatient and outpatient stroke rehabilitation.

Video Abstract available for more insights from the authors (see the Video, Supplemental Digital Content 1, available at: http://links.lww.com/JNPT/A390).

Key words: *gait, implementation science, mobile application, physical therapy specialty, walking speed*

(*JNPT* 2022;46: 251–259)

Departments of Physical Therapy (N.M.S., J.A.H., B.B.) and Medicine (M.T.B.), University of Toronto, Toronto, Canada; The KITE Research Institute, University Health Network, Toronto, Canada (N.M.S., J.A.H., M.T.B.); School of Physiotherapy, Dalhousie University, Halifax, Canada (M.M.L.); Nova Scotia Health Authority, Halifax, Canada (A.M.); School of Rehabilitation Science, McMaster University, Hamilton, Canada (P.S.); Selkirk College, Castlegar, Canada (S.M.); Lunenfeld-Tanenbaum Research Institute, Sinai Health System, Toronto, Canada (M.N.); Institute of Health Policy, Management and Evaluation, Dalla Lana School of Public Health, University of Toronto, Toronto, Canada (M.N.); Unity Health Toronto, Toronto, Canada (B.B.); and Dornsife School of Public Health, Urban Health Collaborative, Drexel University, Philadelphia, Pennsylvania (G.S.L.).

Funding for this project was provided by the Government of Ontario, the Canadian Institutes of Health Research, and the Heart and Stroke Foundation. N.M.S. holds the Toronto Rehabilitation Institute Chair at the University of Toronto.

This work was presented at the 2017 Canadian Stroke Congress in Calgary, Alberta, Canada.

ClinicalTrials.gov registration number: NCT04184843.

The authors declare no conflict of interest.

Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site (www.jnpt.org).

Correspondence: Nancy M. Salbach, PT, PhD, Department of Physical Therapy, University of Toronto, 160-500 University Ave, Toronto, ON M5G 1V7, Canada (nancy.salbach@utoronto.ca).

ISSN: 1557-0576/22/4604-0251
DOI: 10.1097/NPT.0000000000000406

INTRODUCTION

Clinical practice guidelines worldwide recommend using reliable and valid tools to assess walking in stroke rehabilitation.[1-3] The 10-m walk test (10mWT) and the 6-minute walk test (6MWT) are widely recommended,[1,3] as they are valid,[4,5] responsive, and interpretable[6,7] tests that require minimal equipment and training. Best practices for assessment, however, extend beyond the simple administration of a test. Rehabilitation professionals can use estimates of minimal detectable change and normative values[7] to interpret test performance, thus facilitating patient education and goal setting, and increasing the quality of rehabilitation services. Many clinical practice guidelines, however, do not provide guidance on this comprehensive approach to assessment.[8] To support clinical application of recommended practices, experts have suggested that guideline developers provide additional resources, such as toolkits.[9]

Toolkits are defined as "packaged grouping[s] of multiple knowledge translation tools and strategies that codify explicit knowledge."[10] It has been suggested that guideline developers provide toolkits to support clinical application of recommended practices.[11] Toolkits or educational materials aimed at increasing standardized assessment tool use in adult rehabilitation have been previously evaluated for stroke.[12-17] However, these toolkits[15,16] or educational materials[12-14,17] have been commonly combined with additional education sessions,[12-17] equipment,[16,17] and involvement of a champion or knowledge broker,[12,13,16,17] making it more difficult to discern the specific effects of toolkits on practice change. Methodological issues in previous quasi-experimental studies have included targeting practice change at single hospital sites,[17] thus reducing generalizability, and inadequate evaluation of clustering[15,17] to optimize the validity of estimated practice change. As such, there are no studies evaluating the specific effects of a toolkit to elicit change in walking assessment practice across the care continuum post-stroke.

Aims

The primary objective was to evaluate the changes in physical therapists' (PTs) administration of the 10mWT and 6MWT in people post-stroke, after the provision of a theory-based toolkit in stroke rehabilitation settings. A secondary objective was to evaluate the extent of change in PTs' administration of the recommended walk tests post-stroke to monitor changes in walking and interpret performance, after toolkit provision.

METHODS

Study Design

A quasi-experimental, multimethod, multisite, single-group before-and-after study was conducted over a 21-month period. Figure 1 provides an overview of the study design, timeline, and evaluation approach. We have previously described the use of theory to develop the toolkit and evaluate the process of toolkit implementation.[18,19] Briefly, the knowledge-to-action framework[20] was used to guide the overall research process. Self-efficacy theory,[21] a guideline implementability framework,[9] and the transtheoretical model[22] were used to inform the design of the toolkit and a strategy for implementing the toolkit that would optimize the chances of practice change. This article reports on the evaluation of the outcome of toolkit implementation.

Setting

We conducted this study at hospitals employing a professional leader (PL) or professional practice leader (PPL) and providing acute care, inpatient, and/or outpatient rehabilitation services for people post-stroke in Ontario and Nova Scotia, Canada. PLs and PPLs were PTs responsible for supporting evidence-based practice and attainment of professional practice standards.[23] PPLs also treated patients. PLs, PPLs, and registered PTs who reported providing walking rehabilitation to 10 or more patients post-stroke annually were eligible to participate and provided written informed consent. Research ethics boards at the University of Toronto (Protocol 31232) and each hospital approved the study.

