Development, Implementation, and Clinician Adherence to a Standardized Assessment Toolkit for Sensorimotor Rehabilitation after Stroke

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ABSTRACT

Purpose: This study describes the development of a standardized assessment toolkit (SAT) and associated clinical database focusing on sensorimotor rehabilitation in three stroke rehabilitation units (SRUs). Implementation of the SAT was confirmed using objective measures of clinician adherence while exploring reasons for varied adherence. **Method:** Participants were patients post-stroke admitted for inpatient rehabilitation and clinicians from the three SRUs. A collaborative and iterative process was used to develop the SAT. Implementation was measured by clinician adherence, which was charted by means of assessment entries in patient records and transferred to the clinical database. Reasons for lower adherence were interpreted from therapist data logs at one SRU. **Results:** The SAT consisted of 25 assessment tools. Clinician adherence to a subset of the tools ranged from 33% to 99% at admission and from 28% to 94% at discharge. At one site, lower adherence among the tools was explained by patient-related factors (1%–36%) and protocol or logistical reasons (0%–7%) at admission; missing data ranged from 0% to 3%, except for the Montreal Cognitive Assessment (17%). **Conclusions:** In this pragmatic study, objective measures of clinician adherence demonstrated the feasibility of implementing an SAT in daily practice. Moreover, the reasons for lower adherence rates may be related to the patients, protocol, and logistics, all of which may vary with the assessment tool, rather than clinician compliance.

Key Words: guideline adherence; inpatients; outcome measures; rehabilitation; stroke.

RÉSUMÉ

Objectif : décrire la création d'une trousse d'évaluation standardisée (TÉS) et d'une base de données cliniques connexe axée sur la réadaptation sensorimotrice dans trois unités de réadaptation fonctionnelle (URF). Les chercheurs ont confirmé la mise en application de la TÉS au moyen de mesures objectives de l'adhésion des cliniciens et ont exploré les raisons expliquant les variations à cette adhésion. **Méthodologie :** les participants étaient des patients victimes d'un accident vasculaire cérébral (AVC) admis en réadaptation et les cliniciens des trois URF. Les chercheurs ont utilisé un processus coopératif et itératif pour créer la TÉS. Ils en ont mesuré la mise en application par l'adhésion des cliniciens, recensée d'après les résultats d'évaluation dans les dossiers des patients, puis les ont transférées dans la base de données cliniques. Ils ont interprété les raisons d'une plus faible adhésion à partir des notes inscrites sur les feuilles de collecte de données des thérapeutes d'une des URF. **Résultats :** la TÉS se composait de 25 outils d'évaluation. L'adhésion des cliniciens à un sous-groupe d'outils se situait entre 33 % et 99 % à l'admission en réadaptation et entre 28 % et 94 % au congé. Dans un établissement, une plus faible adhésion aux outils s'expliquait par des facteurs liés aux patients (de 1 % à 36 %), au protocole ou à la logistique (0 % à 7 %) à l'admission, alors que les données manquantes variaient de 0 % à 3 %, sauf pour le « Montreal Cognitive Assessment » (17 %). **Conclusions :** dans cette étude pragmatique, les mesures objectives d'adhésion des cliniciens ont démontré la faisabilité de mettre en application une TÉS dans la pratique quotidienne. De plus, les raisons d'un taux d'adhésion plus faible peuvent être liées aux patients, au protocole ou à la logistique, facteurs qui peuvent varier en fonction de l'outil d'évaluation, plutôt qu'aux cliniciens.

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Stroke is a worldwide health burden.¹ In Canada, Kreuger and colleagues² reported a prevalence rate of 1.15% and estimated that 405,000 individuals were living with the consequences of a stroke in 2013. Despite the growing evidence of the benefits of stroke rehabilitation,³ only 37% of persons with moderate to severe stroke were discharged from acute care to a rehabilitation facility in Canada in 2014.⁴ These facilities do not always provide evidence-based rehabilitative care, however, and there is a need to promote the uptake of best-practice recommendations for delivering rehabilitation services.⁵

Using standardized assessment tools is a hallmark of evidence-based recommendations for stroke rehabilitation^{6,7} and the cornerstone of improved efficiency and quality of post-stroke rehabilitation.^{8,9} Over the years, a wealth of information on outcome measures has been published,⁹⁻¹¹ and Internet sites have been developed,¹²⁻¹⁴ to guide clinicians in the choice and application of these measures. Although clinicians generally have a positive attitude toward using outcome measures,¹⁵⁻¹⁷ the actual integration of these measures into daily clinical practice remains a challenge.^{5,16,17}

Barriers to using standardized assessment tools include organizational policy and procedures, clinicians' competence and beliefs, the difficulty of behavioural change, lack of peer support, lack of physical space to administer the evaluation, lack of time, the requirement for special equipment to implement the assessment tools, and scepticism about their perceived relevance.^{16,18-21} Several strategies are used to facilitate using assessment tools: active, targeted approaches consisting of lectures, seminars, and peer involvement; audits and feedback;²²⁻²⁴ administrative and infrastructure support;^{19,25} working in teams;²⁴ and using practice knowledge brokers²⁶ or clinical champions.¹⁹ Other strategies facilitate using the tools in clinical practice: standardized assessment toolkits (SATs), which include instructions for users on how to apply the tools and score them, combined with tailored educational programmes.¹⁶ There is also a need to develop clinical databases to store assessment results and to make them available for quality improvement and research studies.⁵

Surveys, questionnaires,^{15,16,18,21} face-to-face or telephone interviews,²⁷ and answers to clinical vignettes²⁸ inform the use of standardized assessment tools. These methods, although they reach many respondents, carry the inherent bias of self-reports.²⁰ Moreover, these methods provide information on the choice and use of assessment tools, but not on adherence, based on quantitative data, to a specific assessment tool or to an SAT. One important goal of this study was to measure adherence, operationally defined as the percentage of time that assessment tools were administered at each required time point.

