Implementation of the Comprehensive Assessment Toolbox for Stroke in a Medical System

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KEY WORDS

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The need for outcome assessment in stroke management is a critical part of specialized stroke unit development. The Comprehensive Assessment Toolbox for Stroke was developed for this reason. This study describes the implementation of the Toolbox across a medical system as part of a stroke center of excellence. Toolbox data were collected from 2002 to 2004. Demographic data were analyzed. Patients were categorized by stroke severity. Outcome assessment tools were compared via paired sample t *tests. Also, data were analyzed using multivariate methods followed by univariate analysis of variance. Patients improved in outcomes from admission through their hospital stays. Clinically significant improvements were made in the mild and moderately affected groups. The severe stroke group improved the least. Tracking patient outcomes in a consistent way helps with program assessment and comparison. Patients leave rehabilitation at a dependent level in many functional areas.*

The Comprehensive Assessment Toolbox for Stroke (Toolbox) is an integrated system of assessment tools for patients with stroke developed for clinical assessment and research use (Duncan et al., 1999). The clinical use of the Toolbox was developed in response to the Agency for Health Care Policy Research (AHCPR) Post-Stroke Rehabilitation Panel recommendations suggesting that clinicians use reliable and valid outcome measures in evaluating patients with stroke (Post-Stroke Rehabilitation Panel, 1995). The Toolbox provides the clinician with information about the patient's current neurological status, disability and functional status, quality of life, and levels of family support over the course of rehabilitation (Duncan et al., 1999). Forbes, Duncan, and Zimmerman (1997) suggested that there often is wide variability in what is documented across treatment settings for stroke survivors. Kelly-Hayes (2004) also suggested that the use of stroke outcomes should be incorporated into daily nursing care. It is difficult to make comparisons of care for patients with stroke within a facility or between facilities because standardized outcomes are not being used. Forbes and colleagues recommended that further research be conducted to assess the relationship between documentation of care and patient outcomes.

The outcome measures included in the Toolbox were chosen because they were recommended in the AHCPR guidelines (Post-Stroke Rehabilitation Panel, 1995), were used in the Kansas City Stroke Study (Lai, Duncan, & Keighley, 1998), and were considered as Duncan and colleagues (1999) developed the Stroke Impact Scale. The measures were selected to create a system that could be implemented in the clinic without increasing health professionals' burden, yet would have great utility for clinical assessments and research. The assessment tools include the Orpington Prognostic Scale (Kiernan, Mueller, Langston, & Van Dyke, 1987), the National Institutes of Health Stroke Scale (Brott et al., 1989), the Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975), the Geriatric Depression Scale (GDS; Yesavage et al., 1983), the Barthel Activities of Daily Living (ADL) Index (Mahoney & Barthel, 1965), the Lawton Instrumental Activities of Daily Living (IADL) Scale (Lawton, 1988), the Rankin Scale (Rankin, 1957), and the Stroke Impact Scale (Duncan et al., 1999). All these tools were selected from the standard instruments reviewed by the AHCPR Post-Stroke Rehabilitation Panel. In this selection process, the particular strengths and weaknesses of the tools were considered (Post-Stroke Rehabilitation Panel, 1995).

Most measures chosen were reliable and valid in stroke or in a related population (e.g., older adults) if possible. Common criteria for tool selection included wide use of the assessment for that area, applicability to stroke, speed and ease of administration, and validity and reliability. In the outcome measures analyzed in this study, the MMSE, used widely as a cognitive screen, has test-retest reliability, $r = .998$, and moderate-to-strong validity compared with other IQ tests, $r = .660–.776$ (Folstein et al., 1975). The GDS has not been specifically tested in stroke, but it was developed to use with older adults (over age 55). It has been shown to have high internal consistency, $\alpha = .94$, and strong validity with other depression scales, $r = .69–.83$ (Yesavage et al., 1983). The Barthel

ADL scale has been found to be reliable in stroke, k = .98 (van Swieten, Koudstaal, Visser, Schouten, & Van Gijn, 1988), with excellent interrater reliability, $k \geq .88$. The Barthel ADL scale has a low sensitivity for high-functioning patients (Duncan et al., 1999). The Rankin also is reliable, k weighted = .91, but the interrater reliability is less reliable, k = .75 (Wolfe, Taub, Woodrow, & Burney, 1991). The Rankin also has low sensitivity (Duncan et al., 1999).

