International Journal of
Physical Medicine & Rehabilitation

Kinney et al., Int J Phys Med Rehabil 2013, 1:8
DOI: 10.4172/2329-9096.1000166

Research Article Open Access

Standardization of Interdisciplinary Clinical Practice and Assessment in Stroke Rehabilitation

Carolyn L Kinney, Megan C Eikenberry, Stephen F Noll, James Tompkins and Joseph Verheijde*

Department of Physical Medicine and Rehabilitation, Mayo Clinic, 13400 E Shea Boulevard, Scottsdale, AZ, 85259, USA

Abstract

Medical practice has increasingly focused on providing evidence-based interventions. We describe a process to standardize the interdisciplinary assessment of patients presenting for rehabilitation after stroke in a single academic medical center. Multiple assessment tools and outcome measures were reviewed for validity, specificity for stroke population, ease of administration, and utility in research. Interdisciplinary participation in the review process facilitated compliance with new documentation requirements. Measurements were incorporated into the electronic medical record from which an interdisciplinary database was developed for research applications. Clinically, the electronic medical record documentation is accessible to all healthcare providers in our medical system. Objective data from the use of quantifiable outcome measures facilitates clinical decision-making, more appropriate goal setting, and provides opportunities to optimize the value of the care delivered. It creates opportunities for best practices in the rehabilitation of patients with stroke and contributes to the provision of cost-effective patient care. Quantifiable measures also result in improved patient and caregiver understanding of patient impairment and progress, and as we observed, increased patient motivation in therapies. From a research perspective, having an interdisciplinary database in place enhances opportunities for future collaborative and integrated clinical studies. We posit that broad implementation of the care strategy outlined, and the database resulting from it, will also facilitate multicenter clinical research opportunities which will ultimately benefit patients with stroke.

Keywords: Stroke rehabilitation; REDCap; StrokEDGE task force

Introduction

Providing evidence-based interventions has become an integral part of stroke rehabilitation. Multiple assessment tools have been developed across all rehabilitation disciplines to objectively quantify impairments and track improvements. The routine use of outcome measures can enhance the patient evaluation process and clinical decision making. It also assists in developing a plan of care and predicting clinical outcomes [1-3]. These practice enhancements are broadly correlated with improved treatment outcomes, greater cost-efficiency of care, and enhanced opportunities for interdisciplinary and multi-center clinical research [4]. "Comprehensive rehabilitation of patients requires multiple health care professionals (e.g. physician, psychologist, occupational therapist, physiotherapist, nurse, social worker, etc.), who build a team to bring the different professions, assessments and evaluations together to obtain a holistic view of the patients' problems" [5]. The shared decision-making of the interdisciplinary team concept, as opposed to a multidisciplinary team approach, is believed to be more suitable to meet this goal. The term interdisciplinary implies that teams regularly discuss and collaboratively set treatment goals and make it a joint responsibility to integrate separate discipline approaches into a single treatment plan [5]. Conversely, within multidisciplinary teams, professionals enjoy high levels of autonomy and create discipline specific goals and treatment plans for the patient [5]. Medical centers that treat patients with stroke offer an array of rehabilitation interventions, the efficacy of which has been demonstrated in only a few studies, using different outcome measurement tools. Many studies examining interventions for people with stroke are limited methodologically by poor outcome measure selection [6,7]. Practice guidelines have also provided comprehensive reviews and broad recommendations for the use of assessment measures [8,9]. Nonetheless, rehabilitation therapists do not routinely use validated assessment or outcome measures, despite encouragement to incorporate them into routine practice [10]. Frequently cited barriers to clinical use of outcome measures include time constraints, lack of equipment, institution culture and unfamiliarity with assessment tools and their benefits [1,11]. Furthermore, the large number of validated tools hinders consistency of practice even within a single institution.

In order to assure evidence-based best practices for the medical and functional assessment of patients with stroke, in a 7-bed acute inpatient rehabilitation facility, and within an academic medical center (Table 1), we convened an interdisciplinary "Stroke Rehabilitation Standardization" (SRS) team. The team's charter was to critically evaluate stroke assessment and outcome measures within the World Health Organization's International Classification of Functioning, Disability and Health (ICF) framework [12-20]. This structure assured that the interdisciplinary team assessed the full spectrum of function from individual impairment to participation in society. There were four objectives for this project: (1) to identify validated assessment tools and outcome measures across all disciplines, (2) to incorporate the selected tools and measures into our electronic medical record (EMR), (3) to create a decision tree to guide clinicians with evaluation and treatment interventions for patients with stroke, and (4) to develop

Rehabilitation Team (7 Bed Inpatient Rehabilitation Facility)	
Clinicians:	Number
Physical Therapy (PT and PTA)	23
Occupational Therapy (OT and COTA)	17
Speech and Language Pathology	4
Neuropsychology	2
Therapeutic Recreation	1
Physical Medicine and Rehabilitation	7

Table 1: Inpatient Rehabilitation Team.