Intervention

The study intervention involved provision of the iWalk toolkit.[18] The intervention was considered as passive because we did not actively prepare sites, through training, for example, to facilitate practice change. The purpose of the toolkit was to help PTs use an evidence-informed approach to administering stroke-specific 10mWT and 6MWT protocols.[24] The 10mWT involved timing the middle 10 m of a 14-m straight walkway traversed at a comfortable pace. The 6MWT involved walking back and forth along a straight 30-m walkway to determine the number of meters walked in 6 minutes. Protocols for both tests permitted use of mobility devices and physical assistance.[25]

The toolkit consisted of an educational guide,[26] educational video,[27] and mobile app.[25] The guide (i) included 8 modules describing the rationale for the walk tests, and recommended approaches to administering tests, interpreting test performance, educating patients, setting goals, and selecting treatments effective in increasing walking speed and distance;

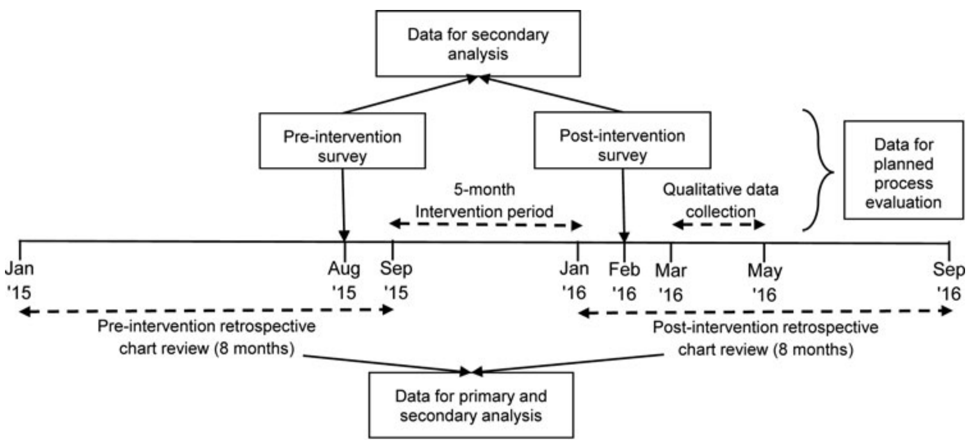

Figure 1. Overview of study design, timeline, and evaluation approach.

(ii) incorporated the required implementation resources (eg, equipment and space checklists); and (iii) described an implementation strategy involving 3 small group learning sessions coordinated by a PL, PPL, or PT. The video showed walkway set-up, and test administration, scoring, and documentation of results. The iWalkAssess app[25] included resources and timing tools to administer the tests and compare test performance to reference values.

In September 2015, we mailed sites printed copies of the iWalk guide. We emailed participants an electronic copy of the iWalk guide and a private YouTube link to the iWalk video. Participants could contact a PT expert on the research team with questions.

Sample size

We based sample size on the need for sufficient power to detect a 15% increase in assessment practice (judged as meaningful by the research team), and to obtain a sample of health records that would reflect the practice of participating PTs. To estimate sample size for paired proportions using McNemar's test,[28] one has to specify the percentage of individuals who are expected to (i) begin and (ii) stop using the tests of interest following the intervention. We hypothesized that 15% of PTs who were not using the 10mWT and 6MWT pre-intervention would begin using them post-intervention, and that 5% of PTs using each measure pre-intervention would stop using them post-intervention for reasons such as staffing or competing priorities.[29] A minimum paired sample size of 150 patients provided 80% power (2-sided $\alpha = 0.05$) to detect these changes. During data collection, however, we noted that select PTs treated few patients post-stroke during the sampling period. Thus, to obtain a representative sample, we aimed to abstract at least 10 health records per PT.

Eligibility of Health Records

A record was eligible if: (i) the patient was admitted for stroke or sustained a stroke in-hospital, (ii) a participating PT was assigned to provide care to the patient and documented findings from at least one assessment, and (iii) the patient was able to walk with assistance from no more than one person at the time of the assessment. In some cases, multiple PTs may enter assessment notes for the same patient due to shared positions and weekend coverage. We only abstracted data from assessment notes made by PTs who were study participants.

Sampling of Health Records

We retrospectively sampled hospital health records over an 8-month period pre-intervention (January to August 2015) and post-intervention (January to August 2016), matching calendar months to control for seasonal influences on clinical practice. Based on estimates from PLs and PPLs of the number of patients with stroke seen per month, sampling health records over an 8-month period was expected to yield the desired sample size. Each hospital provided lists of health records of individuals with stroke. Using these lists, abstractors reviewed consecutive records within the dates of the sampling period and abstracted data from records of patients with stroke, seen by a participating PT who documented findings from at least 1 assessment. Abstractors aimed to abstract data from at least 10 health records per PT. If fewer than 10 health records per PT were available, data from all available health records were abstracted. This approach was considered appropriate, as it reflected the assignment of patients among therapists at each hospital.

Data Collection

Using an electronic form, we abstracted data from health records on patient eligibility, patient characteristics and treatment, and assessments. Patient characteristics included admission data on age, sex, ability to speak English (yes/no), date, side and type of stroke, comorbid conditions based on the Charlson Comorbidity Index,[30] presence of aphasia (yes/no), cognitive impairment (yes/no), walking aid used, level of human assistance to walk (no assist and no supervision, no assist with supervision, assist of 1 person, assist of 2 people, and unable to walk), use of an ankle-foot orthosis (yes/no), as well as hospital setting, and date of hospital admission and discharge (to compute length of stay). For each assessment, data were collected on provider ID, date, assessment type (admission, interim, and discharge), walking aid used, level of human assistance to walk, and documentation (yes/no) of: (i) walk test performance, (ii) age/sex norm value,[18] (iii) community value (ie, crosswalk speed, community ambulatory classification, and community distance),[18] and (iv) walk test goal. Records indicating the patient was able to walk with assistance from no more than one person at the time of the assessment were included in the analysis.