The Toolbox instruments provide a complete profile of the patient, including demographic data and assessments of impairment, disability, and quality of life (Duncan et al., 1999). The following information is recorded as part of the Toolbox: patient demographics, modifiable stroke risk factors, stroke characteristics (onset, type, and severity), history of previous stroke and comorbidities as measured by the Charlson Comorbidity Index (CCI; Charlson, Pompei, Ales, & MacKenzie, 1987), and discharge disposition. The assessment tools are to be completed at acute admission, acute discharge, postacute discharge, and 1-month and 3- or 6-month follow-ups. Any member of the multidisciplinary team can administer the Toolbox, including the physician, nurse, or physical or occupational therapist (Duncan et al., 1999).

The use of standardized stroke assessment measures would permit rehabilitation team members to follow patients from stroke admission to final discharge. The purpose of this article is to describe the implementation of the Toolbox in a medical system continuum of care, discuss the data that were collected and their clinical interpretation, and discuss the challenges of implementing the Toolbox in a healthcare system. The hypothesis is that patients demonstrate improvement on the outcome measures from admission to discharge. Also, with the implementation of a stroke center of excellence (COE) in mid-2001, the authors hypothesized that patient outcomes would improve progressively over the years as COE initiatives were developed and implemented.

Method

The Toolbox was implemented through the Forum Health Medical System in Youngstown, OH, as part of the development of a stroke COE at the Hillside Rehabilitation Hospital (HRH). The primary investigator obtained institutional approval for this project. The Forum Health system consists of two area acute care hospitals that refer patients to the rehabilitation hospital. In addition, there is another area hospital with a primary stroke care center, and acute care hospitals further from the immediate area refer patients with stroke for rehabilitation. After the task force developing the plan for the COE was presented the Toolbox and approved its implementation, the Toolbox was presented to the medical staff and department heads of clinical services at all facilities. The group identified implementation strategies and determined which disciplines would be responsible for data collection. The recommendations for implementation were presented to the entire nursing and rehabilitation professional staff in an in-service session, with additional training on the tools for all professionals involved in their administration. This training was provided by the primary author through scheduled group in-service sessions and in individual meetings, if necessary, to answer questions and clarify information. All care providers involved in patient assessment were provided with copies of the outcome tools and instructions for implementation. Review and clarification of tool use continue to occur, as needed, during additional in-service sessions, individual meetings, and quarterly staff meetings in the hospitals. During training, the appropriateness of assessment tools for patients with particular problems was discussed. For example, patients with aphasia were not assessed with the MMSE. Similarly, if a patient did not understand and could not adequately respond to the GDS, then it was not administered to that patient. These issues are noted on the assessment forms.

From July to December 2001, the Toolbox was implemented as a trial run to answer rater questions and solidify the data collection process. Beginning in January 2002, Toolbox data for analysis were collected on all patients who entered the Forum Health acute care hospitals and were referred to the HRH COE. Health professionals at the acute medical centers began to collect baseline data on all patients admitted with a diagnosis of stroke within the first 72 hours.

Results of the patient's Toolbox performance were faxed to HRH at discharge from acute care. When patients were referred to HRH from an acute hospital outside the Forum Health system, baseline data were collected at admission to rehabilitation, again within the first 72 hours. When data were missing, raters in the acute care and rehabilitation settings were notified by the primary nurse manager of the COE at HRH and encouraged to complete future data collection. After patient discharge, data were forwarded to medical records, and student research assistants entered the data into the hospital Access database that was downloaded from the Kansas University Medical Center Web site (www2.kumc.edu/coa; Duncan et al., 1999). Access to the database is protected. The staffs of the hospitals are provided with annual summary reports of patient outcomes with no identifiers.

