

12-2011

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Catherine E. Lang

Washington University School of Medicine in St. Louis

Marghuretta D. Bland

Washington University School of Medicine in St. Louis

Lisa Tabor Connor

Washington University School of Medicine in St. Louis

Robert P. Fucetola

Washington University School of Medicine in St. Louis

Michelle Whitson

Barnes Jewish Hospital Rehabilitation Services

See next page for additional authors

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Recommended Citation

Lang, Catherine E.; Bland, Marghuretta D.; Connor, Lisa Tabor; Fucetola, Robert P.; Whitson, Michelle; Edmiaston, Jeff; Karr, Clayton; Sturmoski, Audra; Baty, Jack; and Corbetta, Maurizio, "The brain recovery core: Building a system of organized stroke rehabilitation and outcomes assessment across the continuum of care" (2011). *Physical Therapy Faculty Publications*. Paper 16. http://digitalcommons.wustl.edu/pt_facpubs/16

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Authors

Catherine E. Lang, Marghuretta D. Bland, Lisa Tabor Connor, Robert P. Fucetola, Michelle Whitson, Jeff Edmiaston, Clayton Karr, Audra Sturmoski, Jack Baty, and Maurizio Corbetta

**The Brain Recovery Core: Building a system of organized stroke rehabilitation
and outcomes assessment across the continuum of care**

Catherine E. Lang PT, PhD^{1,2,3}, Marghuretta D. Bland DPT, MSCI¹, Lisa Tabor Connor PhD^{2,3,4},
Robert Fucetola PhD³, Michelle Whitson PT, MHS, MA, MBA⁶, Jeff Edmiaston MS, CCC-SLP⁶,
Clayton Karr MSOT, OTR/L⁷, Audra Sturmoski MSPT⁷, Jack Baty MS⁵, Maurizio Corbetta MD^{3,4}

Washington University: ¹Program in Physical Therapy, ²Program in Occupational Therapy,
³Department of Neurology, ⁴Department of Radiology, ⁵Division of Biostatistics
⁶Barnes Jewish Hospital Rehabilitation Services, ⁷the Rehabilitation Institute of Saint Louis, Saint
Louis, MO

Corresponding Author: Catherine Lang
Program in Physical Therapy
Washington University
4444 Forest Park, Campus Box 8502
Saint Louis, MO 63108
314-286-1945

Words in Abstract/Summary: 133

Words in Text: 2958

Tables: 4

Figures: 1

Acknowledgements:

We thank the staff and administrators of Barnes Jewish Hospital, the Rehabilitation Institute of Saint Louis, and Washington University for their enthusiasm, support, and efforts on this project. Funding was provided by HealthSouth Corporation and the Washington University McDonnell Center for Systems Neuroscience.

Abstract/Summary

This Special Interest paper describes a multi-disciplinary, inter-institutional effort to build an organized system of stroke rehabilitation across the continuum of care. This system is focused on a cohort of patients who are admitted with the diagnosis of stroke to our acute facility, are discharged to inpatient and/or outpatient rehabilitation at our free-standing facility, and are then discharged to the community. This paper first briefly explains the justification, goals, and purpose of the Brain Recovery Core (BRC) system. The next sections describe its development and implementation, with details on the physical therapy aspects. The paper concludes with an assessment of how the BRC system has changed and improved delivery of rehabilitation services. It is hoped that the contents of this paper will be useful in initiating discussions and potentially facilitating other, similar efforts.

The need for an organized system

Stroke is a major health problem in the United States and around the world.^{1,2} Rehabilitation has the potential to save many people from disability after stroke.^{3,4} While organized stroke care often exists *within* institutions⁵⁻⁸ that provide care at various stages of the rehabilitation process, it does not often exist *across* institutions, as patients move from one institution to another and then to home. Critical decisions at many points along the continuum of care depend on the results of numerous rehabilitation assessments. Decisions such as admittance to inpatient rehabilitation, length of stay/services, and the selection of specific interventions are all dependent upon results of assessments. Results from assessments are also a critical component of communication with patients, caregivers, other healthcare providers, and third-party payers.