***Corresponding author:** Joseph Verheijde, Department of Physical Medicine and Rehabilitation, Mayo Clinic, 13400 E Shea Boulevard, Scottsdale, AZ, 85259, USA, Tel: 480 301 8450; E-mail: jverheijde@mayo.edu

Received September 15, 2013; **Accepted** November 25, 2013; **Published** November 29, 2013

Citation: Kinney CL, Eikenberry MC, Noll SF, Tompkins J, Verheijde J (2013) The Standardization of Interdisciplinary Clinical Practice and Assessment in Stroke Rehabilitation. Int J Phys Med Rehabil 1: 166. doi:10.4172/2329-9096.1000166

a database for ongoing quality improvement assessment and potential research initiatives. It was anticipated that meeting these objectives would also contribute to the promotion of evidence-based practices in neurorehabilitation throughout the continuum of care at our institution, i.e., acute medical (neuro-critical care, specialized stroke unit), acute inpatient rehabilitation, and outpatient practices.

Methods

We established an interdisciplinary SRS team, consisting of clinicians in physical, occupational, speech and recreational therapies, neuropsychology, and Physical Medicine and Rehabilitation, as well as ad hoc members related to database construction and software adaptation. The team met one to two times monthly over the course of 16 months to implement the project charter (Figure 1). The ICF categories of body structures and body function, activities and participation were used as a framework for stratifying assessment measures, with the goal of including measures for all treatment domains at each ICF level, if appropriate (Figure 2) [21]. Potential assessment measures were identified through several sources, including the APTA StrokEDGE task force recommendations [22], the Strok Engine Assess database from McGill University [23], and a published comprehensive literature search [8]. Qualities deemed desirable for inclusion in our standard assessments included: 1) statistical validity, 2) ease of administration, 3)clinical usefulness for stroke, 4) application in research, 5) nominal (versus descriptive) measurements and 6) low or no added expense for implementation. Assessment measures reviewed are listed in Table 2.

The SRS team systematically reviewed each assessment instrument,

Figure 1: Time Line- Mayo Clinic Standardization committee.

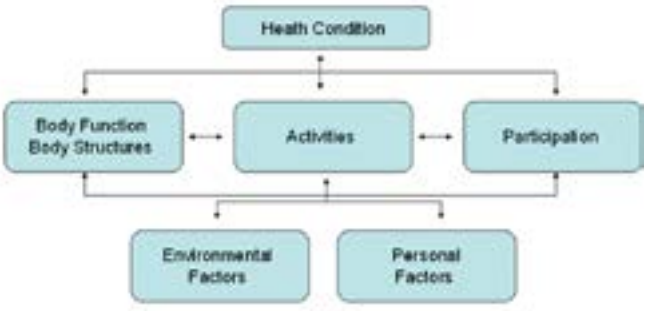

Figure 2: International Classification of Functioning Framework (ICF) [21].

Reviewed Outcome Measures		
Body Structures and Functions		
Global Function	**Voice and Speech Functions**	**Motor and Sensory Related Functions**
NIH Stroke Scale	Boston Naming Test Cognitive Linguistic Quick Test Functional Communication Measures Montreal cognitive Assessment	Ashworth Scale Chedoke McMaster Stroke Assessment Dynamometry Dynavison Assessment Fugl-Meyer Motor Subscores Orpington Prognostic Scale Motor Free Perception Test Rivermead Motor Assessment Stroke Rehabilitation Assessment of Movement Limb Subscales
Activity		
Upper Extremity Use and Activities of Daily Living	**Mobility**	**Learning & Communication**
9 Hole peg Test Action Research Arm Test Barthel Index Box & Blocks Test Functional Independence Measure	10 Meter Walk test 5 Time Sit Stand Test 6 Minute Walk Test Berg Balance Test Dynamic Gait Index Postural Assessment Scale for stroke Patients Sensory Organization Test Timed Up and Go Trunk Control Test Tinetti POMA Trunk Impairment Scale	Cognitive Assessment of Minnesota Cognitive Performance Test Lowenstein OT Cognitive Assessment Montreal Cognitive Assessment Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) Rivermead Behavioral Memory Test
Participation		
Beck Depression Inventory Center for Epidemiologic Studies of Depression Geriatric Depression Scale Goal Attainment Scale Hamilton Depression Scale Modified Rankin Scale Patient Health Questionnaire 9-item Depression Scale SF-12 Stroke- Adapted Sickness Impact scale Stroke Impact scale Woodcock-Johnson Tests of Cognitive Abilities		

Table 2: Assessments and outcome measures reviewed.

confirming the validity of the tool and the integrity of the resources supporting its use. The team discussed clinical applications related to our stroke patient population, identifying strengths and weaknesses, such as "floor" or "ceiling" effects [24]. We reviewed the prevalence of each assessment tool in the neurorehabilitation literature and considered the availability of stroke specific psychometric properties such as reliability, cut off scores, minimal detectable change, and minimal clinically important difference values to assist clinicians with score interpretation [1]. From a practical perspective, we anticipated some challenges associated with incorporating each recommended instrument into our electronic medical record (EMR) and interdisciplinary database. These potential challenges included: provider time necessary to administer each test, the possibility of having excessive, irrelevant, and/or uninformative details, the clinical feasibility to implement in our setting, and the ability to audit clinician adherence to the identified core measures. In addition, we evaluated the financial impact of acquiring assessment tools, license subscriptions, and any related equipment.