To our knowledge, only two studies (based on the same clinical database)^{25,29} have objectively measured

clinician adherence in administering the suite of tools comprising an SAT that had been developed to assess the continuum of stroke care. This SAT, however, did not focus on sensorimotor rehabilitation; it also did not examine adherence to the individual assessment tools comprising the SAT or the reasons for variable adherence rates.

The purposes of the current multicenter pragmatic study were, therefore, to (1) describe the development of a consensus SAT for the sensorimotor evaluation of patients admitted for inpatient stroke rehabilitation and its associated clinical database, (2) report on SAT implementation in daily practice by objectively evaluating clinicians' adherence to selected assessment tools in the SAT, and (3) examine the reasons for variable adherence. Implementing the SAT and associated clinical database were crucial steps in creating a multicentre clinician-research platform (CRP) to optimize clinical care and to support the clinical research programme of the Sensorimotor Rehabilitation Research Team.³⁰

METHODS

Design

This study had two parts. In the first part, we developed an SAT and created an associated clinical database. We then implemented the SAT at the three sites and report on a cohort study of the patient records stored in the database during the implementation period to measure the adherence of the clinicians to the individual assessment tools at admission and discharge from inpatient rehabilitation.

The second part was carried out at one site (with the same patients included for this site in the first part) to examine the reasons for variations in clinician adherence.

First part

Subjects

Researchers, managers, clinical champions, and the clinicians at three stroke rehabilitation units (SRUs) participated in developing and implementing the SAT. The clinicians (in terms of full-time equivalent positions) consisted of 17.6 occupational therapists, 17 physiotherapists, 2 physicians, 4.1 neuropsychologists, 3 speech-language pathologists, and 1 nutritionist.

For the cohort study (first part), patients aged 18 years or older with a confirmed ischemic or hemorrhagic stroke who had been admitted for inpatient rehabilitation at one of the three SRUs were eligible for inclusion in the study. Patients were excluded if they had another neurological condition (spinal lesions, cerebral palsy, Parkinson's disease, cerebral tumours, traumatic brain injury, infection or intoxication); musculoskeletal disorder (severe arthritis or osteoarthritis, amputations); pre-existing intellectual, visual, or auditory impairments not related to the patient's stroke but likely to affect rehabilitation potential;

cancer requiring active treatment; and re-admittance for a second stroke after participation in the study.

Ethics approval to create the CRP was granted by the institutional ethics committees. The rehabilitation professionals consented to creating the CRP and implicitly to implementing an SAT, which was also considered to be a quality improvement project. Patients were required to provide informed consent to have their data included in the analysis for the research study, but the data of those refusing to consent were also retained for clinical programme evaluations.

Agreeing on which assessment tools to include

Researchers, clinical champions, managers, and selected occupational and physical therapists representing the three sites met in an iterative process to review the assessment tools recommended in the Canadian Best Practice Recommendations for Stroke Care³¹ and other information on outcome measures (websites, reviews). The *International Classification of Functioning, Disability and Health*³² provided a framework. The aim was to include the required number of assessment tools in a consensus SAT that would provide sufficient information for patient safety, clinical decision making, and outcome assessment for most patients admitted for sensorimotor rehabilitation after stroke.

Although the focus was on assessment tools for sensorimotor impairments and function of the upper and lower extremities, we also included assessment tools providing information on swallowing function, cognition, visual neglect, anxiety and depression, and communication. The pros and cons of each assessment tool were discussed without using a specific scoring system, and the tools were chosen for their psychometric properties, ease of and time needed for application, and the clinicians' experience with administering them. Assessment tools already in use by the clinical teams were retained if they were recommended.³⁰

Some tools were included for screening purposes; others were included to guide the therapeutic approach, measure progression, or provide patient outcomes. The purpose of each tool determined when it should be administered: at admission, at discharge, at admission and discharge, or at a 6-month follow-up. The SAT was reviewed by the three clinical teams, and they made adjustments before finalizing it.

A multifaceted approach, inspired by studies that examined ways to facilitate the implementation of best practices, was used to introduce the SAT into clinical practice.^{15,16,22–24} As outlined earlier, it consisted of a collaborative process to select the tools, including tools familiar to the rehabilitation professionals, when possible,²⁵ and encouraged the participation of SRU managers in the process.¹⁹ To encourage uptake by the clinicians, a clinical champion led the process at each site,^{19,25,26} a de-

tailed procedures manual for the administration of each assessment tool was developed,^{25,30,33} educational meetings were led by the clinical champions to guide the clinicians in the use of the procedures manual and teach them how to apply unfamiliar tools,^{19,25} and small group practice sessions were held to train the clinicians.