Despite persistent calls for consistency, validity, and standardization^{5,9,10}, assessment tools vary across and within institutions and therapy assessment results are not routinely transmitted to later points of service. This results in barriers to efficient and effective care delivery such as: difficulty communicating results within a facility, lack of awareness of assessment done at previous facilities, and the inability to determine individual progress because of using different assessment tools. Given that initial severity of impairments and the rate of change of those impairments are key prognostic indicators post stroke¹¹⁻¹⁷, making clinical decisions without the full complement of assessment data is problematic and inefficient.

Goal and Purpose of the organized system

The Brain Recovery Core (BRC) team is a multidisciplinary, inter-institutional partnership between Washington University School of Medicine, Barnes Jewish Hospital, and the Rehabilitation Institute of Saint Louis (Table 1). The major goal of the BRC system is *to build and sustain* a system of organized stroke rehabilitation across the continuum of care, from the acute stroke service to return to home and community life. Our efforts are focused on the large cohort of people who are admitted with stroke to our acute facility, are sent to inpatient and/or outpatient rehabilitation at our free-standing facility, and are then discharged to the community. The purpose of the system is to support the clinical services and the research team by providing: 1) individual patient data across the continuum of care in order to make better prognostic clinical decisions; 2) population data on outcomes within and across services, disciplines, and individual therapists; 3) a common set of measurements that lay the foundation for within and across service efforts to improve rehabilitation management; and 4) outcome data from new clinical programs or research interventions. The key ingredients of this system are: 1) a systematic assessment battery, covering motor, language, and cognitive domains, that builds across the continuum of care and meets the needs of each service; and 2) a database to collect, store, and search assessment, treatment, and follow-up data that is accessible to rehabilitation clinicians, administrators, and researchers. An example of the clinical utility of the system is as follows: therapy staff often identify a specific need or desire to improve service delivery, such as creating a group exercise program to improve the mobility of their patients. With this system, we are now able to determine whether or not a new program produced the

desired outcomes, e.g. “did mobility improve as anticipated?” and “was it worth the effort to create a new program?”.

From conceptual idea to implementing the Brain Recovery Core system

The idea of the BRC system first arose in 2008 within a group of rehabilitation researchers and then with representatives from the clinical facilities. It took nearly 14 months to: 1) agree to create the system, 2) determine the specifics of how it would operate, 3) obtain pilot funds, 4) hire a coordinator to run the project, and 5) start implementation efforts. Three important features of the team and environment facilitated the development of this project. First, there were already numerous research and clinical contacts between the partners. Second, there was a ten-year history of consenting and tracking patients into a clinical Stroke Registry at the acute stroke facility. The third key feature was that the researchers had access to and secured commitments from the administrative officials at each facility. The positive history of interactions between partners and, perhaps more importantly, the support from administrative officials¹⁸⁻²⁰ were critical in implementing the BRC system.

Building a standardized assessment battery

The first component of the BRC system is an assessment battery, covering motor, language, and cognitive domains, which builds across the continuum of care and meets the needs of each service. Here we provide details on the motor portions of the battery that are the responsibility of physical therapy. Criteria for selection of measurement tools were: 1) tools must have published reliability, validity, and responsiveness, preferably in people with stroke; and 2) tools must meet the clinical needs and constraints of each service. While the first criterion is a necessity for collecting uniform patient information^{9,21}, the second criterion was essential for convincing therapists to routinely use the battery.