We implemented recommended procedures to optimize reliable data abstraction.[31-33] Specifically, we developed and piloted a standardized chart abstraction form and guide with 10 health records. The study coordinator trained 7 abstractors with health sciences experience, continually monitored data quality, and provided abstractors with feedback. To evaluate abstraction consistency, 6 abstractors independently abstracted data a second time from 10% of health records sampled from acute care, inpatient and outpatient settings, pre- and post-intervention, at 4 hospitals in Ontario (n = 2) and Nova Scotia (n = 2), to optimize generalizability. After removing data from repeated assessments with the same patient or missing data on one walk test, we obtained paired data on 59 health records (8%). Interrater reliability was excellent with a κ value of 0.84 (95% confidence interval [CI]: 0.69, 0.99) and 0.72 (95% CI: 0.51, 0.93) for documentation (yes/no) of 10mWT and 6MWT administration, respectively.

We administered an online questionnaire pre- and post-intervention to collect data on sociodemographic and practice characteristics of participating PTs, and their use of intervention components, respectively. Detailed results have been reported.[18]

Data Analysis

First, 6 binary (yes/no) dependent variables were constructed to capture implementation of 6 individual or composite recommended clinical practices for each walk test during the length of stay: (i) administration of walk test at least once; (ii) administration of walk test at least twice (to monitor change); (iii) comparison of performance to norms; (iv) comparison of performance to community values (eg, crosswalk speed/type of community ambulator for the 10mWT; distance required to walk in the community for the 6MWT); (v) goal setting; and (vi) comparison to norms or community values or goal setting. We interpreted the percentage of participants completing recommended practices as low (<33%), moderate (33%-66%), and high (>66%).[18]

Then we obtained (i) unadjusted rates of implementing each recommended clinical practice pre- and post-intervention within and across practice settings, and (ii) risk differences pre- to post-intervention, along with the associated 95% CIs, using proc nlmixed. Proc nlmixed fits generalized linear mixed models with a maximum likelihood approach.[34] Next, 3 multivariable models were developed for each walk test using proc glimmix with the following dependent variables: walk test administration (primary outcome); walk test administration twice; and walk test administration and comparison to reference values or goal setting. Proc glimmix performs estimation and statistical inference for generalized linear mixed models using a pseudo-likelihood approach and allows for incorporation of more random effects.[34] Time, clustering variables, and covariates were independent variables entered into each model.

It was possible that PTs working in the same hospital would practice in a similar way (hospital-level clustering), and that patients receiving treatment from the same PT would be assessed in a similar way (provider-level clustering).[35] If clustering effects are strong, then it is recommended to account for them in the analysis; otherwise, they may alter the results.[36] We therefore performed multilevel modeling, specifically random-effects logistic regression, using SAS v9.4, to check for any clustering effects on the primary outcomes. Since clustering at the provider level was significant ($P < 0.05$), we accounted for provider-level clustering in the final models.

We also controlled for covariates with potential to influence standardized assessment of walking based on previous research.[37,38] Covariates included hospital setting (acute care, inpatient rehabilitation, and outpatient rehabilitation), and patient ambulation ability (walks with assistance or no assistance), and presence of aphasia (yes/no) and cognitive impairment (yes/no) on admission. Odds ratios (OR) and 95% CIs were reported.

RESULTS

Figure 2 describes the results of recruitment and health record screening. Nine hospitals providing acute care (n = 6), inpatient rehabilitation (n = 5), and outpatient rehabilitation (n = 6), overseen by 3 PPLs and 4 PLs, participated.[18] Preintervention data from 348 health records involving 42 PTs, and postintervention data from 375 health records involving 34 PTs were analyzed. Table 1 presents patient characteristics by sampling time and hospital setting. Pre- versus postintervention samples were similar with respect to median age (73 vs 73 years), and percentage with male sex (58.9% vs 55.7%), ischemic stroke (81.6% vs 85.6%), and need for supervision and/or assistance to walk on admission (73.9% vs 77.1%). Table 1 in Supplemental Digital Content 2 (available at: http://links.lww.com/JNPT/A391) presents cluster size at the hospital, provider, and patient levels.

Intervention Delivery

Seven sites (78%) completed 3 learning sessions within 3 (n = 3), 4 (n = 2), or 5 (n = 2) months. One site covered the recommended learning activities in 2 sessions within 6 months. One site was delayed by an influenza outbreak and completed the first 2 sessions within 7 months. The percentage of PTs that reviewed each iWalk guide module ranged from 62% to 97%. Eighty-three percent reported viewing the video, and 75% used the app for at least 1 month. Previous reports of implementation fidelity and participant engagement with the intervention[18,19] provide an in-depth description of the extent to which toolkit resources and implementation activities supported practice change across sites.