To encourage buy-in, it was important to respect the different local clinical cultures and allow leeway in the process. For example, only one site was staffed by physicians, neuropsychologists, speech therapists, and nurses. The FIM was administered by nurses at one site and by occupational and physical therapists at the other sites; the SAT implementation date varied. We made sure that the material and the space needed to administer the SAT were available,¹⁹ that clinical data collection forms were gathered regularly to ensure timely recording of assessment results, and that a trial period was included to familiarize the clinicians with the implementation process.²⁵

Target dates were set for implementing the SAT and collecting data for the database; the latter activity would allow the data from this first phase of SAT implementation to be analyzed and then used as a baseline for future comparisons. Two sites recruited patients over a 12-month period, and the third recruited patients over a 5-month period; the delay at the third site was due to major hospital management and staff restructuring.

Creating a clinical database

Research Electronic Data Capture (REDCap)³⁴ was chosen to manage the common clinical database. REDCap (based at Vanderbilt University, Nashville, TN) is a secure, web-based application used by more than 2,500 institutions in more than 100 countries around the world. This powerful data collection application allows users to fully customize it for their own use and is hosted at one of our three sites. This site oversees the architecture and improvement of the REDCap database, while each site retains access to and control of its unique clinical database. The data are secured and stored on a separate server within the Health Ministry's firewall.

Clinicians recorded the assessment results for each patient on data collection forms, and the data were then extracted and entered into the database. To enable us to pool the data among the sites, the REDCap data were de-identified and exported to an Excel matrix for analysis.

Assessing implementation success

Implementation, or administration of the assessment tools in daily practice, was assessed by measuring adherence to the SAT measurement protocol for the selected assessment tools on the basis of data contained in the database. Like Bland and colleagues,²⁹ we defined *adherence* operationally as the percentage of time that assessment tools were administered at admission and discharge. We chose to report on adherence to

administering 12 of the 21 assessment tools (the 4 participation assessment tools were not implemented in the current study) in the Body Functions and Structures and Activities sections (see [Table A.1](#) in the Appendix) to demonstrate the feasibility of implementing the SAT in daily practice at the three sites; 2 assessment tools were administered on the affected and non-affected sides, and 1 (the 10-metre walk test, or 10mWT) was administered at comfortable and fast speeds.^{35–53}

We mainly selected tools for assessing sensorimotor function to be administered by the physical and occupational therapists, but we also included tools for assessing anxiety and depression and cognitive impairment. Although assessment results for the other tools were included in the database, they were not quantitatively evaluated for the purposes of the present study. Some tools, such as the Modified Ashworth Scale (MAS), the Erasmus MC modifications to the (revised) Nottingham Sensory Assessment (EmNSA), and manual muscle testing, include multiple tests (of muscle groups or sensory sites), and variation in administration of the tests and recording results made analysis difficult. The Bells Test and a Swallowing Qualitative Scale were not implemented at one site because professionals other than physical and occupational therapists were administering these tests, and hand dynamometry was implemented later at two sites.

Second part

The second part of the project took place at one site and examined the reasons for a lack of adherence to administering the selected assessment tools by analyzing the reports provided by the clinicians in their data logs. This analysis was not part of the original project, and the lack of additional research funds at the other two sites prevented them from participating.

Subjects

Participants were post-stroke ($n = 69$), admitted for inpatient rehabilitation to the site over a 12-month period, had signed an informed consent form, and complied with the inclusion and exclusion criteria defined for the first part of this study. Participating clinicians were five occupational therapists, five physiotherapists, two neuropsychologists, three nurses, and two physicians (in equivalent full-time positions).

Developing categories of reasons for non-adherence

The research therapist met with the clinicians to discuss how they had noted the reasons for a lack of assessment results in the data logs and worked with them to develop categories of reasons. The research therapist and the main site researcher established three main categories: (1) the assessment did not apply because of patient-related factors such as lack of mobility or dexterity, severe aphasia, or impaired cognition; (2) a patient was not assessed for measurement protocol or logistical

reasons; or (3) missing data were identified when clinicians did not carry out a required evaluation and did not provide an explanation.

There were several reasons for placing results in the second category: an assessment score was maximal at admission, a patient was not re-evaluated at discharge, and the discipline designated to administer the assessment tool did not treat a patient – for example, if a patient did not require physiotherapy interventions, the Berg Balance Scale (BBS) was not administered, or a patient may have missed an appointment for evaluation or been discharged before an evaluation was scheduled. When in doubt about a classification in the data logs, the research therapist met with the clinicians to clarify it.

We recognize that such a simple classification may not have covered all the possible reasons for non-adherence, but it nevertheless allowed a first examination of possible factors that help explain non-adherence.

Statistical analysis

Descriptive statistics (means, SDs) were used to describe patient characteristics. To calculate adherence in part one, data on the administration of each assessment tool were extracted from the clinical database for each patient at admission and at discharge and reported as a percentage of the total number of patients. The reasons for not administering the assessment tools (part two) were obtained from the data logs for each patient and expressed as a percentage of the number of patients at one site.