Table 2 shows the three physical therapy services and the specific needs and constraints which the battery had to address. These were determined from discussions with therapists, administrators, and BRC team members. Since our goal was to use the battery across the points of care, the needs and constraints of one service had to be balanced with those of the other services. In other words, we had to select tools that could consistently be used across services and still provide sufficient information for clinical decision-making and outcome measurement within each service. The population of people served by our facilities spans the range of very severe to normal across the continuum of care. Thus, we had to select tests that cover the full range. System-wide rules for test administration are used to avoid the burden of testing inappropriately. Rules for the Berg Balance Scale are described here as an example. If a person receives a 0 on the first 5 items, the rest of the items are not administered and are assigned scores of 0. BRC data indicate that the scale is readily capturing changes at the low end (e.g. moving from a 0 to a 10). On the upper end, preliminary BRC data indicate that 5% and 8% of persons on the inpatient and outpatient services, respectively, achieve top scores (defined as a score of 55 or 56). If a person achieves a score of 55 or 56, then the treating therapist can either chose a different way to assess higher-level or job-specific balance (e.g. walking on ladders for a roofer), or can choose not to evaluate balance further (i.e. no additional balance needs). Lastly, selection of specific measurement tools was informed by the idea that healthcare changes are easier to accept and make when the change is not too

different from current practice.^{22, 23} Thus, when given a choice, we selected measurement tools that were already in use on one or more services.

Table 3 outlines the physical therapy battery, the rationale for each tool, and the points of service where it is used. Some tools are used for diagnostic decisions (i.e. what are the main impairments contributing to limited mobility?), some are used for evaluating outcomes, and some are used for both. How they are used determined when they were administered (e.g. admission only vs. admission and discharge or monthly). The selected battery is a reasonable, but not perfect solution to the needs, constraints, and challenges discussed above. The battery is the minimal requirement for all patients admitted with stroke on each service. It is intended to provide sufficient information for clinical decision-making on the majority of patients seen on each service. Therapists may administer additional tools for individual patients as appropriate (e.g. ataxia rating scale for persons with cerebellar stroke). As sufficient data are collected, the battery is assessed from clinical and statistical perspectives and revised accordingly.

Implementing and monitoring the standardized battery

The battery was implemented first on the acute service, followed by the inpatient, and then the outpatient services. From healthcare change literature, a multi-faceted implementation approach was selected.^{18, 20, 23-28} Components of the multi-faceted approach included: 1) clear administrative and supervisory support; 2) a clinical “champion” on each service; 3) distribution of educational materials about the battery that included each tool, the rationale for selecting it, how to administer it, and where to record scores; 4) educational and interactive meetings with staff; and 5) feedback to staff and administration. For each service, the BRC coordinator and a team member with content expertise first met with the lead therapist and a supervisor to discuss the details of the battery, service-specific needs, and the implementation process. The lead therapist served as the champion of the project – the person that would advocate for using the battery and would answer specific questions about how to administer the tools. This first meeting was used to review educational materials to be provided to staff, plan the implementation time points for that service, determine equipment needs, and problem-solve potential barriers to implementation.

The second step was to have educational, interactive meetings with therapy staff. Meetings were used to orient staff to the BRC system and goals, disseminate and discuss educational materials, and answer questions. After the staff meeting, a 2-3 month trial period began. During the trial period, staff participated in in-services to learn to use unfamiliar assessment tools and to problem-solve process issues. Common process-related issues were: insufficient forms or equipment, lack of knowledge regarding where forms or equipment were kept, and how to include forms as part of the medical record. Therapists identified barriers to implementation and generated feasible solutions. The BRC coordinator shared solutions from one service with other services. For example, staff on all three physical therapy services independently identified the lack of a consistent, reliably-measured space as a barrier to completing the 10 m walk test. The acute hospital arranged to have wall tiles changed to a contrasting color at the beginning and end of a 10 m distance as a permanent solution. This solution was shared with the inpatient and outpatient services and similar changes were made

there. The BRC coordinator also observed and provided feedback to staff performing assessments.

The trial period ended when the lead therapist indicated the staff was familiar with battery administration and using battery scores for clinical decision-making. Another meeting was held with therapy staff to answer final questions, communicate additional details, and move from the trial period to live implementation. Live implementation meant that all therapists on the service were expected to use the BRC battery for evaluations of all patients with stroke admitted to that service.