Data Analysis

Data were analyzed from 2002 to 2004. The data were stratified into three groups based on stroke severity as determined by the Orpington Prognostic

Score (Kiernan et al., 1987). On the Orpington, 2.2–2.8 indicates a minor stroke, 3.2–4.4 indicates a moderate stroke, and 5.2–6.8 indicates a severe stroke. Paired-sample *t* tests were used to compare baseline to discharge scores on the MMSE, Barthel ADL, Lawton IADL, GDS, and Rankin score for each patient severity group to identify progress during the hospital length of stay.

Missing data were handled as follows. All descriptive statistics (including frequencies, means, ranges, and standard deviations) and univariate analyses of variance (ANOVAs) were computed so that cases with no missing values for variables in a group were included in the analysis of that group. Cases may have had missing values for variables used in other groups.

Two-way ANOVAs were used to determine differences on the outcome measures for each level of stroke severity between the 3 years. For all statistical tests, the significance level was set at (alpha) = .05. A Fisher's least significant difference (LSD) test was used as a post hoc analysis. In addition, because outliers were identified in the data set, the ANOVAs were repeated without the outliers, and there were no substantial changes in the observed significance.

Extraneous variables present in the toolbox were examined to determine whether statistical control of these factors was warranted. Of these, only the CCI surfaced as a potential confounding variable, because comorbidity affects patients' recovery rates. To determine whether control for this was needed, ANOVAs by year of CCI were computed for each of the stroke severity groups: mild, moderate, and severe. No statistically significant difference in CCI was found over time for any of the severity groups, $F(2, 80) = 0.407$, $p = .68$; $F(2, 331) = 2.388$, $p = .09$; $F(2, 119) = 0.190$, $p = .83$, respectively. The largest limitation of the Toolbox is related to some missing values resulting from the associated paperwork and time constraints of data collection.

Results

Table 1 presents the demographic data for all patients throughout the 3 years. Mean age, gender distribution, and stroke location were similar between years. Each year, approximately 60% of patients had moderate strokes. Minor strokes accounted for the smallest percentage of patients who went through the acute care and rehabilitation system, with 18% in 2002, 12% in 2003, and 16% in 2004. The percentages of patients with severe strokes admitted through the entire system each year were 19% in 2002, 26% in 2003, and 23% in 2004.

Patient improvement in Toolbox measures throughout the hospital stay was thought to be a very important outcome measure to support rehabilitation services. When possible, the investigators compared the discharge scores with the established cutoff scores for each measure to determine whether patients were approaching or achieving independence for that outcome measure.

Table 2 lists the mean score results from the MMSE. Patients with aphasia were not assessed with the MMSE. On the MMSE, scores less than 24 indicate cognitive impairment (Folstein et al., 1975). In the patient group of minor strokes for all 3 years both admission and discharge MMSE scores were above 24, indicating intact cognition, but discharge scores in 2004 improved throughout the hospital stay and were significantly different from the other years. Both the moderate and severe groups had admission MMSE scores lower than 24 for all 3 years, and at discharge the scores improved to 24 or above except in the severe stroke group in 2002. Improvement in the MMSE scores was significant for all 3 years in the moderate stroke group, but not significant in the severe group (Table 2).

Table 3 lists the mean Barthel ADL scores. On the Barthel ADL scale, scores of 60 and below indicate that the patient remains dependent in ADLs (Mahoney & Barthel, 1965). All stroke groups, regardless of severity, had ADL scores on admission that suggested that they were dependent in ADLs. At discharge, the minor stroke group reached a level substantially above 65 on the Barthel scale for all 3 years, indicating that most were independent in their ADLs. In 2002, 46% of the minor stroke patients reached this score or better; in 2003, 100% reached it; and, in 2004, 57% reached it. In the moderate stroke severity group, the 2003 and 2004 mean Barthel scores were 65 and above. However, in 2002, although there was a significant improvement in the Barthel ADL score, the mean score did not reach 65 at discharge. In 2002, 45% of patients reached a score higher than 65, and these percentages improved in 2003 (67%) and 2004 (77%). In the severe stroke group, both admission and discharge scores continued to indicate that the patients in this group were dependent in ADLs. There was significant improvement through the hospital stay, but it was not enough to qualify patients as independent. In 2002 and 2004, no patients reached a score of 65, and only 11% of the patients reached this in 2003.