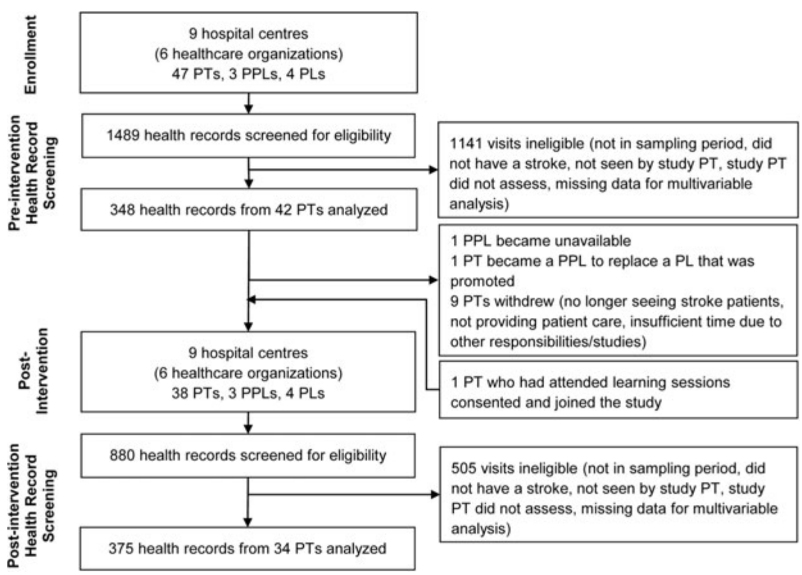

Figure 2. Results of recruitment and health record screening pre- and post-intervention.

Table 1. Characteristics of Patients With Stroke Sampled Pre- and Post-intervention by Hospital Setting[a]

	Preintervention					Postintervention				
Characteristic	n	AC n = 112	IP n = 183	OP n = 53	Pooled n = 348	n	AC n = 133	IP n = 214	OP n = 28	Pooled n = 375
Age, median (P_{25}, P_{75}), y	348	73 (64, 83)	71 (59, 82)	68 (59, 76)	73 (64, 83)	375	73 (60, 81)	70.5 (58, 79)	70 (60, 77.5)	73 (60, 81)
Male sex	348	62 (55.4)	111 (60.7)	32 (60.4)	205 (58.9)	375	84 (63.2)	112 (52.3)	13 (46.4)	209 (55.7)
Speaks English	348	107 (95.5)	161 (88.0)	49 (92.5)	317 (91.1)	375	120 (90.2)	183 (85.5)	25 (89.3)	328 (87.5)
Type of stroke	348					374				
Ischemic		96 (85.7)	141 (77.1)	47 (88.7)	284 (81.6)		120 (90.2)	178 (83.1)	22 (78.6)	320 (85.6)
Hemorrhagic		16 (14.3)	42 (23.0)	6 (11.3)	64 (18.4)		13 (9.8)	36 (16.8)	5 (17.9)	54 (14.4)
Side of lesion	346					370				
Right		54 (48.2)	84 (45.9)	22 (41.5)	160 (46.2)		60 (45.1)	89 (41.6)	15 (53.6)	164 (44.3)
Left		54 (48.2)	81 (44.3)	27 (50.9)	162 (46.8)		58 (43.6)	97 (45.3)	8 (28.6)	163 (44.1)
Bilateral		4 (3.6)	16 (8.7)	4 (7.6)	24 (6.9)		13 (9.8)	27 (12.6)	3 (10.7)	43 (11.6)
Days post-stroke on admission, median[b] (P_{25}, P_{75})	301	0 (0, 1)	12 (6, 22)	73 (49, 137)	6 (0, 14)	355	0 (0, 1)	13 (6, 34)	49 (44, 78)	6 (0, 22)
Hospital length of stay, median (P_{25}, P_{75}), d	296	9 (5, 18)	36 (24, 55)	–	25 (12, 43)	356	8 (4, 14)	35 (21, 53)	–	24 (9, 43)
Charlson Comorbidity Index, median (P_{25}, P_{75})	348	1 (0, 2)	1 (0, 2)	1 (0, 1)	1 (0, 2)	375	1 (0, 2)	1 (0, 2)	1 (0, 2)	1 (0, 2)
Diabetes		31 (27.7)	42 (23.0)	23 (43.4)	96 (27.6)		37 (27.8)	61 (28.5)	10 (35.7)	108 (28.8)
Any tumor		12 (10.7)	19 (10.4)	5 (9.4)	36 (10.3)		9 (6.8)	14 (6.5)	1 (3.6)	24 (6.4)
Peripheral vascular disease		9 (8.0)	13 (7.1)	5 (9.4)	27 (7.8)		2 (1.5)	11 (5.1)	1 (3.6)	14 (3.7)
Myocardial infarction		5 (4.5)	14 (7.7)	1 (1.9)	20 (5.7)		12 (9.0)	15 (7.0)	5 (17.9)	32 (8.5)
Congestive heart failure		9 (8.0)	9 (4.9)	2 (3.8)	20 (5.7)		3 (2.3)	8 (3.7)	1 (3.6)	12 (3.2)
Aphasia	348	34 (30.3)	58 (31.7)	10 (18.9)	102 (29.3)	375	26 (19.5)	84 (39.3)	6 (21.4)	116 (30.9)
Cognitive impairment	348	42 (37.5)	74 (40.4)	7 (13.2)	123 (35.3)	375	35 (26.3)	98 (45.8)	7 (25.0)	140 (37.3)
Walking aid on admission	348					375				
Unable to walk		13 (11.6)	37 (20.2)	2 (3.8)	52 (14.9)		9 (6.8)	26 (12.2)	0	35 (9.3)
Walker		48 (42.9)	103 (56.3)	13 (24.5)	164 (47.1)		62 (46.6)	120 (56.1)	10 (35.7)	192 (51.2)
Cane		4 (3.6)	8 (4.4)	20 (37.7)	32 (9.2)		7 (5.3)	17 (8.0)	5 (17.9)	29 (7.7)
No aid		45 (40.2)	29 (15.9)	18 (34.0)	92 (26.4)		55 (41.4)	44 (20.6)	13 (46.4)	112 (29.9)
Other aid		2 (1.8)	6 (3.3)	0	8 (2.3)		0	7 (3.3)	0	7 (1.9)
Assistance required to walk on admission	348					375				
No assist/no supervision		22 (19.6)	30 (16.4)	39 (73.6)	91 (26.1)		32 (24.1)	35 (16.4)	19 (67.9)	86 (22.9)
No assist but with supervision		33 (29.5)	50 (27.3)	11 (20.8)	94 (27.0)		43 (32.3)	83 (38.8)	8 (28.6)	134 (35.7)
Assist of 1 person		35 (31.3)	53 (29.0)	1 (1.9)	89 (25.6)		42 (31.6)	55 (25.7)	1 (3.6)	98 (26.1)
Assist of 2 people/unable to walk		22 (19.6)	50 (27.3)	2 (3.8)	74 (21.2)		16 (12.0)	1 (3.6)	0	57 (15.2)
Use of AFO on admission	330	1 (0.9)	3 (1.6)	2 (3.8)	6 (1.8)	375	0	4 (1.9)	1 (3.6)	5 (1.3)
PTA assisted with therapy	345	24 (21.4)	109 (59.6)	36 (67.9)	169 (49.0)	374	20 (15.0)	98 (45.8)	11 (39.3)	129 (34.5)
Patients with an admission PT assessment, n (%)	348	73 (65.2)	121 (66.1)	48 (90.6)	242 (69.5)	375	88 (66.2)	143 (66.9)	27 (96.4)	258 (68.8)
Patients with ≥1 interim PT assessment, n (%)	348	63 (56.3)	139 (76.0)	27 (50.9)	229 (65.8)	375	67 (50.4)	166 (77.6)	20 (71.4)	253 (67.4)
Patients with a discharge PT assessment, n (%)	348	23 (20.5)	144 (78.7)	34 (64.2)	201 (57.8)	375	52 (39.1)	167 (78.0)	14 (50.0)	233 (62.1)