RESULTS

Part One

Developing the standardized assessment toolkit

We developed an SAT consisting of 25 assessment tools (see [Table A.1](#) in the Appendix).^{35–53} They focus mainly on the sensorimotor evaluation of the upper and lower extremities, organized according to the ICF classification³² of body functions and structures (impairments), activities (functional mobility, balance, upper extremity performance, and communication), and participation (leisure and quality of life). Some tools were included to screen for cognitive impairments, visual neglect, anxiety and depression, and the presence and type of communication impairments. Other tools were used to assess progression and to measure patient outcomes. Most of the assessment tools are to be administered at both admission and discharge. The assessment tools in the Participation section were not implemented in this study; they were left in the table for future studies that include a 6-month follow-up evaluation.

Implementing the SAT in daily practice

To determine how the SAT was implemented in daily practice, we evaluated the clinicians' adherence to

Table 1 Patient Characteristics ($n = 264$)

Characteristic	Mean (SD)*
Age, y	60.3 (15.4)
Gender, no. (%)	
Male	166 (63)
Female	98 (37)
Side of cerebral lesion, no. (%)	
Right	124 (47)
Left	114 (44)
Bilateral	24 (9)
Onset to rehabilitation admission, d ($n = 263$)	27.7 (18.4)
Length of rehabilitation stay, d	48.4 (31.1)
Admission FIM [†] score (out of 126; $n = 168$)	83.1 (24)

*Unless otherwise indicated

†One site delayed administration of the FIM.

selected assessment tools. [Table 1](#) presents the patient characteristics and the selected process variables. A total of 305 patients were admitted to the three sites over the course of this study, and 264 were retained for analysis. The reasons for exclusion were refusing to participate or being unable to provide consent ($n = 21$), a stay of less than 1 week ($n = 6$), death ($n = 2$), another pre-existing neurological diagnosis ($n = 9$), return to acute care hospital ($n = 2$), or sent to long-term care ($n = 1$).

[Figure 1](#) illustrates adherence to administering a subset of the assessment tools, as a percentage. [Figure 1a](#) shows adherence to the tools implemented at all three SRUs. [Figure 1b](#) shows the assessment tools that were either not implemented at one of the sites or not performed at either admission or discharge at all sites: the Montreal Cognitive Assessment (MoCA), Hospital Anxiety and Depression Scale (HADS), the Chedoke-McMaster Stroke Assessment Activity Inventory (CMSA-AI), and the FIM, implemented later at one site.

Adherence did not reach 100% for any tool at either admission or discharge. At admission, adherence to all the assessment tools ranged from 33% to 99%; at discharge, adherence ranged from 28% to 94%. Among the tools administered at both admission and discharge, adherence was higher at admission, except for the 10mWT, at comfortable and fast speeds, and the 6-minute walk test (6MWT). Adherence at admission was 70% or higher for six assessment tools: shoulder pain, CMSA Impairment Inventory (CMSA-II), BBS, HADS, FIM, and CMSA-AI. Adherence was lowest for the Chedoke Arm and Hand Activity Inventory, version 9 (CAHAI V9) at admission and discharge.

Part two

[Figure 2](#) illustrates the reasons for the lack of assessment results for 69 patients at one site for three assessment tools, administered by professionals in three

disciplines at admission and at discharge. Adherence data were drawn from the records in the clinical database, and the reasons were obtained from the therapists' data logs.

Adherence (at both time points) to the three tools varied from 75% to 97%. The occupational therapists were unable to administer the Box and Block Test (BBT) on the affected side for 25% of the patients at admission and for 16% at discharge, mainly because of a patient-related factor: poor motor recovery. However, the BBT was administered in most cases (97% at admission) on the less-affected side, demonstrating high adherence, although cognitive impairments or communication skills (patient-related factors) limited its administration in a few cases.

The main reasons given for not applying the HADS (14%), which was administered by a neuropsychologist at admission, were poor patient communication skills, cognitive problems, and logistical problems. Missing data for the HADS were 3% at admission, rising to 16% at discharge. The BBS was not administered to about 7% of patients at admission and 14% at discharge for measurement protocol reasons: either the patients were not treated by a physical therapist or they had a maximal score at admission and were not re-evaluated at discharge. Unexplained missing results (at admission and discharge) for the BBT and BBS occurred in 1% or fewer of the patients.

[Table 2](#) presents the adherence results and reasons for the lack of results for the assessment tools illustrated in [Figure 2](#), as well as for the Bells Test, for the cohort of 69 patients. The physicians used the MoCA with 71% of the patients, and the main reasons for the lack of results were patient related (12%); the amount of missing data was high at 17%. Among the functional mobility and balance assessment tools, the 6MWT had the lowest adherence (55%), explained in part by patient-related reasons at admission (36%). Adherence remained low at discharge (65%), 17% for patient-related reasons and 12% for reasons of protocol or logistics. Among the upper extremity performance assessment tools, the Nine-Hole Peg Test (NHPT) on the affected side had the lowest adherence (64%) at admission for patient-related reasons (poor motor control), and adherence remained low (68%) at discharge for the same reasons. Except for the MoCA, missing data were rare, ranging from 0% to 3% at admission and 0% to 16% at discharge.