Table 4 presents the mean score results for the Lawton IADL Scale. On the Lawton IADL Scale, a maximum score of 27 indicates complete independence in IADLs (Lawton & Brody, 1969). In the IADLs no patient group had admission or discharge scores that indicated independence. All groups improved significantly during the hospital stay, and the minor

Table 1. Patient Demographic Information for 2002, 2003, and 2004

	2002 (*N* = 208) Years *(SD)*	2003 (*N* = 179) Years *(SD)*	2004 (*N* = 176) Years *(SD)*
Mean age	73.14 (11.17)	72.59 (13.42)	72.75 (11.97)
Age range, years	42–93	23–100	39–98
Gender	% (*n*)	% (*n*)	% (*n*)
Male	47 (98)	40 (72)	46 (81)
Female	53 (110)	60 (107)	54 (95)
Stroke severity	% (*n*)	% (*n*)	% (*n*)
Minor	18 (38)	12 (21)	16 (28)
Moderate	63 (131)	62 (111)	62 (109)
Severe	19 (39)	26 (47)	22 (39)
Charlson Comorbidity Index	Mean *(SD)*	Mean *(SD)*	Mean *(SD)*
Minor	1.29 (1.27)	1.10 (1.41)	1.44 (1.34)
Moderate	1.40 (1.24)	1.03 (1.52)	1.30 (1.22)
Severe	0.81 (0.86)	0.91 (0.99)	0.92 (0.90)
Average length of stay	Mean *(SD)*	Mean *(SD)*	Mean *(SD)*
Minor	15.0 (8.7)	17.1 (5.5)	25.5 (67.9)
Moderate	20.7 (8.4)	22.7 (14.7)	21.0 (8.6)
Severe	25.2 (10.2)	50.8 (93.1)	25.3 (11.1)
Stroke location	% (*n*)	% (*n*)	% (*n*)
Left hemisphere	47 (89)	45 (77)	36 (57)
Right hemisphere	43 (83)	47 (81)	53 (84)
Cerebellum	6 (12)	5 (8)	6 (10)
Bilateral	2 (4)	2 (3)	2 (3)
Brainstem	2 (3)	2 (4)	3 (5)

Table 2. Mini-Mental State Examination[a] Mean Admission and Discharge Scores from the Rehabilitation Setting by Stroke Severity

	2002		2003		2004	
Severity	Baseline	Discharge	Baseline	Discharge	Baseline	Discharge
Minor						
Mean *(SD)*	24.9 (4.7)	27.5 (2.1)	24.7 (4.0)	26.2 (4.8)	24.3 (5.0)	25.0 (6.3)
Range	9–30	24–30	16–30	21–30	9–29	9–30
N	24	6	19	5	26	10
t[b] *(df)*	-2.138 (4)	*p* = .099	-2.359 (4)	*p* = .078	-3.595(14)	*p* = .003
Moderate						
Mean *(SD)*	22.4 (6.3)	24.0 (7.0)	22.1 (5.4)	25.9 (4.4)	20.0 (7.0)	23.1 (6.6)
Range	5–30	4–30	8–30	13–30	6–30	6–30
N	84	26	76	25	89	49
t[b] *(df)*	-3.090 (25)	***p* = .005**	-4.409 (23)	***p* = .000**	-7.408(43)	***p* = .000**
Severe						
Mean *(SD)*	19.2 (5.5)	22.7 (4.6)	21.7 (5.4)	25.5 (4.4)	16.2 (7.7)	25.0 (5.6)
Range	9–26	20–28	13–28	17–29	4–28	18–30
N	9	3	16	6	25	6
t[b] *(df)*	-0.143 (1)	*p* = .910	-1.633 (4)	*p* = .178	-2.228 (5)	*p* = .076

[a]Mini-Mental State Examination scores range from 0 to 30; [b]Paired-sample *t* test baseline to discharge.

and moderate severity groups achieved discharge scores that approached independence in IADLs.