Abbreviations: AC, acute care; AFO, ankle-foot orthosis; IP, inpatient rehabilitation; OP, outpatient rehabilitation; P_{25}, 25th percentile; P_{75}, 75th percentile; PT, physical therapist; PTA, physical therapist assistant.

[a]Values are n (%) unless otherwise indicated.

[b]Computed for those who were admitted with stroke (those who experienced a stroke post-admission were removed).

Table 2. Unadjusted Change in Documented Clinical Practice Pre- to Post-intervention by Hospital Setting

Clinical Practice	Preintervention of Times Practice Implemented, %				Postintervention of Times Practice Implemented, %				Unadjusted Difference
	AC n = 112	IP n = 183	OP n = 53	All (A) n = 348	AC n = 133	IP n = 214	OP n = 28	All (B) n = 375	B-A (95% CI)
10mWT administered once	1.8	15.9	17.0	11.5	3.8	43.9	46.4	29.9	18.4 (12.7, 24.1)
10mWT administered twice	0	12.6	7.6	7.8	0	20.1	32.1	13.9	6.1 (1.6, 10.6)
10mWT administered and performance compared with normative value	0	0.5	0	2.5	3.0	15.9	7.1	36.0	33.5 (23.4, 43.7)
10mWT administered and performance compared with crosswalk speed or used to classify community ambulation	0	0	0	0	2.3	8.9	3.6	20.7	20.7 (13.2, 28.3)
10mWT administered and goal set	0	0	0	0	2.3	3.3	3.6	9.9	9.9 (4.4, 15.5)
10mWT administered and performance compared with norm/crosswalk speed or goal set	0	0.6	0	0	3.0	18.2	14.3	12.5	12.3 (8.9, 15.6)
6MWT administered once	0	24.0	30.2	17.2	3.8	43.9	53.6	30.4	13.2 (7.0, 19.3)
6MWT administered twice	0	15.3	11.3	9.8	0	17.8	28.6	12.3	2.5 (2.3, 7.1)
6MWT administered and performance compared with normative value	0	0.5	0	1.9	3.0	14.5	14.3	34.2	32.3 (22.9, 41.8)
6MWT administered and performance compared with community distance	0	0	0	0	0	1.4	0	2.6	2.6 (−0.3, 5.6)
6MWT administered and goal set	0	0	1.9	1.9	2.3	5.6	3.6	14.2	12.3 (4.9, 19.7)
6MWT administered and performance compared with norm/community distance or goal set	0	0.6	1.9	0.6	3.0	15.9	14.3	11.2	10.6 (7.3, 13.9)

Abbreviations: AC, acute care; CI, confidence interval; IP, inpatient rehabilitation; OP, outpatient rehabilitation; 6MWT, 6-minute walk test; 10mWT, 10-m walk test.

Unadjusted Results

Table 2 presents the unadjusted percentage of hospital visits for which each recommended clinical practice was implemented. Pre-intervention, the 10mWT and the 6MWT were administered once in 11.5% and 17.2% of hospital visits, respectively. A significant increase in all practices pre- to post-intervention was observed, except for interpreting 6MWT performance using community distances. The largest increase was observed for administering the 10mWT and comparing performance to norms (risk difference: 33.5%, 95% CI: 23.4%, 43.7%), and administering the 6MWT and comparing performance to norms (risk difference: 32.3%, 95% CI: 22.9%, 41.8%). Practice changed the least in acute care and the most in outpatient settings.