DISCUSSION

In the first part of this study, a consensus SAT and associated clinical database were developed and implemented in three SRUs. The SAT focused on the sensorimotor assessment of patients admitted for inpatient rehabilitation post-stroke. Assembled collaboratively by stroke rehabilitation clinicians, researchers, and SRU managers, it represented a consensus recommendation

Figure 1 Percentage of adherence to the assessment tools, based on the results in the clinical database at admission and discharge: (a) implemented at all three sites and (b) either not implemented at one site or not performed at admission or discharge at all sites. In Figure 1a, adherence was measured in 264 patients; in Figure 1b, the number of patients is indicated on the x-axis for each assessment tool.

Sh-P = shoulder pain; CMSA-II = Chedoke-McMaster Stroke Assessment Impairment Inventory; 10mWT-comfortable = 10-metre comfortable walk test; 10mWT-fast = 10-metre fast walk test; 6MWT = 6-minute walk test; BBS = Berg Balance Scale; CAHAI (V9) = Chedoke Arm and Hand Activity Inventory, version 9; BBT-affected = Box and Block Test – affected side; BBT-less affected = Box and Block Test – less-affected side; NHPT-affected = Nine-Hole Peg Test – affected side; NHPT-less affected = Nine-Hole Peg Test – less-affected side; MoCA = Montreal Cognitive Assessment; HADS = Hospital Anxiety and Depression Scale; CMSA-AI = Chedoke-McMaster Stroke Assessment Activity Inventory.

of the minimum number of assessment tools required to screen and evaluate patients to ensure their safety, provide indications for the therapeutic approach, and assess patients' progression and outcomes.

The implemented SAT consisted of 21 assessment tools, 14 of which targeted the motor domain and particularly the sensorimotor impairments and function of the upper and lower extremities. In comparison, other SATs included 7 tools²⁹ and 1 tool,³³ respectively, in the motor domain. Evaluations in the communication and cognitive domains, as well as dysphagia, visual neglect, and mood screening tools, were included to promote safety and to provide insight into therapy responses.

Although there was variability in the administration process of some assessment tools at both admission and

discharge in the individual SRUs, most tools were implemented in daily practice at all three SRUs. The feasibility of SAT implementation in daily practice was objectively confirmed by clinician adherence measures, based on data from the clinical database for a subset of assessment tools, to be administered at admission and discharge from inpatient rehabilitation. We chose not to report on the other tools because they evaluated multiple muscles or sensory sites (muscle testing, MAS, EmNSA) and were thus more complex to analyze and report. Others were implemented later at one site (hand dynamometry) or not implemented at all sites (Swallowing Qualitative Scale, Bells Test) because they were administered by professionals other than occupational and physical therapists.

Figure 2 Adherence and the reasons for lack of assessment results for three assessment tools.

BBT-affected = Box and Block Test – affected side; BBT-less affected = Box and Block Test – less-affected side; HADS = Hospital Anxiety and Depression Scale; BBS = Berg Balance Scale.

Table 2 Adherence and Lack of Assessment Results at One Site ($n = 69$)

Assessment tools	%							
	Patients assessed		Assessment not applicable because of patient-related factors		Assessment not administered for measurement protocol or logistical reasons		Missing data	
	A	D	A	D	A	D	A	D
Body functions and structures								
MoCA	71	—	12	—	0	—	17	—
HADS	84	71	13	6	0	7	3	16
Bells Test	90	—	9	—	0	—	1	—
CMSA-II	84	—	7	—	7	—	2	—
Shoulder pain	93	87	0	0	7	12	0	1
Activities: functional mobility and balance								
FIM	100	91	0	0	0	0	0	9
CMSA-AI	91	86	2	1	7	13	0	0
BBS	91	84	2	1	7	15	0	0
10mWT-comfortable	78	78	14	7	7	12	0	3
10mWT-fast	68	74	25	10	7	12	0	4
6MWT	55	65	36	17	7	12	2	6
Activities: upper extremity performance								
BBT-affected	75	80	25	16	0	3	0	1
BBT-less affected	97	93	3	3	0	3	0	1
NHPT-affected	64	68	36	28	0	3	0	1
NHPT-less affected	96	90	1	3	0	4	3	3
CAHAI (V9)	81	75	19	10	0	12	0	3

A = admission; D = discharge; MoCA = Montreal Cognitive Assessment; HADS = Hospital Anxiety and Depression Scale; CMSA-II = Chedoke-McMaster Stroke Assessment Impairment Inventory; CMSA-AI = Chedoke-McMaster Stroke Assessment Activity Inventory; BBS = Berg Balance Scale; 10mWT-Comfortable = 10-metre comfortable walk test; 10mWT-Fast = 10-metre fast walk test; 6MWT = 6-minute walk test; BBT-Affected = Box and Block Test – affected side; BBT-less Affected = Box and Block Test – less-affected side; NHPT-Affected = Nine-Hole Peg Test – affected side; NHPT-less affected = Nine-Hole Peg Test – less-affected side; CAHAI (V9) = Chedoke Arm and Hand Activity Inventory, version 9.