Our target is to consistently achieve $\geq 90\%$ completion rates on each service. Several steps are followed to monitor and improve compliance. First, the BRC coordinator observes assessments on each service monthly to ensure correct administration and provide feedback to therapists. Second, review of rehabilitation records is done monthly to quantify compliance. Monitoring and providing specific feedback are important aspects of successful healthcare implementation strategies.^{20, 27-30} Compliance data are provided to supervisors, who then share data with staff. The review of records helped identify staff that had not been educated about the BRC battery, such as per-diem therapists. Administrators now include education about the BRC project and the battery into orientation for new hires and the annual competencies for all therapists.

Building and implementing a way to capture longer-term outcomes after stroke

The BRC team is interested in understanding the longer-term outcomes of people with stroke who receive services at our institutions. There is a lack of routine clinical procedures for assessing functional outcomes later in the stroke rehabilitation process or after rehabilitation services have ended, particularly in the United States. Many institutions, including ours, use follow-up mail surveys to measure the quality of care received (e.g. professionalism of staff, patient satisfaction), but the survey questions are distinctly different from outcome assessment. In the absence of real data on how well patients are coping in the context of their own lives, our healthcare institutions have no way of knowing if the stroke rehabilitation services they are delivering are sufficient and/or effective.

To capture longer-term outcomes at the end of the continuum of stroke rehabilitation care, we developed a process for 6 and 12 month telephone or email follow-ups. We chose to measure functional outcomes at specific time points post stroke instead of at individualized time points, such as at the end of therapy services. The reason for this was that variability in the need for services, treatment interventions, length of stay, and third-party reimbursements make comparisons using individualized time points only minimally useful.³¹ The 6 month time point was chosen because neurological recovery post stroke has reached a plateau and physical function is typically stable by this time.^{11, 31, 32} The 12 month time point was chosen because cognitive and language function and participation in social roles may take up to 1 year to stabilize post stroke.³³⁻³⁶

Telephone and email follow-ups were selected as economical methods to obtain the data. In-person assessments were rejected because of the associated costs. We could not rely solely on email-based methods because around half of our population does not have access and/or experience with computers. Telephone follow-ups are being completed in 20 – 25 minutes per call by on-the-job trained staff. For those patients providing email addresses,

emails are distributed and responses are returned via our secure database (see below). Three assessment tools and two multi-level questions are being administered (Table 4).

Collecting, managing, and sharing rehabilitation data

The second component of the BRC system is a database to collect, store, and search assessment, treatment, and follow-up data that it is accessible to rehabilitation clinicians, administrators, and researchers. Because data would be accessible across facilities and to researchers, institutional review board (IRB) approval was required. IRB approval and a systematic verbal informed consent process have been in place for 10 years at the acute facility, where the informed consent process is managed by the stroke team nurse coordinators. IRB approval and a systematic informed consent process had to be established at the inpatient and outpatient rehabilitation facility. Approval had to be provided by three separate committees; this took approximately 7 months. Case managers were chosen to handle the consenting process on the inpatient and outpatient rehabilitation services because of their educational background. The same general process, described above, was used to implement and monitor the consent process. Our target is to consent $\geq 90\%$ of all individuals with stroke admitted to acute hospital, and the inpatient and outpatient rehabilitation services.

Paralleling the development of the consent process was the construction of a database to collect and store patient information. Data are collected and managed using REDCap (Research Electronic Data Capture) hosted by Washington University.³⁷ REDCap is a secure, web-based application designed to support large projects, 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. The database allows for both data transfer from the electronic medical records at the acute hospital and manual data entry from the paper medical record at the other services. In addition, REDCap has a survey feature, which is used to collect 6 and 12 months follow-ups via email or via manual entry during telephone calls with the patients.