Adjusted Findings

Table 3 presents the final multivariable models. Compared with preintervention, the odds of administering each walk test once and administering each walk test and interpreting test performance were significantly greater post-intervention, after adjusting for provider-level clustering, hospital setting, ambulation ability, and presence of aphasia and cognitive impairment on admission. The odds of administering each walk test twice also significantly increased after adjusting for provider-level clustering only (without inclusion of covariates).

DISCUSSION

Following passive dissemination of a toolkit to hospitals with PPLs or PLs, our study is the first to show significant increases in the interpretation of 10mWT and 6MWT results, in addition to increases in walk test administration, adjusting for key covariates. The moderate-to-high level of engagement with the intervention in terms of attending learning sessions, reviewing iWalk guide modules, viewing the video, and using the iWalkAssess app, and reported improvement in PTs' knowledge, attitudes, skill, self-efficacy,[18,19] suggests the toolkit intervention contributed to improving walking assessment practice.

Therapists value tests that provide clinically meaningful results.[38] Weak belief in the relevance of a recommended practice to patients is a strong barrier to practice change.[39] While previously examined interventions designed to influence assessment practice have included education and strategies to foster interpretation of walk test performance,[17,40-42] few[40] have measured interpretation as an outcome. One pre-/poststudy[40] conducted in an acute care hospital observed a large increase in the odds of using or interpreting any 1 of 10 assessment tools (including the 10mWT and 6MWT) based on documentation in health records, adjusting for patient age, PTs' experience, and therapist-level clustering. However, these results are not directly comparable to the current study, as the intervention was organizationally intensive and not specific to

Table 3. Logistic Regression Models[a]

Independent Variable	Model 1 10mWT Administered Once	Model 2 6MWT Administered Once	Model 3 10mWT Administered Twice	Model 4 10mWT Compared With Norm/Crosswalk Speed or Goal Set	Model 5 6MWT Administered Twice	Model 6 6MWT Compared With Norm/ Community Distance or Goal Set
Time						
Postintervention	9.7 (4.8, 19.8)	3.5 (2.0, 5.9)	4.4 (2.1, 9.2)[b]	2.2 (1.2, 4.0)[b]	101.6 (13.0, 795.4)	57.5 (12.0, 274.5)
Preintervention	(Reference)	(Reference)	(Reference)	(Reference)	(Reference)	(Reference)
Hospital setting						
Inpatient	56.0 (12.3, 253.4)	67.9 (16.5, 279.3)			9.2 (1.5, 56.3)	6.3 (0.9, 44.8)
Outpatient	22.2 (3.1, 160.6)	53.2 (9.2, 308.9)			9.8 (0.8, 113.9)	13.5 (1.1, 162.7)
Acute care	(Reference)	(Reference)			(Reference)	(Reference)
Physical assistance to walk						
Yes	0.9 (0.5, 1.6)	0.5 (0.3, 0.9)			1.7 (0.8, 3.7)	1.0 (0.4, 2.2)
No	(Reference)	(Reference)			(Reference)	(Reference)
Aphasia present						
Yes	1.0 (0.5, 1.8)	1.2 (0.7, 1.9)			0.8 (0.3, 1.8)	1.0 (0.4, 2.5)
No	(Reference)	(Reference)			(Reference)	(Reference)
Cognitive impairment						
Yes	0.8 (0.5, 1.5)	0.7 (0.4, 1.2)			0.6 (0.3, 1.2)	0.6 (0.2, 1.3)
No	(Reference)	(Reference)			(Reference)	(Reference)
Intracluster correlation coefficient	0.29	0.25	0.30	0.23	0.15	0.14

Abbreviations: 6MWT, 6-minute walk test; 10mWT, 10-m walk test.
[a]Values shown are odds ratio (95% confidence interval). All models account for provider-level clustering.
[b]Model with covariates did not converge.

stroke, and the outcome considered use of any assessment tool.

We observed significantly higher magnitudes of single test administration in inpatient and outpatient rehabilitation compared with acute care settings. The low value placed on assessing walking speed and distance, difficulty finding space near treatment areas for permanent walkway set-up, and the lack of onsite facilitation may explain low uptake of walk tests at acute care sites.[18,19] In a pre-/poststudy,[17] unadjusted use of a stroke test battery, consisting of the Berg balance scale, 6-m walk test, and 6MWT, increased by 39% during the first 6 months of the active intervention among inpatients in a rehabilitation hospital. This increase is slightly higher than observed for inpatient settings in the current study, likely due to the more complex intervention design, including leadership support; local consensus procedures; printed materials; electronic health record modification; interactive education sessions; 14-month audit and feedback; a research assistant supporting data collection, test timing, and equipment set up; and reminders, rewards, equipment purchase, and an annual standardization event to ensure consistent administration of measures. Taken together, this evidence suggests that providing a theory-based toolkit that describes an implementation process can achieve substantial practice change in the presence of onsite professional leadership.[18,19]

Finally, our study provides evidence that PTs are less likely to administer the 6MWT, but not the 10mWT, in patients who required physical assistance to walk on admission. Therapists at select acute care and inpatient rehabilitation hospitals believed that the 6MWT was only appropriate to administer when patients could walk 6 minutes continuously, despite the allowance for rests in the test protocol. Some did not wish to discourage patients who struggled to walk.[19] Presence of aphasia or cognitive impairment on admission were not significantly associated with walk test administration although previous qualitative findings identify these factors as barriers to walking assessment.[38]

Limitations

Strengths of our study included a multisite approach to optimize generalizability; analysis of documented assessment practice with low vulnerability to social desirability bias; matching pre- and postintervention sampling of health records by calendar period to control for seasonal variation in practice; and accounting for clustering in the analysis. Limitations included the lack of a control group, preventing causal inference, and the use of sites with a PL/PPL, which limits generalizability. Also, it was not possible to identify and account for patient transfers between hospitals. Finally, knowledge of the study hypothesis may have led to increased documentation of walk test administration post-intervention, resulting in an overestimation of toolkit impact.