Mean adherence rates for performance measures such as the 10mWT-fast, 6MWT, CAHAI (V9), and NHPT at admission were less than 60%; however, analyzing the reasons for less than 100% adherence for the different assessments made at one site (discussed next) clearly indicated that the cause was usually patient-related factors or protocol and logistical problems rather than clinicians' non-compliance with the SAT. More important, the clinicians have continued to use the SAT and clinical database since completion of the implementation phase. One site carried out a comparative study of cohorts of patients in two successive years (2014 and 2015),⁵⁴ whereas the SAT and REDCap database contributed to a second site's Stroke Services Distinction award from Accreditation Canada (2017–2022), thereby indicating its sustainable integration into daily practice.

The multifaceted approach to developing and implementing the SAT most likely ensured its implementation – notably, favourable clinician attitudes and clinicians' experience with administering assessment tools;^{5,16,30} the participation of the SRU managers, clinical champions, and clinicians in consensus-type meetings with the researchers during development; and ratification of the SAT by the three SRU rehabilitation teams.^{19–24,29} Other essential elements were the clinical champions and their interactions with the clinicians,^{24,26} preparing a very detailed procedures manual^{25,29,33} for each assessment tool, a familiarization period, ongoing reminders and feedback,²⁵ and the regular collection of clinicians' data logs to ensure timely entry of assessment results. More important, this pragmatic study respected the care cultures of the sites and refrained from imposing too many changes on their usual practice.^{23,25}

Qualitative evidence from community of practice meetings indicated that both researchers and clinicians perceived the process of developing and implementing the SAT to have improved collaboration and promoted a fruitful, bilateral exchange of knowledge for the benefit of the patients. The process also likely fostered a shared understanding of patient status and enabled us to better identify problems, plan treatment, and monitor progress and decision making as well as improve communication between inpatient and outpatient services.¹⁷

This study reports new and important information on clinician adherence to administering individual assessment tools in an SAT. These adherence results are based on objective data extracted from a clinical database as opposed to self-reported use of assessment tools.^{15,18,19,21,27} To our knowledge, only two studies, based on the same SAT developed to assess the continuum of stroke care,^{25,29} have reported objective results of adhering to an SAT implementation. In contrast with the present study, however, they provided adherence data on the suite of assessment tools in the SAT, not on the individual assessment tools. They also did not investigate the reasons for poorer adherence.

For example, in the present study, the overall (admission and discharge) adherence for the various assessment tools in the SAT ranged from 28% to 99%. Although there are no comparative data for individual tools, Bland and colleagues²⁹ reported a median adherence of 52%–88% across all settings and professional disciplines for the suite of tools in their SAT. A second report, based on data from the same SAT,²⁵ found that adherence for the battery of assessment tools administered by the physical therapists fluctuated each month from approximately 78% to approximately 94%; administering the discharge assessments proved the most difficult.

The high adherence for the FIM, shoulder pain, and BBS assessment tools in the present study is not unexpected because the protocol emphasized completing the FIM assessment within 72 hours of admission, and the BBS and shoulder pain assessments were already being used by the rehabilitation teams.³⁰ As previously reported for the suite of tools in another SAT,²⁹ adherence to individual tools in the present study tended to be higher at admission than at discharge.

We compared adherence to the assessment tools administered by the occupational and physical therapists with their self-reported use, as indicated in their responses to the following survey question in a previous study:³⁰ “In the last three months, in what percentage of patients under your care have you used the following assessment tool?” The occupational therapists (22 out of 24) reported using the BBT 66% (SD 28%) and the NHPT 71% (SD 23%) of the time, and the physiotherapists (25 out of 26) reported using the BBS 100% (SD 2%) and the 10mWT 78% (SD 31%) of the time. These self-reports are higher than the adherence measured in the present study (BBT, 53%, and NHPT, 48% on the affected side; BBS, 88%, and 10mWT, 64%). Thus, these comparisons support the widely held notion that such self-reports²⁰ overestimate actual administration of assessment tools.

The mean level of adherence ($n = 3$ sites) for the CAHAI (V9) was the lowest for all the assessment tools. Most occupational therapists did not regularly use it before taking part in this study because they perceived it as being complex to score, and they showed some resistance to implementing it at two of the sites.³⁰ It is intriguing, however, that at the one site for which we reported reasons for lack of adherence (see “Part two” section), adherence to CAHAI (V9) administration at admission and discharge was 81% and 75%, respectively. The occupational therapists did not administer the test at either admission or discharge to 19% and 10% of the patients, respectively, because of patient-related factors, whereas at discharge, logistical and protocol factors explained 12% of the lack of results, and missing data explained the remaining 3%.

Several explanations are likely for the much higher reported adherence to administering the CAHAI (V9) at this

one site (see Table 2) compared with the mean value for the three sites (see Figure 1). One explanation is that the number of patients included in the study at this site represented only 26% of the total sample size, and data from this site had less impact on the mean than the data from the combined number of patients from the two other sites. Therapists' acceptance of this assessment tool varied among sites, as stated earlier, as did the severity of upper limb deficits among the patients. Therapist behaviour was also likely influenced by different team dynamics, managerial input, and monitoring the therapists' reasons for missing assessment values at one site.

The order of magnitude of adherence results for the 10mWT and the 6MWT is similar when the mean of the three sites (shown in Figure 1) is compared with the values from one site (see Table 2); this suggests that patient-related factors prevented higher adherence levels. However, the lower mean adherence levels for the BBT and NHPT on the less-affected sides, compared with adherence at the one site, point to factors other than patient-related or protocol and logistical reasons. In our classification, the lack of results would be considered missing data. These low mean adherence levels, along with the higher levels for the CAHAI (V9), suggest that therapists' compliance was an important factor.