Chosen assessments were formatted into the EMR at our institution, with the assistance of information technology consultants. Where possible, we designed electronic forms that could be completed and scored, if indicated, directly in the EMR. We planned for all assessments to be grouped under one easily located form set in the patient's record.

We utilized the software program REDCap (Research Electronic Data Capture) to create a database for the SRS information. Study data were collected and managed using REDCap electronic data capture tools [25,26] hosted at our institution. REDCap is "a secure, web-based application designed to support data capture for research studies, providing: 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for importing data from external sources" [25].

Project Design

Forty-eight assessments or outcome measures were reviewed by the SRS team and 20 were selected as part of the SRS core set. The list of selected measures is outlined in Table 3. The SRS team set out to select no more than three assessments per therapy discipline within each ICF level. With many assessment tools fitting the selection criteria, practical decisions prevailed in certain cases, such as whether the department owned the necessary equipment and whether the clinicians had broad experience with using the tool. The SRS team also limited the number of assessments chosen within each discipline per ICF category to reduce redundancy among chosen measure in terms of the constructs assessed. For instance, several depression assessments were reviewed in the ICF category for participation; however the team included only two in the final EMR. Tables 4-6 summarize the selected assessments and outcome measures with the rationale for inclusion. The SRS team recognized the dynamic nature of the subject matter and decision making process. Therefore, the team committed to a later review and revision of the list, as the clinicians gained experience with using the assessment tools, both clinically and for research purposes. For clinical application of the process, the SRS team agreed on two initial assessment collection points: (1) admission to acute inpatient rehabilitation and (2) discharge from acute inpatient rehabilitation. Each assessment was to be completed within a 72 hour time window of admission and discharge.

Selected Stroke Assessments		
Body Structures/Functions	Activity	Participation
DPAB Functional Communication Measures Handheld Dynamometry NIHSS Montreal Cognitive Assessment STREAM	10 Meter Walk Test 6 Minute Walk Test 9 Hole Peg Test Action Research Arm Test Battery for the Assessment of Neuropsychological Status Berg Balance scale Box 7 Blocks Test Dynamic Gait index Functional Independence Measure Timed Up and Go	Modified Rankin SF-12 Stroke Impact Scale Beck Depression Inventory

Table 3: Selected standardized stroke assessments and outcome measures.

The forms for each assessment measure were built into the EMR, grouped under an "Interdisciplinary Stroke Rehabilitation Reference Form" heading for easy tracking. For some assessments, such as the Stroke Rehabilitation Assessment of Movement and the Montreal Cognitive Assessment, the measure was completed in paper format with the summative scores later entered into the EMR stroke reference form. These assessments require patients to input responses, including drawing, and do not lend themselves to direct EMR entry.

The REDCap database was developed capturing only the summated scores for the chosen assessment measures. Data was captured both directly from the EMR, as well as manually from self-report patient questionnaires after scoring, such as the Short Form-12.

Results

After finalizing the list of assessment measures, the new process for rehabilitation evaluation was presented to the rehabilitation therapy staff. We recognized the value of clinician autonomy and a patient-centered evaluation process, and therefore we did not limit the use of the many assessment tools and outcome measures available to clinicians. However, to reduce variability and facilitate consistency, it was required, as a minimum, that all clinicians perform their discipline-specific core set of assessments proposed by the SRS team. The majority of the clinicians were unfamiliar with at least some of the chosen instruments. Multiple educational sessions provided the clinicians with information on the justification rationale for the selected assessments, how to administer the tests, proper procedures for scoring each assessment, and instruction on how to complete the scoring form in the EMR. Clinicians also completed the certification training required for some measures, such as the National Institute of Health Stroke Scale (NIHSS), the Functional Independence Measure (FIM), and the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS). Additional training to further improve standardization among staff included peer mentoring and video case examples.

A decision tree was created to assist physical therapy clinicians with standardized assessment selection. In some cases, floor effects limited the ability of an assessment to be appropriately completed; therefore, the decision tree assisted clinicians unfamiliar with these limitations. For example, if a patient requires maximal assistance to ambulate, it would be inappropriate to perform a 6 minute walk test, as a condition of this test requires patients to ambulate without physical assistance (Figure 3).

The SRS team continued to meet regularly to monitor staff adherence to the SRS project objectives, review any missing data and analyze practical challenges associated with the project's implementation. In the early phases of the implementation, staff adherence with assessing all components of the selected assessments was 50%. With additional feedback and education to the rehabilitation team, the adherence to completion of all requisite data fields improved to 78%. Based on initial feedback after trial implementation of the process, an important revision was made to the EMR summary form. Despite efforts to avoid