CONCLUSIONS

A theory-based toolkit and implementation strategy likely contributed to increasing PTs' standardized assessment and interpretation of walking speed and distance post-stroke, after controlling for provider-level clustering; hospital setting; and patient walking, communication, and cognition capacity on admission. Assessment of walking speed increased to a greater extent than walking distance. Effects were observed primarily in inpatient and outpatient settings employing PPLs or PLs. Findings may help guide plans for implementation of clinical toolkits and educational materials available online targeting assessment in neurological practice.[15,43,44]

ACKNOWLEDGMENTS

We thank the physical therapists, PPLs, and PLs who participated for their time and contributions.

REFERENCES

1. Teasell R, Salbach NM, Foley N, et al. Canadian Stroke Best Practice Recommendations: Rehabilitation, Recovery, and Community Participation following Stroke. Part One: Rehabilitation and Recovery Following Stroke; 6th Edition Update 2019. *Int J Stroke*. 2020:15(7): 763-788.
2. Winstein CJ, Stein J, Arena R, et al. Guidelines for adult stroke rehabilitation and recovery: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*. 2016; 47(6):e98-e169.
3. Veerbeek JM, Van Wegen EEH, van Peppen RPS, et al. KNGF clinical practice guideline for physical therapy in patients with stroke. Royal Dutch Society for Physical Therapy; 2014. https://www.dsnr.nl/wp-content/uploads/2012/03/stroke_practice_guidelines_2014.pdf. Accessed February 16, 2022.
4. Cheng DK, Dagenais M, Alsbury-Nealy K, et al. Distance-limited walk tests post-stroke: a systematic review of measurement properties. *NeuroRehabilitation*. 2021;48(4):413-439.
5. Salbach NM, O'Brien KK, Brooks D, et al. Considerations for the selection of time-limited walk tests poststroke: a systematic review of test protocols and measurement properties. *J Neurol Phys Ther*. 2017;41(1): 3-17.
6. Salbach NM, O'Brien K, Brooks D, et al. Speed and distance requirements for community ambulation: a systematic review. *Arch Phys Med Rehabil*. 2014;95(1):117-128.e11.
7. Salbach NM, O'Brien KK, Brooks D, et al. Reference values for standardized tests of walking speed and distance: a systematic review. *Gait Posture*. 2015;41(2):341-360.
8. Jolliffe L, Lannin NA, Cadilhac DA, Hoffmann T. Systematic review of clinical practice guidelines to identify recommendations for rehabilitation after stroke and other acquired brain injuries. *BMJ Open*. 2018;8(2): e018791.
9. Gagliardi AR, Brouwers MC, Palda VA, Lemieux-Charles L, Grimshaw JM. How can we improve guideline use? A conceptual framework of implementability. *Implement Sci*. 2011;6(1):26. doi:10.1186/1748-5908-6-26.
10. Yamada J, Shorkey A, Barwick M, Widger K, Stevens BJ. The effectiveness of toolkits as knowledge translation strategies for integrating evidence into clinical care: a systematic review. *BMJ Open*. 2015;5(4): e006808.
11. Gagliardi AR. "More bang for the buck": exploring optimal approaches for guideline implementation through interviews with international developers. *BMC Health Serv Res*. 2012;12:404. doi:10.1186/1472-6963-12-404
12. Lang CE, Bland MD, Connor LT, et al. The brain recovery core: building a system of organized stroke rehabilitation and outcomes assessment across the continuum of care. *J Neurol Phys Ther*. 2011;35(4): 194-201.
13. Bland MD, Sturmoski A, Whitson M, et al. Clinician adherence to a standardized assessment battery across settings and disciplines in a poststroke rehabilitation population. *Arch Phys Med Rehabil*. 2013;94(6): 1048-1053.e1.
14. Petzold A, Korner-Bitensky N, Salbach NM, Ahmed S, Menon A, Ogourtsova T. Increasing knowledge of best practices in occupational therapists treating post-stroke unilateral spatial neglect: results of a knowledge-translation intervention study. *J Rehabil Med*. 2012;44(2): 118-124.
15. Tyson SF, Burton L, McGovern A. The impact of a toolkit on use of standardised measurement tools in stroke rehabilitation. *Clin Rehabil*. 2015; 29(9):926-934.
16. Richards CL, Malouin F, Nadeau S, et al. Development, implementation, and clinician adherence to a standardized assessment toolkit for sensorimotor rehabilitation after stroke. *Physiother Can*. 2019;71(1): 43-55.
17. Moore JL, Virva R, Henderson C, et al. Applying the knowledge-to-action framework to implement gait and balance assessments in inpatient stroke rehabilitation [published online ahead of print November 27, 2020]. *Arch Phys Med Rehabil*. doi:10.1016/j.apmr.2020.10.133.
18. Salbach NM, MacKay-Lyons M, Solomon P, et al. The role of theory to develop and evaluate a toolkit to increase clinical measurement and interpretation of walking speed and distance in adults post-stroke [published online ahead of print January 16, 2021]. *Disabil Rehabil*. doi:10.1080/09638288.2020.1867653.
19. Salbach NM, McDonald A, MacKay-Lyons M, et al. Experiences of physical therapists and professional leaders with implementing a toolkit to advance walking assessment poststroke: a realist evaluation. *Phys Ther*. 2021;101(12):1-10. doi: 10.1093/ptj/pzab232.
20. Graham ID, Logan J, Harrison MB, et al. Lost in knowledge translation: time for a map? *J Contin Educ Health Prof*. 2006;26(1):13-24.
21. Bandura A. Self-efficacy: toward a unifying theory of behavioral change. *Psychol Rev*. 1977;84:24.
22. Prochaska JO, DiClemente CC. Stages and processes of self-change of smoking: toward an integrative model of change. *J Consult Clin Psychol*. 1983;51(3):390-395.
23. Chinn E, Dealy J, Stepien J, et al. Physiotherapists' perspectives on professional practice leadership models: key features to enhance physiotherapy practice [published online ahead of print October 27, 2021]. *Physiother Can*. doi:10.3138/ptc-2020-0103.
24. Cheng DK, Nelson M, Brooks D, Salbach NM. Validation of stroke-specific protocols for the 10-meter walk test and 6-minute walk test conducted using 15-meter and 30-meter walkways. *Top Stroke Rehabil*. 2019:1-11. doi:10.1080/10749357.2019.1691815.
25. Salbach NM, Bayley M, Brooks D, et al. iWalkAssess: the latest evidence-informed approach to walking assessment post-stroke. http://www.iwalkassess.com/. Accessed February 16, 2022.
26. Salbach N, Bayley M, Brooks D, et al. iWalk: a guide to an evidence-informed approach to using the 10-metre and 6-minute walk tests post-stroke. https://www.physicaltherapy.utoronto.ca/research/ktalab/ongoing-research/rehabilitation-tools-guidelines-applications/. Accessed February 16, 2022.
27. iWalk educational video: administration of the 10-metre walk test and 6-minute walk test with a person post-stroke. YouTube. https://www.youtube.com/watch?v=PI_gERx5EmI&t=309s. Updated March 6, 2020.
28. Sample size for McNemar test program. https://statstodo.com/McNemar.php. Published 2022. Accessed February 16, 2022.
29. Duncan EAS, Murray J. The barriers and facilitators to routine outcome measurement by allied health professionals in practice: a systematic review. *BMC Health Serv Res*. 2012;12:96.
30. Quan H, Li B, Couris CM, et al. Updating and validating the Charlson comorbidity index and score for risk adjustment in hospital discharge abstracts using data from 6 countries. *Am J Epidemiol*. 2011;173(6):676-682.
31. Gearing RE, Mian IA, Barber J, Ickowicz A. A methodology for conducting retrospective chart review research in child and adolescent psychiatry. *J Can Acad Child Adolesc Psychiatry*. 2006;15(3):126-134.
32. Liddy C, Wiens M, Hogg W. Methods to achieve high interrater reliability in data collection from primary care medical records. *Ann Fam Med*. 2011;9(1):57-62.
33. Vassar M, Holzmann M. The retrospective chart review: important methodological considerations. *J Educ Eval Health P*. 2013;10:12.
34. Programming Documentation for SAS® 9.4 and SAS® Viya® 3.3. https://documentation.sas.com/doc/en/pgmsascdc/9.4_3.3/pgmsaswlcm/home.htm. Accessed February 16, 2022.
35. Salbach NM, Wood-Dauphinee S, Desrosiers J, et al. Facilitated interprofessional implementation of a physical rehabilitation guideline for stroke in inpatient settings: process evaluation of a cluster randomized trial. *Implement Sci*. 2017;12(1):100.
36. Boutron I, Moher D, Altman DG, Schulz KF, Ravaud P, Group C. Extending the CONSORT statement to randomized trials of nonpharmacologic treatment: explanation and elaboration. *Ann Intern Med*. 2008;148(4): 295-309.
37. Salbach NM, Guilcher SJ, Jaglal SB. Physical therapists' perceptions and use of standardized assessments of walking ability post-stroke. *J Rehabil Med*. 2011;43(6):543-549.
38. Pattison KM, Brooks D, Cameron JI, Salbach NM. Factors influencing physical therapists' use of standardized measures of walking capacity poststroke across the care continuum. *Phys Ther*. 2015;95(11):1507-1517.