Table 5 lists the mean score results for the GDS. On the GDS, scores of 5 or above indicate that a patient is showing signs of depression (Yesavage et al., 1983). In all the severity groups, admission and discharge mean scores were less than 5, indicating no signs of depression. There was significant change in the average scores in the minor stroke group in 2002, the moderate stroke groups for all 3 years, and in the severe stroke group in 2003. There was a further decrease in the GDS score for all groups throughout the hospital stay, except in the severe stroke group in 2002, which showed an increase, yet the mean GDS score did not reach 5. On an individual basis, some patients had GDS scores that indicated depression, but scores decreased during the hospital stay. In the minor stroke group, 20% of patients did so in 2002,

Table 3. Barthel Activities of Daily Living[a] Mean Admission and Discharge Scores by Stroke Severity

	2002		2003		2004	
Severity	**Baseline**	**Discharge**	**Baseline**	**Discharge**	**Baseline**	**Discharge**
Minor						
Mean *(SD)*	47.1 (19.2)	75.4 (19.0)	44.4 (14.2)	88.6 (11.8)	50.7 (21.2)	69.3 (14.6)
Range	0–85	35–100	25–70	70–100	20–90	50–95
N	35	13	17	7	22	7
t[b] *(df)*	-6.085 (12)	***p* = .000**	-5.979 (5)	***p* = .002**	-7.743 (12)	*p* = .000
Moderate						
Mean *(SD)*	29.0 (19.7)	59.1 (23.2)	32.1 (17.6)	71.1 (19.4)	31.0 (17.2)	65.5 (19.9)
Range	0–85	0–95	0–75	25–100	0–70	15–95
N	117	38	74	33	75	29
t[b] *(df)*	-11.596 (37)	***p* = .000**	-9.965 (29)	***p* = .000**	-11.844 (25)	*p* = .000
Severe						
Mean *(SD)*	10.0 (12.5)	16.3 (19.6)	15.9 (20.1)	41.0 (30.6)	7.8 (7.6)	23.3 (17.6)
Range	0–85	0–95	0–75	25–100	0–90	0–100
N	32	8	35	10	29	3
t[b] *(df)*	-2.428 (7)	***p* = .046**	-3.590 (8)	***p* = .007**	-1.796 (2)	*p* = .214

[a]Barthel Activities of Daily Living scores range from 0 to 100; [b]Paired-sample *t* test baseline to discharge.

Table 4. Lawton Instrumental Activities of Daily Living[a] Mean Admission and Discharge Scores by Stroke Severity

	2002		2003		2004	
Severity	**Baseline**	**Discharge**	**Baseline**	**Discharge**	**Baseline**	**Discharge**
Minor						
Mean *(SD)*	13.5 (3.5)	21.3 (2.4)	14.0 (3.4)	22.2 (2.6)	14.6 (4.4)	22.4 (2.8)
Range	9–22	18–27	11–20	19–27	10–24	18–27
N	36	19	21	17	28	22
t[b] *(df)*	-9.497 (17)	***p* = .000**	-7.494 (16)	***p* = .001**	-12.119 (38)	***p* = .000**
Moderate						
Mean *(SD)*	12.2 (3.1)	18.1 (4.1)	12.7 (3.3)	18.9 (3.9)	11.8 (2.9)	19.6 (3.7)
Range	9–21	9–23	9–24	9–27	9–25	9–27
N	122	54	106	83	104	90
t[b] *(df)*	-11.609 (53)	***p* = .000**	-13.464 (79)	***p* = .000**	-17.688 (86)	***p* = .000**
Severe						
Mean *(SD)*	10.2 (2.1)	12.5 (4.3)	11.3 (3.4)	13.8 (4.5)	10.2 (2.1)	14.1 (4.8)
Range	9–21	9–21	9–25	9–25	0–25	9–25
N	38	13	46	34	38	28
t[b] *(df)*	-2.392 (12)	***p* = .034**	-5.075 (33)	***p* = .000**	-5.069 (27)	***p* = .000**

[a]Lawton Instrumental Activities of Daily Living minimum score 9, maximum score 27; [b]Paired-sample *t* test baseline to discharge.