The results in the second part of this study provide new information that helps unravel the underpinnings of adherence to specific assessment tools. The clinician-inspired classification (patient-related factors, protocol or logistical factors, and missing data) used to examine the reasons for non-adherence does not include an exhaustive list of reasons and may oversimplify the issue. Also, it relates to adherence measures in the context of SAT implementation by clinicians at one site working in the same environment. Nevertheless, this classification was able to pinpoint the import of different reasons for non-adherence among the tools and provides the impetus for future studies on non-adherence.

Using this classification, it was possible to show that, except for the MoCA and HADS, the missing data in the cohort of patients ($n = 69$) at one site ranged from 0% to 3% at admission and from 0% to 9% at discharge (see Table 2). This means that the clinicians would have demonstrated almost 100% adherence had they not encountered patient-related or protocol and logistical impediments. The MoCA had the highest percentage of missing data (17%), in part because the physicians did not always take the time to administer it, and the neuropsychologists encountered protocol and logistical problems in administering the HADS at discharge, resulting in 16% missing data.

Patient-related factors (mainly poor motor control) explained a particularly high percentage (25%–36%) of missing results at admission for four performance measures: the 10mWT–fast, 6MWT, BBT, and NHPT on the

affected side. At discharge, 10%–28% of the patients were still deemed to be unable to complete these assessments. These floor effects not only result in lower adherence values but also raise the question of whether these assessment tools should be included in the SAT at admission. However, the fact that some patients could not complete these tests provides valuable information about important patient mobility and dexterity functions.

Thus, when documenting adherence, factors such as the floor or ceiling effects of the assessment tools; cognitive, language, or motor impairments; measurement protocol; patient's missed evaluation sessions; and systemic organizational factors must be considered. They may differentially affect adherence to specific assessment tools. More important, when we analyzed the reasons for the missing assessment results at one site, it became clear that clinicians generally complied with the SAT and that factors other than their compliance contributed to adherence levels of less than 100%.

This study had several limitations. First, the SAT targeted sensorimotor rehabilitation only in the inpatient intensive rehabilitation phase (the 6-month follow-up assessment was not implemented); however, it may provide a suite to which assessment tools for cognitive and communication skills can be added to provide a more complete SAT. Second, the adherence levels were compiled in the early implementation period of the SAT, over a relatively short period and with a limited number of patients; future studies will determine whether these adherence levels change as the teams gain more experience. Third, the clinician-inspired classification used to examine the reasons for non-adherence does not include an exhaustive list of reasons and may oversimplify the issue; it may also not be generalizable to all sites.

CONCLUSIONS

A consensus SAT was developed and implemented in three SRUs, located in three cities associated with researchers of the Sensorimotor Rehabilitation Research Team, as an essential step in creating a multicenter CRP. The SAT implementation was well accepted by the clinicians, and it was shown to be feasible in daily practice using objective measures of clinician adherence. Its continued use in the three SRUs beyond this study's timeframe suggests that it may be transposable to other SRUs that provide inpatient rehabilitation after stroke.

Being mindful of the clinical investment in this assessment process, future studies will determine whether the number of assessment tools can be reduced to streamline the process. Moreover, as documented at one site, lower adherence rates may be related to patient, protocol, and logistical reasons rather than to clinician compliance. The SAT and clinical database provide the foundation for future quality improvement projects in the SRUs individually or collectively as well as a database for research

studies, and they favour a best-practice approach to rehabilitative care and clinician involvement in research projects.

KEY MESSAGES

What is already known on this topic

Administering standardized assessments, a cornerstone of best-practice recommendations for stroke rehabilitation, remains a challenge for many clinicians in daily practice. To date, information on administering assessment tools has been gleaned from self-reports of use, whereas objective information on actual adherence, based on objective data, has been lacking.

What this study adds

This study reports the development and implementation of an SAT for sensorimotor assessment of patients admitted for post-stroke inpatient rehabilitation. It provides new, objective information on adherence to individual assessment tools in the SAT. It is the first study to examine the reasons for missing assessment results, and it demonstrates the need to consider various patient, system, and assessment tool characteristics in determining adherence levels.

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APPENDIX: STANDARDIZED ASSESSMENT TOOLKIT

The standardized assessment toolkit (SAT) that we developed consists of 25 assessment tools, focused mainly on the motor domain and organized according to the *International Classification of Functioning, Disability and Health* classification³² of body functions and structures (impairments), activities (functional mobility and balance, upper extremity performance, and communication), and participation (leisure and quality of life). Some tools were included to screen for cognitive impairments (Montreal Cognitive Assessment [MoCA]), visual neglect (Bells Test), anxiety and depression (Hospital Anxiety and Depression Scale [HADS]), and the presence (yes or no) and type of communication impairments. The Chedoke-McMaster Stroke Assessment Impairment Inventory (CMSA-II) was included to inform on the severity of sensorimotor impairments and thereby assist in formulating individualized treatment plans. Other tools were used to assess progression with clinical care and rehabilitation and to provide patient outcomes. All domains (motor, cognitive, and language) of the FIM were assessed. All but three of the assessment tools (MoCA, Bells Test, and CMSA-II) were to be administered at both admission and discharge. [Table A.1](#) lists the assessment tools in the SAT.