Selected Stroke Outcome Measures		
Assessment	**Description and Rationale for Inclusion**	**Discipline**
ICF Category: Body Structures/Function		
National Institute of Health Stroke Scale	Quantitative measure of neurological deficit post stroke. Assists with stratification of stroke severity [28]. Valid and reliable in acute stroke population [29,30]. Recommended by APTA StrokEDGE for clinical and research use [7].	MD-PMR
Stroke Rehabilitation Assessment of Movement	Designed for use by physical therapists to provide a quantitative evaluation of motor functioning of the UE and LE after stroke. Reliable and valid in stroke with established stroke MDC values [31-33]. APTA StrokEDGE recommends use in the acute rehabilitation setting and research [7]. Moderately correlated with the Fugl-Meyer but faster to complete [34].	PT
Dynavision Performance Assessment Battery	Uses a light board designed to test and train visual scanning, visual attention and visual-motor reaction time [35]. Equipment readily available within our clinic. Reliable and may predict driving ability in individuals with brain injury [31].	OT
Handheld Dynamometry	Excellent test-retest reliability in people with neurologic impairment [36]. Age matched norms available [36].	OT
Montreal Cognitive Assessment	Cognition screen. Reliable and valid in patients with stroke [37]. Chosen as a screen for mild cognitive impairment secondary to established cut off scores [38].	OT
Functional Communication Measures	Series of 8 measures describing aspects of functional communication. Endorsed by National Quality Forum. The FCMs are a component of the American Speech-Language Hearing Association National Outcome Measurement System data collection and reporting tool [27].	ST/OT

Table 4: Selected Outcome Measures-ICF Category: Body Structures/Function.

Selected Stroke Outcome Measures		
Assessment	**Description and Rationale for Inclusion**	**Discipline**
ICF Category: Activities		
Functional Independence Measure	Required in Inpatient Rehabilitation Facilities. Valid in stroke population [39]. MCID stroke values established [40]. Highly recommended for use in acute rehabilitation and research by APTA StrokEDGE [7].	PT, OT, ST, RN
10 Meter Walk Test	Brief gait speed assessment. Reliable and valid in stroke population [41,42]. Established stroke specific MCID values [43]. Differentiates between household and community ambulatory [44]. Strongly recommended by APTA StrokEDGE for use in inpatient rehabilitation and research [7].	PT
6 Minute Walk Test	Assesses distance walked over 6 minutes as a sub-maximal test of aerobic capacity. Reliable and valid in acute stroke [45,46]. MCID stroke values available [43]. Strongly recommended by the APTA StrokEDGE [7].	PT
Berg Balance Scale	Assesses non vestibular balance impairment and functional mobility. Reliable and valid in patients with stroke [47,48]. Chosen as a balance measure because of established MDC values and ease of administration clinically [49]. Recommended for use in acute rehabilitation and research by APTA StrokEDGE [7].	PT
Dynamic Gait Index	Measures gait stability and balance in patients with and without vestibular disorders. Reliable and valid in stroke population with established MDC values [50,51]. Chosen to capture gait stability impairments in higher level patients. Highly recommended for use in acute rehabilitation and research by APTA StrokEDGE [7].	PT
Timed Up and Go	Assesses mobility, balance, walking ability, and fall risk. Reliable and valid in stroke. Although a floor effect is present, chosen secondary to its ability to predict falls after acute rehabilitation discharge [52]. Highly recommended for use in acute rehabilitation and research by APTA StrokEDGE [7].	PT
9 Hole Peg Test	Reliable and valid in acute stroke population [53]. Established acute stroke specific MDC values [53]. Although there are concerns of a floor effect in patients with acute stroke [54], chosen to capture dexterity in those with emerging hand function. Recommended by StrokEDGE for use in acute rehabilitation setting and research [7].	OT
Action Research Arm Test	Reliable and valid in stroke [9,55,56]. Chosen for high correlation with Fugl-Meyer and Wolf Motor Function Test with less time of administration [57]. Equipment available in our clinic. Recommended for use in acute rehabilitation setting and research by APTA StrokEDGE [7].	OT
Box & Blocks Test	Assesses unilateral gross manual dexterity. Valid [58] and reliable in stroke population with established stroke MDC values [53]. Recommended for use in acute rehabilitation and research by APTA StrokEDGE [7].	OT
Battery for the Assessment of Neuropsychological Status	Quantifies cognitive impairment in 5 domains with index scores and a total score. Found to be valid in patients with acute stroke [59].	ST/OT

Table 5: Selected Outcome Measures-ICF Category: Activities.

Selected Stroke Outcome Measures		
Assessment	**Description and Rationale for Inclusion**	**Discipline**
ICF Category: Participation		
Modified Rankin Handicap Scale	Single item global outcome that categorized functional ability with consideration of pre stroke level of function. Valid [60] and reliable in patients with acute stroke [61]. Recommended for use in acute rehabilitation settings by APTA StrokEDGE.	MD-PMR
Stroke Impact Scale	Self-reported participation measure scoring 8 domains of function. Found to be reliable [62] and valid [63,64] in patients with stroke. Limited data supporting the use of this measure in the acute rehabilitation setting, however it may be reasonable to consider using [7]. As a modification, the last global recovery question was used as a patient reported outcome measure. The SIS in its entirety was less relevant for inpatients.	MD-PMR
Short Form-12	12 item health status questionnaire that produces two scores, a physical mental component summary score. Found to be reliable and valid in patients with mild stroke [65]. The SF 36 was strongly recommended in acute rehabilitation setting and research by APTA StrokEDGE [7].	TR
Beck Depression Inventory	Quantifies severity of depression, if present. Has been found to be reliable [66] and valid [67] in the stroke population. Due to inherent properties of being a self-report, this inventory may not be appropriate in patients with severe cognitive impairment.	TR

Table 6: Selected Outcome Measures-ICF Category: Participation.