The final step in building the database is providing access to collected data to our BRC constituents. This is achieved via a password-protected, BRC web-page with data queries for the three main groups of constituents. First, clinicians can access stored data from individual patients. Second, administrators, therapy supervisors, and the BRC Coordinator can access data related to compliance and outcomes such as completion rates. Third, researchers can access de-identified rehabilitation data to conduct retrospective analyses or to find potential subjects for new studies.

2010 Compliance and Benefits to date

The efforts of the BRC team, therapy staff, and administrators have resulted in a system of organized stroke rehabilitation across the continuum of care. Figure 1A shows physical therapy compliance rates for April – December 2010. Compliance fluctuates and therapists report the greatest difficulty with administering discharge (inpatient) and monthly (outpatient) assessments. In general, these compliance rates are better than those reported for other healthcare change efforts (mean compliance with 143 clinical recommendations = 54%).³⁸ We note that intra- and inter-rater reliability of individual battery tools are not being evaluated as

part of this project. While this may be considered a flaw of the project, our intent was to take evidence from the literature (i.e. selection of tools already shown to be reliable) and implement a system to use them in routine clinical practice. Figure 1B shows the percentage of patients consented to have their data stored in the database, from April – December 2010. As discussed above, the consent process was required because private health information needed to be accessible across separate facilities. Multiple efforts are being pursued to increase the percentage of people who agree to have their information stored, since this type of system is most valuable with maximum inclusion.

A brief summary of benefits realized thus far include: 1) provision of ongoing evidence-based education on evaluation and outcome measurement for stroke rehabilitation to therapy staff; 2) a “common language” of objective assessment results with which therapists are now engaging in discussion about exactly how they are making clinical decisions; 3) a perceived reduction in the time to complete assessments; and 4) improvement of numerous service delivery processes (e.g. regular availability of assessment kits, consistency in re-evaluations across staff). Continued efforts are needed to improve the BRC system, sustain it over time, and adapt it to meet the needs of the constituents.

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Table 1. The Washington University departments of Physical Therapy, Occupational Therapy, Neurology, Biostatistics, and Psychiatry partnered with Barnes Jewish Hospital and the Rehabilitation Institute of Saint Louis, two separate healthcare institutions on their shared medical campus, to form the Brain Recovery Core.

	Barnes Jewish Hospital	Rehabilitation Institute of Saint Louis	
		Inpatient rehabilitation	Outpatient rehabilitation
Facility information	1228-bed acute, teaching hospital; flag-ship hospital of BJC Healthcare, a large not-for-profit healthcare company in the Midwest United States Joint Commission* Seal of Approval; Joint Commission* Primary Stroke Center	96-bed free-standing facility providing inpatient and outpatient rehabilitation services; jointly owned by BJC Healthcare and HealthSouth Corporation; managed by HealthSouth Corporation, a large for-profit healthcare company in the United States Joint Commission* Accredited	
General focus of care	Medical treatment of stroke and any resulting complications	Achieve independence in mobility and ADLs	Maximize functional potential; Return to previous life roles as able
Numbers of therapists providing rehabilitation services to people with stroke on each service			
PTs and PTAs	1 Primary stroke >30 secondary/float	6 full-time >10 float/per-diem	6 full-time 1 part-time >10 float/per-diem
OTs and COTAs	1 Primary stroke >20 secondary/float	6 full-time >10 float/per-diem	5 full-time 2 part-time >10 float/per-diem
SLPs and SLPAs	1 Primary stroke 4 secondary/float	6 full-time >6 float/per-diem	4 full-time >6 float/per-diem

ADL: Activities of daily living; PT: Physical Therapist; PTA: Physical Therapist Assistant; OT: Occupational Therapist; COTA: Certified Occupational Therapy Assistant; SLP: Speech-Language Pathologist; SLPA: Speech Language Pathologist Assistant

*Joint Commission is a United States agency that accredits healthcare institutions.

Table 2. The specific needs and constraints of each physical therapy service as determined from discussions with therapy staff, administrators, and Brain Recovery Core team members.