11% in 2003, and 5% in 2004. In the moderate stroke group, 21% of patients did so in 2002, 20% in 2003, and 19% in 2004. Finally, in the severe patient group, as expected in 2002, no patients showed this improvement; however, in 2003, 63% improved, and in 2004, 7% improved.

On the Rankin Scale, higher scores (5 maximum) indicate greater disability, and scores of 2 or less indicate that the person is able to function independently (Rankin, 1957). In all severity groups, both admission and discharge scores indicated that the patients remained dependent on this global disability indicator. Each group showed significant improvement on the Rankin score, with lower scores at discharge, with the exception of the severe stroke group for all 3 years. In the severe groups, there was very little change (0.1) consistently across all 3 years.

In order to see whether the implementation and continued development of the Stroke COE was influencing patient outcomes, an ANOVA was used to compare the outcome measures across the 3 years (2002, 2003, and 2004). Each patient group (minor, moderate, severe) showed improvement in all outcome measures from 2002 to 2003 and 2003 to 2004,

Table 5. Geriatric Depression Scale[a] Mean Admission and Discharge Scores by Stroke Severity

Severity	2002 Baseline	2002 Discharge	2003 Baseline	2003 Discharge	2004 Baseline	2004 Discharge
Minor						
Mean *(SD)*	3.3 (3.6)	2.3 (3.6)	3.5 (2.6)	3.1 (2.3)	2.3 (1.9)	2.3 (2.1)
Range	0–15	0–15	1–10	1–10	0–14	0–11
N	26	18	20	18	24	23
t[b] *(df)*	2.748 (16)	***p* = .014**	1.706 (17)	*p* = .106	1.585 (38)	*p* = .121
Moderate						
Mean *(SD)*	4.8 (3.0)	2.6 (2.2)	3.8 (3.0)	2.8 (2.4)	4.8 (3.4)	3.0 (2.7)
Range	1–13	1–9	1–13	1–12	0–14	0–11
N	87	60	87	70	85	76
t[b] *(df)*	4.215 (46)	***p* = .000**	3.734 (60)	***p* = .000**	3.800 (64)	***p* = .000**
Severe						
Mean *(SD)*	3.1 (2.6)	4.4 (3.2)	4.3 (3.1)	3.9 (3.4)	4.3 (3.6)	3.2 (1.8)
Range	0–11	1–9	1–11	1–11	0–14	0–8
N	16	10	23	26	29	23
t[b] *(df)*	-0.397 (8)	*p* = .702	2.070 (19)	*p* = .052	1.500 (20)	*p* = .149

[a]Geriatric Depression Scale scores range from 0 to 15. Scores greater than 5 are a positive screen for depression; [b]Paired-sample *t* test baseline to discharge.

but the only statistically significant changes occurred on the Barthel Index, $F(2, 136) = 3.917$, $p = .02$, and the Lawton IADL scale, $F(2, 350) = 3.245$, $p = .04$. A Fisher's LSD comparison revealed significant differences between 2002 and 2004, with 2004 having more favorable outcome scores.

The Toolbox data also provided a way to track discharge disposition. In the minor and moderate stroke severity groups, 75% or more of the patients went home with assistance or independently across all 3 years. In contrast, in 2002 and 2003, 65% and 51%, respectively, of the severe stroke patients were discharged to a nursing home. However, in 2004 only 46% of these patients were discharged to a nursing home, and 49% were discharged home with assistance. The remaining 5% were transferred back to the acute hospital because of medical complications.

Finally, one of the challenges of completing the Toolbox in a clinical setting is prompting the staff to complete the outcome tools. To increase compliance, the percentage completion of the tools has been tracked since implementation. Compliance in completing the Toolbox items varied each year, ranging from 15% to 60% on each tool in 2002, and improved to 20%–78% by 2004. Each year the overall completion rate has increased.