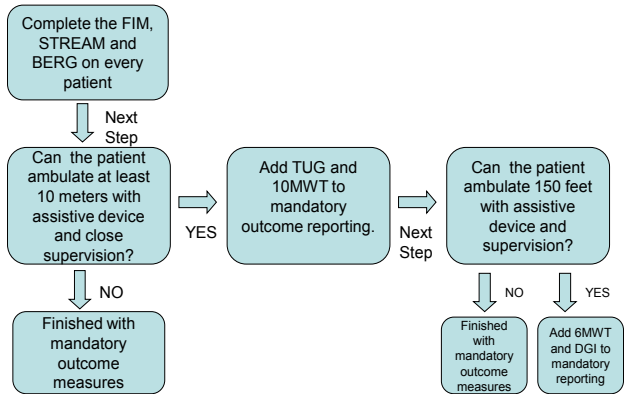

Figure 3: Decision.

the occurrence of missing values, it was noted that several data fields were left blank. Additionally, there were instances that a value of zero was utilized either to indicate a test was not completed or that the value was not relevant to the specific patient's assessment. We recognized that there could have been several reasons why a value field had been left blank. Potential reasons for this missing data included: failure to enter data, failure to perform the assessment, or a data value that was insufficiently measurement-specific and hence confusing. To avoid that a field would be left blank, the standardization team, with guidance from the biostatistician, decided to include a value option of "N/A." This N/A value could be entered in cases where the patient was not able to participate in the assessment, where a given assessment tool was not relevant, or was clinically inappropriate. In these instances, a text field was created on the EMR form to add this required notation. The N/A value option permitted all data fields to be completed in the EMR and within REDCap, and clarified absences of data entry, An additional rationale for applying the N/A value is to clearly differentiate between the quantitative value of the number zero and a qualitative entry for a test determined irrelevant or inappropriate. For example, the Timed Up and Go test is measured quantitatively in seconds. It would be impossible to complete the components of the test in zero seconds. Registering a value of zero when the test was not performed will lead to the results being incorrectly analyzed. To mitigate such problems, a "N/A" would be recorded.

Discussion

We have described one process by which an interdisciplinary rehabilitation team, practicing in a single academic medical center, can standardize the approach for patient assessment after stroke, and track patient progress through the inpatient rehabilitation phase of stroke recovery. Our process differed from other reported implementation efforts by its full interdisciplinary scope, in collaboration for development, in education of the rehabilitation providers, and in the comprehensiveness of its products produced in the EMR and the REDCap database. In addition, this project included current updated, validated assessment measures not previously reported on in the literature [7,27]. At present, we have completed 9-11 months of data collection, and have found the project to provide benefits for clinical staff, patients, and their families. The assessments for each patient are reviewed across disciplines on a weekly basis in a rehabilitation team-rounds format. The specific results assist in guiding the clinical team to address areas of greatest impairments in each patient. The results of the tests are routinely shared with the patient and their families with the goal to engage them as essential members of the health-care team. Although not measured directly, clinicians have noted the patients take a more active role in their rehabilitation when provided objective metrics on their progress. This finding has been reported, though not quantified, in the existing literature [1]. Objective measurement of patient motivation through the use of assessment metrics is worth further investigation, particularly as ongoing constraints in therapy sessions make patient engagement increasingly important. Standardization of practice has resulted in use of consistent assessments tools, facilitating clinical management and auditing of progress. Practice standardization has also improved communication between therapy disciplines, including handoffs and collaboration for treatment plans. It has further enhanced consistency in the communication between clinicians and patients and/or families regarding treatment expectations.

Clinicians have found that the objective data does not constrain their ability to use a variety of treatment approaches, but rather facilitate clinical decision-making and appropriate goal setting, leading to improved value of care. This outcome is a positive one, but is one that was not anticipated at the initiation of the project. Improved clinical decision-making promotes best practices in the rehabilitation of patients with stroke, enhances patient outcomes and improves cost efficient care delivery [1]. The use of quantifiable outcome measures validates the treatment interventions prescribed and improves the quality of the documentation, all of which can assist in securing reimbursement.

The educational value of the project was evident to all members of the SRS team. It provided a stimulus for clinicians to complete certification requirements for some of the assessment tools. All members of the therapy staff have been trained to administer the assessments pertinent to their discipline. Notably, clinicians are now more knowledgeable about standardized assessment and outcome measures in domains across disciplines, facilitating a true interdisciplinary team approach to patient care. New members of the rehabilitation team receive education in the outcome assessments, similar to the process utilized during the initial implementation of the SRS project. In order to sustain a core set of measurements and keep it current, staff members are encouraged to contribute by introducing new assessments for consideration by the SRS team.

The SRS project included developing both a form for the EMR as well as a database as a platform for clinical research. By choosing certain tools, such as the NIHSS, the rehabilitation database can now be linked to an existing acute stroke database maintained within our institution. The EMR documentation is accessible to all healthcare providers in our medical system. From a research perspective, a combined database enhances opportunities for interdisciplinary clinical studies. We posit that broad implementation of the care strategy outlined, and the database resulting from it, will facilitate multicenter clinical research studies to benefit patients with stroke.