Point of care	Specific needs and constraints
Acute hospital	<ul style="list-style-type: none"> • Main role of service is to provide evaluations that inform discharge planning; many patients are seen only 1 time for the evaluation; median length of stay for persons with stroke is 3 days • Time available per evaluation is approx. 30 minutes • Patients are evaluated in hospital rooms, not in a therapy gym • Any required testing equipment must be easily portable room-to-room • Measurement tools needed to assess a broad range of severity; severe and moderate motor deficits are readily apparent to all members of the healthcare team; more mild deficits that are not readily apparent and need to be detected at initial evaluation in order to obtain needed referrals upon discharge.
Inpatient rehabilitation	<ul style="list-style-type: none"> • Main role of service is to provide treatments that will result in independence with mobility and ADLs; patients are seen 2 times/day; average length of stay for a person with stroke is 16 days • Physical therapy plan of care with goals must be in place within 24-48 hours • Time available per evaluation is approx. 60 minutes • Patients are evaluated in both hospital rooms and in the therapy gym • The FIM is a required assessment at admission and discharge; physical therapists complete the transfers, locomotion, and stairs items • Measurement tools must be appropriate to measure changes at both the lower functional status seen at admission and the higher functional status often seen at discharge.
Outpatient rehabilitation	<ul style="list-style-type: none"> • Main role of service is to provide treatments that will improve mobility and function, with the hope of resuming pre-stroke activities as much as possible • Time available per evaluation is approx. 45 minutes • Patients are evaluated in a therapy gym • Measurement tools needed to assess mild to severe deficits with a focus on activity- and participation-level outcomes and not on impairment-level outcomes

FIM: Functional Independence Measure

Table 3. Brain Recovery Core assessment battery for physical therapists.

Measure ^{References} [ICF level] Adm. Time	Rationale for inclusion	Points administered		
		acute	Inpt. rehab.	Outpt. rehab.
<p>Active range of motion (AROM): shoulder flexion, wrist extension, knee extension 14, 39-44</p> <p>[Body function – UE & LE motion]</p> <p>~3 min.</p>	<p>A quick goniometric measure of ability to voluntarily activate limb muscles. AROM may be best at capturing and quantifying activation deficits at the lower end of the spectrum, which is particularly important at early time points post stroke. For the upper extremity, the ability to move segments against gravity is a strong predictor of UE function, even at different time points post stroke. Since the ability to move segments is similarly affected across the upper extremity, then measuring 2 segments (vs. all segments) is sufficient. Relationships between lower extremity AROM and gait are somewhat weaker. Knee extension was selected because relationships between impairments and gait have been evaluated most often with this movement.</p> <p>Note that fractionated movement is not specifically tested in this evaluation. This is because the ability to fractionate movement is strongly related to the ability to move in people with stroke, particularly early after stroke. Thus, there is no need to assess both.</p>	Ad	Ad*	
<p>Motricity Index (MI) 41, 42, 45-47</p> <p>[Body function – UE and LE strength]</p> <p>~5 min.</p>	<p>The MI quantifies strength through manual muscle testing on key, representative muscles groups, 3 for the UEs and 3 for the LEs. Like AROM, it is an indirect measure of the ability to volitionally activate limb muscles. Strength measures may be better able to capture deficits at the higher end of the spectrum, i.e. can the muscles be actively sufficiently to produce force against externally imposed loads. The MI provides scores quantifying the overall strength impairments for the UE and the LE. The MI is used to quantify motor impairments post stroke in clinical practice and in research around the world.</p>	Ad	Ad*, Dc*	Ad*
<p>Modified Ashworth Scale: Plantarflexors 48, 49</p> <p>[Body function – tone]</p> <p>~2 min.</p>	<p>This is the most common clinical measure used to assess tone. Assessment at only the ankle plantarflexors was chosen because information gained from this segment is reasonably representative of tone across the LE and provides sufficient information for clinical decision making.</p> <p>Note that tone is not assessed at the acute hospital because: 1) hypotonia is typically seen early after stroke and this scale does not quantify hypotonia; and 2) information on tone does not influence clinical decision-making at this early evaluation point.</p>		Ad	Ad