Discussion

Through implementation of the Toolbox as a standard way to collect patient outcome data in acute care and rehabilitation, the monitoring of progress and the identification of impairments and disabilities are made quantifiable (Duncan et al., 2002). Also, as demonstrated by Duncan and colleagues, greater adherence to the AHCPR Post-Stroke Rehabilitation Panel guidelines (which recommend that valid and reliable measures be used for outcome assessment) is associated with improved patient outcomes. In a recently published article considering the evidence, benefits, harms, and recommendations for the five elements of poststroke rehabilitation included in the guidelines, the authors stated that the benefits of using standardized assessment instruments included ensuring reliable documentation of patient performance and progress. There was no identification of harm (Rodin, Saliba, & Brummel-Smith, 2006). The development of this COE emphasized these guidelines, including the use of baseline assessments and standardized scales to characterize patient response to medical and therapeutic interventions. The significant improvements between 2002, when the COE was begun, and 2004 on the Barthel Index and Lawton IADL scale (in moderate stroke) are examples of this positive change in patient outcomes.

Improvements were noted in subsequent years in the Barthel Index. The Barthel Index mean score for patients with a moderate stroke was less than 65, indicating dependence in ADLs at discharge in 2002, yet it increased to more than 65 at discharge in 2003 and 2004, indicating greater independence. Furthermore, in the minor stroke group, this score was higher than 65 at discharge for every year. In the severe stroke patients, the Barthel Index score remained below 65 at discharge every year. Despite the low sensitivity of the Barthel Index in high-functioning patients, the assessment tool was useful in this setting because a majority of patients treated were moderately or severely

involved. This information has been used by the rehabilitation team to indicate success in improved patient care provided through a team approach to basic ADL achievement. ADL completion is part of the nursing and therapy concentration in the patient's plan of care. Also, by quantifying the level of dependence or independence for a patient, the case workers are better able to advise families about the amount of care that the survivor may need upon discharge from the center.

Although other outcome measures did not reveal a statistically significant difference, the analysis of the outcomes revealed clinically useful information. On average, the low GDS scores indicated that patients were not experiencing high levels of depressive symptoms. However, some patients' GDS scores exceeded the accepted cutoff score, indicating possible clinical depression. Before the initiation of the Toolbox, this area was not consistently assessed in this rehabilitation hospital. Depression can be common in stroke survivors and affects participation in rehabilitation programs (Schleifer, 2003; Sinyor, Amato, Kalouped, Becker, & Goldenberg, 1986; Turner-Stokes, 2002). The incorporation of the GDS as a screening and outcome tool was deemed helpful. In the first year of Toolbox use, the neuropsychology department was not involved in administration of the GDS. However, after patients were identified through screening, the neuropsychology department decided to become more involved in patient screening. This facilitated identification of an individual patient's psychological status and often led to increased intervention through counseling sessions and group activities. There was an improvement in the GDS scores from 2002 to 2004, with a steady decrease in mean GDS scores at discharge from rehabilitation from 2002 to 2004.

The Rankin scores at discharge from rehabilitation revealed that most patients continued to be dependent, with no severity group reaching a score of 2 or less. The average length of stay in acute care is typically 4–5 days, and in the rehabilitation hospital the mean length of stay was 20 days for the minor and moderate groups. Length of stay for the severe group was 25 days in 2002 and 2004, with 2003 being longer (50 days). However, patients are still in the early stages of spontaneous recovery (first 3 months), and, depending on stroke severity, they may need additional time in rehabilitation to optimize their abilities and outcomes. This was previously demonstrated by Jorgensen and colleagues (1995) in the Copenhagen Stroke Study. The investigators found that at discharge from rehabilitation, patients with very severe or severe stroke had poorer prognosis for both neurological and functional recovery. For all patient groups in this study, the length of stay was the shortest in minor stroke, longer in moderate stroke, and longest in severe stroke (Table 1). However, all groups were discharged on average within 31 days of their stroke onset. This is less than the optimal amount of time for therapeutic effectiveness because recovery is facilitated by practice and repetition over time of a variety of tasks (Hanlon, 1996; Post-Stroke Rehabilitation Panel, 1995). Also, with more intensity of practice (additional time and intensity of task practice in inpatient rehabilitation), it may be possible to advance the patient's recovery and improve performance on measures such as the Barthel and Rankin scales, helping patients become more independent before discharge. Because the rehabilitation environment is limited in length of stay by the prospective payment system and other reimbursement sources, patients are discharged before they reach their full potential. This supports the need for additional therapy, either in a skilled nursing facility, at home, or in an outpatient setting.