We recognize this project has certain limitations. First there is no consensus on the external validity of the multiple instruments utilized by rehabilitation professionals. We accept that each measurement tool has its own strengths and limitations. Another limiting factor is that the SRS team developed and implemented this project within a closed care-delivery system and with a well-established practice of interdisciplinary collaboration. Stroke rehabilitation is provided at a variety of clinical settings, and our described process may not adapt to other care delivery systems. Our rehabilitation unit is small; however requires a significant number of clinicians to provide continued care

on a daily basis. Implementation of an interdisciplinary standardization protocol may be more challenging in larger settings. Furthermore, our project was focused on the inpatient rehabilitation phase of stroke recovery, and we have not yet tested its utility across the continuum of care. The authors also acknowledge as a limitation that during the selection of standards and outcome measures for the discipline of occupational therapy, the focus remained on so-called components based measures. During the ongoing review process, the inclusion of performance based measurements will be assessed. Finally, the logistics regarding expanding this project's outcomes beyond the acute inpatient rehabilitation facility are currently being developed.

Acknowledgements

The authors are members of the SRS team. The authors gratefully acknowledge the contributions of these additional SRS team members: Janella Clarke, CCC-SLP; Steven Hust, PT; Joseph G. Hentz, MS; Bernadette Kauffman, CTRS, MSOT; Jeff A. Knecht, MSPT; Dona E. Locke, PhD; Celena Thompson, CCC-SLP; Fred H. White, PT, DPT, GCS; Karen Wooten; Richard Yancey, MSOT.

References

1. Potter K, Fulk GD, Salem Y, Sullivan J (2011) Outcome measures in neurological physical therapy practice: part I. Making sound decisions. J Neurol Phys Ther 35: 57-64.
2. Jette DU, Halbert J, Iverson C, Miceli E, Shah P (2009) Use of standardized outcome measures in physical therapist practice: perceptions and applications. Phys Ther 89: 125-135.
3. Haigh R, Tennant A, Biering-Sørensen F, Grimby G, Marincek C, et al. (2001) The use of outcome measures in physical medicine and rehabilitation within Europe. J Rehabil Med 33: 273-278.
4. Sullivan JE, Andrews AW, Lanzino D, Perron AE, Potter KA (2011) Outcome measures in neurological physical therapy practice: part II. A patient-centered process. J Neurol Phys Ther 35: 65-74.
5. Körner M (2010) Interprofessional teamwork in medical rehabilitation: a comparison of multidisciplinary and interdisciplinary team approach. Clin Rehabil 24: 745-755.
6. Cano SJ, Hobart JC (2008) Watch out, watch out, the FDA are about. Dev Med Child Neurol 50: 408-409.
7. Sullivan JE, Crowner BE, Kluding PM, Nichols D, Rose DK, et al. (2013) Outcome measures for individuals with stroke: process and recommendations from the American Physical Therapy Association neurology section task force. Phys Ther 93: 1383-1396.
8. Duncan PW, Zorowitz R, Bates B, Choi JY, Glasberg JJ, et al. (2005) Management of Adult Stroke Rehabilitation Care: a clinical practice guideline. Stroke 36: e100-143.
9. Lang CE, Bland MD, Connor LT, Fucetola R, Whitson M, et al. (2011) The brain recovery core: building a system of organized stroke rehabilitation and outcomes assessment across the continuum of care. J Neurol Phys Ther. 35: 194-201.
10. Van Peppen RP, Maissan FJ, Van Genderen FR, Van Dolder R, Van Meeteren NL (2008) Outcome measures in physiotherapy management of patients with stroke: a survey into self-reported use, and barriers to and facilitators for use. Physiother Res Int 13: 255-270.
11. Wedge FM, Braswell-Christy J, Brown CJ, Foley KT, Graham C, et al. (2012) Factors influencing the use of outcome measures in physical therapy practice. Physiother Theory Pract 28: 119-133.
12. Saltychev M, Tarvonen-Schröder S, Eskola M, Laimi K (2013) Selecting an optimal abbreviated ICF set for clinical practice among rehabilitants with subacute stroke: retrospective analysis of patient records. Int J Rehabil Res 36: 172-177.
13. Tempest S, Harries P, Kilbride C, De Souza L (2012) To adopt is to adapt: the process of implementing the ICF with an acute stroke multidisciplinary team in England. Disabil Rehabil 34: 1686-1694.
14. O'Halloran R, Worrall L, Hickson L (2012) Stroke patients communicating their healthcare needs in hospital: a study within the ICF framework. Int J Lang Commun Disord 47: 130-143.
15. Algurén B, Bostan C, Christensson L, Fridlund B, Cieza A (2011) A multidisciplinary cross-cultural measurement of functioning after stroke: Rasch analysis of the brief ICF Core Set for stroke. Top Stroke Rehabil 18 Suppl 1: 573-586.
16. Glässel A, Kirchberger I, Kollerits B, Amann E, Cieza A (2011) Content validity of the Extended ICF Core Set for stroke: an international Delphi survey of physical therapists. Phys Ther 91: 1211-1222.
17. Starrost K, Geyh S, Trautwein A, Grunow J, Ceballos-Baumann A, et al. (2008) Interrater reliability of the extended ICF core set for stroke applied by physical therapists. Phys Ther 88: 841-851.
18. Geyh S, Cieza A, Kollerits B, Grimby G, Stucki G (2007) Content comparison of health-related quality of life measures used in stroke based on the international classification of functioning, disability and health (ICF): a systematic review. Qual Life Res 16: 833-851.
19. Tempest S, McIntyre A (2006) Using the ICF to clarify team roles and demonstrate clinical reasoning in stroke rehabilitation. Disabil Rehabil 28: 663-667.
20. Geyh S, Cieza A, Schouten J, Dickson H, Frommelt P, et al. (2004) ICF Core Sets for stroke. J Rehabil Med : 135-141.
21. Alford VM, Remedios LJ, Webb GR, Ewen S (2013) The use of the international classification of functioning, disability and health (ICF) in indigenous healthcare: a systematic literature review. Int J Equity Health 12: 32.
22. (2011) StrokEdge Taskforce - Compendium of Instructions for Outcome Measures.
23. StrokEngine Assess. September 6, 2013.
24. Vogt WP, Burke Johnson R (2005) Dictionary of Statistics & Methodology: A Nontechnical Guide for the Social Sciences: Sage Publications.
25. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, et al. (2009) Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform 42: 377-381.
26. Obeid JS, McGraw CA, Minor BL, Conde JG, Pawluk R, et al. (2013) Procurement of shared data instruments for Research Electronic Data Capture (REDCap). J Biomed Inform 46: 259-265.
27. National Outcomes Measurement Systems (NOMS).
28. Brott T, Adams HP Jr, Olinger CP, Marler JR, Barsan WG, et al. (1989) Measurements of acute cerebral infarction: a clinical examination scale. Stroke 20: 864-870.
29. Fink JN, Selim MH, Kumar S, Silver B, Linfante I, et al. (2002) Is the association of National Institutes of Health Stroke Scale scores and acute magnetic resonance imaging stroke volume equal for patients with right- and left-hemisphere ischemic stroke? Stroke 33: 954-958.
30. Goldstein LB, Samsa GP (1997) Reliability of the National Institutes of Health Stroke Scale. Extension to non-neurologists in the context of a clinical trial. Stroke 28: 307-310.
31. Ahmed S, Mayo NE, Higgins J, Salbach NM, Finch L, et al. (2003) The Stroke Rehabilitation Assessment of Movement (STREAM): a comparison with other measures used to evaluate effects of stroke and rehabilitation. Phys Ther 83: 617-630.
32. Chen HM, Hsieh CL, Sing Kai Lo, Liaw LJ, Chen SM, et al. (2007) The test-retest reliability of 2 mobility performance tests in patients with chronic stroke. Neurorehabil Neural Repair 21: 347-352.
33. Daley K, Mayo N, Wood-Dauphinée S (1999) Reliability of scores on the Stroke Rehabilitation Assessment of Movement (STREAM) measure. Phys Ther 79: 8-19.
34. Wang CH, Hsieh CL, Dai MH, Chen CH, Lai YF (2002) Inter-rater reliability and validity of the stroke rehabilitation assessment of movement (stream) instrument. J Rehabil Med 34: 20-24.
35. Klavora P, Heslegrave RJ, Young M (2000) Driving skills in elderly persons with stroke: comparison of two new assessment options. Arch Phys Med Rehabil 81: 701-705.
36. Bohannon RW (1986) Test-retest reliability of hand-held dynamometry during a single session of strength assessment. Phys Ther 66: 206-209.
37. Toglia J, Fitzgerald KA, O'Dell MW, Mastrogiovanni AR, Lin CD (2011) The Mini-Mental State Examination and Montreal Cognitive Assessment in persons with mild subacute stroke: relationship to functional outcome. Arch Phys Med Rehabil 92: 792-798.