<p>Light touch sensation: Dorsum of Foot^{12, 50-55}</p> <p>[Body function – somatosensation]</p> <p>~2 min</p>	<p>Assessment of somatosensation is important in determining prognosis following stroke and for patient education. Light touch is the somatosensory modality most often tested. Since stroke typically affects multiple somatosensory modalities, diminished sensation on this item also conveys information about diminished sensation in other modalities. Assessment at only the bottom of the foot was chosen because information from this location is important for safe mobility.</p>	Ad	Ad	Ad
<p>FIM items: transfers, locomotion, stairs⁵⁶, for review see⁵⁷</p> <p>[Activity – mobility]</p> <p>5-10 min.</p>	<p>The FIM is the gold standard measure for rehabilitation outcomes. It was designed as a measure to assess functional level and need for assistance with basic activities of daily living. Using the FIM is a requirement for maintaining accreditation at inpatient rehabilitation facilities in the United States.</p> <p>Note that FIM items quantify performance only up to the level of independence.</p>	Ad†	Ad, Dc	Ad (per patient report)
<p>Berg Balance Scale⁵⁸⁻⁶¹</p> <p>[Activity – balance, risk of falls]</p> <p>~10 min.</p>	<p>This is the most common clinical measure of balance across a variety of patient populations. It quantifies 2 aspects of balance: the ability to maintain upright posture and the ability to make appropriate adjustments for voluntary movement. Data on predicting fall risk from Berg scores are available. Likewise, estimates of minimal detectable change have been published. Operational rules were put in place to shorten testing (see text).</p>	Ad	Ad, Dc	Ad, Mo
<p>10 m Walk Speed‡^{57, 62-66}</p> <p>[Activity – walking ability]</p> <p>3-5 min.</p>	<p>Walking speed is the most common measure of walking performance across a variety of patient populations. It allows quantification of walking ability above the threshold of independent ambulation. Published normative and threshold values are available. Walking speed is also the most common outcome measure for gait in clinical rehabilitation trials.</p>	Ad	Ad, Dc	Ad, Mo
<p>Timed Up and Go‡^{57, 67, 68}</p> <p>[Activity – functional mobility]</p> <p>3-5 min.</p>	<p>This is a common functional mobility measure used for a variety of patient populations. It is useful for quantifying deficits in transfers and functional mobility as patients achieve scores of 4 or greater on the FIM. Published normative values are available.</p>		Dc	Ad, Mo
<p>6 Minute Walk Test‡^{57, 63-65, 69-71}</p> <p>[Activity – walking endurance]</p> <p>~10 min.</p>	<p>This is the most common measure of walking endurance across a variety of patient populations. Early after stroke, walking speed and 6MWT are well correlated (people walk slowly and not very far), but later they become more dissociated. Published distances needed for community ambulation are available.</p>		Dc	Ad, Mo

UE: upper extremity; LE: lower extremity; Ad: admission; Dc: discharge; Mo: monthly;

*UE portions are done by Occupational Therapy on the inpatient and outpatient rehabilitation services.

†Stairs not routinely evaluated at the acute hospital, only done with higher-level patients per PT's judgment.

‡If the patient cannot walk without physical assistance from another person, this test is omitted and scored as "unable".

Table 4. Assessment tools and questions used for the 6 and 12 month follow-ups.