Although cognitive and language domains were not the focus of this SAT, the MoCA and communication screening tools, as well as the HADS to screen for anxiety and depression, were included given the impact of these impairments on motor recovery.⁵³ In addition, these tools provide information that might help explain the recovery profile of individual patients. Shoulder pain, initially assessed by noting its presence (yes or no), was implemented later using the CMSA-II Stage of Shoulder Pain³⁸ to provide a more detailed and standardized evaluation. Further details on the reliability, validity, and responsiveness of the assessment tools are available on the corresponding websites.^{12–14} At discharge from inpatient

rehabilitation, an opinion on driving ability was included in the Participation section.

PROCEDURES MANUAL

The purpose and detailed instructions for the administration and recording of each assessment tool were outlined in a procedures manual. For example, the measurement of comfortable walking speed over 10 metres (10mWT) at admission was to be assessed when a patient could walk with the physical assistance of one or two persons. If this was not possible, the assessment of gait speed was recorded as “not applicable” and assessed later, once the patient could meet the requirements. The 6MWT, however, required that the patient walk without physical assistance other than using walking aids. The date when the respective tests were carried out was noted.

For all walking tests, the type of walking aid, use of an ankle-foot orthosis or a sling for the upper extremity, and degree of independence were to be noted. For assessments of the upper extremity, when patients lacked sufficient motor control to perform, for example, the gross and fine manual dexterity tests, clinicians were directed to note “not applicable” in the data log, and these tests were considered not completed at admission. These tests were then administered when clinicians deemed the patient was able to complete them.

For all assessments, if a patient attained a maximal score at the admission assessment, the test was not repeated at discharge unless deterioration was noted over the rehabilitation period. Clinicians were required to administer the FIM within 72 hours of admission to the rehabilitation centre and to complete the other assessments within the first week of admission. Discharge assessments were made at discharge from intensive inpatient rehabilitation. Clinicians could, of course, administer tools other than those in the toolkit.

Table A.1 Standardized Assessment Toolkit for Sensorimotor Rehabilitation

Assessment tool	Purpose		When to be administered		
	Screening	Assessment	A	D	6-mo follow-up
Body functions and structures					
Hospital Anxiety and Depression Scale ^{35*}	Anxiety and depression		x	x	x
Montreal Cognitive Assessment ³⁶	Cognitive impairment		x		
Bells Test ³⁷	Visual neglect		x		
Chedoke-McMaster Stroke Assessment Impairment Inventory ³⁸	Physical impairment; stage of arm, hand, leg, and foot		x		
Swallowing Qualitative Scale		Dysphagia	x	x	
Shoulder pain ^{†‡} (yes or no)		Shoulder pain	x	x	x
Modified Ashworth Scale ³⁹		Spasticity (wrist and fingers, flexors and ankle plantar flexors)	x	x	x
Erasmus MC modifications to the (revised) Nottingham Sensory Assessment ⁴⁰		Light touch (hand and fingers, dorsal aspect of the foot); proprioception (thumb, first toe)	x	x	
Daniels and Worthingham muscle testing ⁴¹		Muscle strength (shoulder and elbow flexors, wrist extensors, hip flexors, knee extensors, ankle dorsal flexors)	x	x	x
Hand dynamometry ⁴²		Grip strength	x	x	x
Activities: functional mobility and balance					
FIM ⁴³		Physical and cognitive disabilities	x	x	
Chedoke-McMaster Stroke Assessment Activity Inventory ³⁸		Disability (gross motor function index, walking index)	x	x	
10-metre walk test (comfortable and fast) ⁴⁴		Functional mobility, gait speed	x	x	x
6-minute walk test ⁴⁵		Walking capacity, endurance	x	x	x
Berg Balance Scale ⁴⁶		Balance	x	x	
Activities: upper extremity performance					
Chedoke Arm and Hand Activity Inventory (version 9) ⁴⁷		Arm and hand function	x	x	
Box and Block Test ⁴⁸		Unilateral gross manual dexterity	x	x	x
Nine-Hole Peg Test ⁴⁹		Fine manual dexterity	x	x	x
Activities: communication [‡]					
Communication (impaired: yes/no)		Communication disability	x	x	
Type of communication disorder: aphasia, cognitive-linguistic or dysarthria		Communication disability	x	x	
Oral and writing expression and comprehension (impaired: yes or no)		Communication disability	x	x	
Participation					
Qualitative information on driving capacity		Driving capacity at the end of rehabilitation	x		x
Post-Stroke Checklist ⁵⁰	Identification of long-term problems in stroke survivors				x
Reintegration to Normal Living ⁵¹		Participation: activities of daily living, social relationships			x
EuroQuol-5D ⁵²		Participation, body structure, body function			x

Note: The Participation section of the table provides measures not yet implemented.

*Copyrighted; available for purchase (go to <https://www.gi-assessment.co.uk/products/hospital-anxiety-and-depression-scale-hads/>).

†Chedoke-McMaster Stroke Assessment “Stage of Shoulder Pain” was implemented later to standardize shoulder pain evaluation.

‡Implemented at two sites.

A = admission; D = discharge.