38. Nasreddine ZS, Phillips NA, Bédirian V, Charbonneau S, Whitehead V, et al. (2005) The Montreal Cognitive Assessment, MoCA: a brief screening tool for mild cognitive impairment. J Am Geriatr Soc 53: 695-699.

39. Tur BS, Gursel YK, Yavuzer G, Kucukdeveci A, Arasil T (2003) Rehabilitation outcome of Turkish stroke patients: in a team approach setting. Int J Rehabil Res 26: 271-277.

40. Beninato M, Gill-Body KM, Salles S, Stark PC, Black-Schaffer RM, et al. (2006) Determination of the minimal clinically important difference in the FIM instrument in patients with stroke. Arch Phys Med Rehabil 87: 32-39.

41. Collen FM, Wade DT, Bradshaw CM (1990) Mobility after stroke: reliability of measures of impairment and disability. Int Disabil Stud 12: 6-9.

42. Flansbjer UB, Holmbäck AM, Downham D, Patten C, Lexell J (2005) Reliability of gait performance tests in men and women with hemiparesis after stroke. J Rehabil Med 37: 75-82.

43. Perera S, Mody SH, Woodman RC, Studenski SA (2006) Meaningful change and responsiveness in common physical performance measures in older adults. J Am Geriatr Soc 54: 743-749.

44. Perry J, Garrett M, Gronley JK, Mulroy SJ (1995) Classification of walking handicap in the stroke population. Stroke 26: 982-989.