Assessment tool / question	Information and rationale for inclusion
Stroke Impact Scale (SIS) ^{31, 72-79}	This was chosen as our main assessment tool because it measures stroke-specific outcomes in multiple domains. Developed with input from patients with stroke and their caregivers, the SIS is a 59-item, patient-based, self-report scale measuring outcomes across eight domains: Strength, Hand Function, Mobility, Activities of Daily Living, Memory, Communication, Emotion, and Participation. Items from the first four domains can be summed to create a Physical Function score while scores on other domains are represented separately. Floor and ceiling effects are minimal compared to other common tests (e.g. Functional Independence Measure, Barthel Index, SF-36). Using this single tool (vs. multiple tools for multiple domains) reduces the testing burden. Finally, the SIS can be used via interview, telephone, or mail, and answers can be provided by proxy if needed.
Modified Rankin Scale ^{31, 80-83}	This scale, used here as a secondary outcome assessment, is a single-item tool for determining overall disability. A rating of 0-5 is used, with 0 indicating no symptoms and 5 indicating severe disability. It provides a gross indicator of global outcome and is somewhat insensitive to change. Because of its ease of use, low testing burden (< 2 minutes), and commonality of use in stroke clinical trials, it was included as a secondary measure.
Reintegration to Normal Living ^{84, 85}	This is a quality of life measure capturing how a person is able to resume normal life activities after an incapacitating illness or injury. It quantifies a person's satisfaction with basic self-care, in-home mobility, leisure activities, travel, and productive pursuits. It was included in the follow-ups to capture an individual's satisfaction with the outcome vs. their perception of outcomes themselves (as captured by the SIS).
Return to work questions	This is a multi-level set of questions asking if the person has returned to work after stroke. Available answers and follow-up questions capture information related to: not previously working, working in the same vs. different job, working for the same employer vs. different employer, paid vs. voluntary work, part-time vs. full-time etc.
Return to driving question	This is a question asking if the person has returned to driving. Available answers capture information related to: return to driving, and driving prior to stroke. Driving is significantly associated with community integration after stroke. ⁸⁶

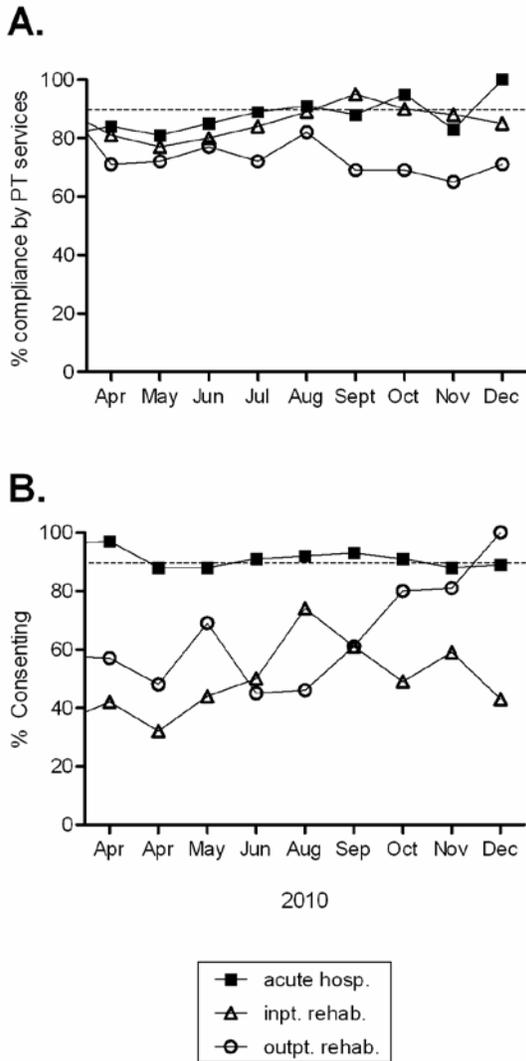


Figure 1. A: Compliance with the required physical therapy (PT) battery on all three services. B: Percent of patients consenting to have their rehabilitation and demographic information stored in the BRC database. Note that the acute hospital consent process has been in place for 10 yrs, while the inpatient and outpatient rehabilitation consent processes started in March 2010. The dashed horizontal lines indicate the desired 90% target rates.