39. Sibley KM, Gardner P, Bentley DC, et al. Exploring factors influencing physiotherapists' perceptions of measuring reactive balance following a theory-based multi-component intervention: a qualitative descriptive study [published online ahead of print June 19, 2021]. *Disabil Rehabil*. doi:10.1080/09638288.2021.1916840.
40. McDonnell B, Stillwell S, Hart S, Davis RB. Breaking down barriers to the utilization of standardized tests and outcome measures in acute care physical therapist practice: an observational longitudinal study. *Phys Ther*. 2018;98(6):528-538.
41. Romney W, Salbach N, Parrott JS, Deutsch JE. A knowledge translation intervention designed and implemented by a knowledge broker improved documented use of gait speed: a mixed-methods study. *J Geriatr Phys Ther*. 2020;43(3):E1-E10.
42. Romney W, Wormley M, Veneri D, et al. Knowledge translation intervention increased the use of outcome measures by physical therapists in inpatient rehabilitation [published online ahead of print March 12, 2021]. *Physiother Theory Pract*. doi:10.1080/09593985.2021.1898065.
43. Academy of Neurologic Physical Therapy. ANPT Outcome Measures Recommendations. https://www.neuropt.org/practice-resources/neurology-section-outcome-measures-recommendations. Accessed February 16, 2022.
44. Stroke Engine. www.medicine.mcgill.ca/strokengine-assess/about-en.html. Accessed February 16, 2022.