45. Fulk GD, Echternach JL (2008) Test-retest reliability and minimal detectable change of gait speed in individuals undergoing rehabilitation after stroke. J Neurol Phys Ther 32: 8-13.

46. Kosak M, Smith T (2005) Comparison of the 2-, 6-, and 12-minute walk tests in patients with stroke. J Rehabil Res Dev 42: 103-107.

47. Flansbjer UB, Blom J, Brogårdh C (2012) The reproducibility of Berg Balance Scale and the Single-leg Stance in chronic stroke and the relationship between the two tests. PM R 4: 165-170.

48. Mao HF, Hsueh IP, Tang PF, Sheu CF, Hsieh CL (2002) Analysis and comparison of the psychometric properties of three balance measures for stroke patients. Stroke 33: 1022-1027.

49. Stevenson TJ (2001) Detecting change in patients with stroke using the Berg Balance Scale. Aust J Physiother 47: 29-38.

50. Jonsdottir J, Cattaneo D (2007) Reliability and validity of the dynamic gait index in persons with chronic stroke. Arch Phys Med Rehabil 88: 1410-1415.

51. Lin JH, Hsu MJ, Hsu HW, Wu HC, Hsieh CL (2010) Psychometric comparisons of 3 functional ambulation measures for patients with stroke. Stroke 41: 2021-2025.

52. Andersson AG, Kamwendo K, Seiger A, Appelros P (2006) How to identify potential fallers in a stroke unit: validity indexes of 4 test methods. J Rehabil Med 38: 186-191.

53. Chen HM, Chen CC, Hsueh IP, Huang SL, Hsieh CL (2009) Test-retest reproducibility and smallest real difference of 5 hand function tests in patients with stroke. Neurorehabil Neural Repair 23: 435-440.

54. Jacob-Lloyd HA, Dunn OM, Brain ND, Lamb SE (2005) Effective Measurement of the Functional Progress of Stroke Clients. The British Journal of Occupational Therapy 68: 253-259.

55. Nijland R, van Wegen E, Verbunt J, van Wijk R, van Kordelaar J, et al. (2010) A comparison of two validated tests for upper limb function after stroke: The Wolf Motor Function Test and the Action Research Arm Test. J Rehabil Med 42: 694-696.

56. Platz T, Pinkowski C, van Wijck F, Kim IH, di Bella P, et al. (2005) Reliability and validity of arm function assessment with standardized guidelines for the Fugl-Meyer Test, Action Research Arm Test and Box and Block Test: a multicentre study. Clin Rehabil 19: 404-411.

57. Hsieh YW, Wu CY, Lin KC, Chang YF, Chen CL, et al. (2009) Responsiveness and validity of three outcome measures of motor function after stroke rehabilitation. Stroke 40: 1386-1391.

58. Lin KC, Chuang LL, Wu CY, Hsieh YW, Chang WY (2010) Responsiveness and validity of three dexterous function measures in stroke rehabilitation. J Rehabil Res Dev 47: 563-571.

59. Larson E, Kirschner K, Bode R, Heinemann A, Goodman R (2005) Construct and predictive validity of the repeatable battery for the assessment of neuropsychological status in the evaluation of stroke patients. J Clin Exp Neuropsychol 27: 16-32.

60. Wolfe CD, Taub NA, Woodrow EJ, Burney PG (1991) Assessment of scales of disability and handicap for stroke patients. Stroke 22: 1242-1244.

61. Kwon S, Hartzema AG, Duncan PW, Min-Lai S (2004) Disability measures in stroke: relationship among the Barthel Index, the Functional Independence Measure, and the Modified Rankin Scale. Stroke 35: 918-923.

62. Carod-Artal FJ, Ferreira Coral L, Stieven Trizotto D, Menezes Moreira C (2009) Self- and proxy-report agreement on the Stroke Impact Scale. Stroke 40: 3308-3314.

63. Duncan PW, Bode RK, Min Lai S, Perera S; Glycine Antagonist in Neuroprotection Americans Investigators (2003) Rasch analysis of a new stroke-specific outcome scale: the Stroke Impact Scale. Arch Phys Med Rehabil 84: 950-963.

64. Duncan PW, Lai SM, Tyler D, Perera S, Reker DM, et al. (2002) Evaluation of proxy responses to the Stroke Impact Scale. Stroke 33: 2593-2599.

65. Bohannon RW, Maljanian R, Landes M (2004) Test-retest reliability of short form (SF)-12 component scores of patients with stroke. Int J Rehabil Res 27: 149-150.

66. Aben I, Verhey F, Lousberg R, Lodder J, Honig A (2002) Validity of the beck depression inventory, hospital anxiety and depression scale, SCL-90, and hamilton depression rating scale as screening instruments for depression in stroke patients. Psychosomatics 43: 386-393.

67. Desrosiers J, Noreau L, Rochette A, Bravo G, Boutin C (2002) Predictors of handicap situations following post-stroke rehabilitation. Disabil Rehabil 24: 774-785.

Citation: Kinney CL, Eikenberry MC, Noll SF, Tompkins J, Verheijde J (2013) The Standardization of Interdisciplinary Clinical Practice and Assessment in Stroke Rehabilitation. Int J Phys Med Rehabil 1: 166. doi:10.4172/2329-9096.1000166