The Lawton IADL scores improved, but patients were not independent in their IADLs at discharge from the rehabilitation setting. The severe stroke group showed the least change on the Lawton IADL scale in all 3 years and had the lowest mean discharge scores. Zinn and colleauges (2004) demonstrated that recovery of IADLs is slower in patients with cognitive impairment. The data set for this study confirms this finding, with patients with severe stroke also having MMSE scores that were below or very close to the cutoff score of 24 (suggesting cognitive impairment) at discharge from rehabilitation.

As documented in previous studies (Jorgensen et al., 1995; Partridge, Morris, & Edwards, 1993), the authors have found that patients with a severe stroke seem to make the smallest functional gains during rehabilitation. On the outcome measures of ADLs and IADLs and the Rankin Scale, patients in the severe stroke group were dependent at discharge from rehabilitation and often were not discharged home. Factors that appeared to affect discharge placement to home included willingness of the family to help the patient at home and patient motivation. However, as Horn and colleagues (2005) demonstrated, early and more aggressive therapy (including physical, occupational, and speech) produces better outcomes as measured by the Functional Independence Measure total, motor, and cognitive scores for patients at all stroke severity levels. In addition, a related study conducted by Maulden, Gassaway, Horn, Smout, and DeJong (2005) concluded that fewer days from acute symptom onset to initiation of aggressive rehabilitation was associated with better functional outcomes at discharge and a shorter length of stay. This was especially true in their severe stroke group. In this study, even though the severely affected patients did

not reach levels of functional independence delineated by the specific tools, they did improve on all the measures. The authors are unable to assess whether this outcome would be the same if immediate therapy had not started as soon as patients were stable and could tolerate rehabilitation. Further research is needed to assess the most appropriate level of intervention for patients with severe stroke in the rehabilitation setting in the early phase of their recovery.

A limitation of this clinical study is that various clinicians collected the data. However, in most analyses of the individual outcome measures, the number of cases was sufficient. Generally, compliance in completing the outcome tools has increased over the 3-year period. Continued in-service education, individual support and personal discussions, and staff meetings have been essential to ensure that data are collected in a systematic fashion. In acute hospital settings, therapy departments used tool completion as part of their departmental quality improvement. At the rehabilitation stroke COE, the nurse manager has used tool completion charts to increase the staff's compliance. Also, incorporating completion of the Toolbox assessments into practitioners' documentation requirements is being considered. This direct connection with job performance should increase tool completion.

Another consideration is the appropriateness of the assessment tools included in the Toolbox. Some of the tools chosen as part of the Toolbox were developed decades ago (e.g., Rankin Index, 1957; Barthel Index, 1965; MMSE, 1975; GDS, 1983; and Lawton IADL scale, 1988). In selecting the Toolbox assessment tools, the authors considered many factors, including applicability to the stroke population, reliability and validity, efficiency of clinical use, and ease of interpretation (Duncan et al., 1999). These assessment tools, especially the Barthel Index and the Rankin, remain widely used in many stroke research trials.

The decision to implement the Toolbox in this COE was not intended to prevent any of the healthcare professionals from using other assessment measures that were specifically related to and important for their discipline. The implementation was intended to promote consistency in data collection across all disciplines, which would reflect patient performance and progress in ways that would be meaningful to the entire stroke team. Also, it was planned to use this information to compare our stroke rehabilitation program with those of other facilities that implemented the Toolbox. However, to our knowledge no other facility is consistently using the Toolbox. One possible reason is the additional time needed to collect data and the consistency needed in data collection and interpretation to make data meaningful. Numerous assessment measures applicable to stroke are available, with no agreement about the best measures to use to reflect quality and outcomes in patient care. The authors currently use additional outcome measures in the facility to reflect overall patient progress, such as the Functional Independence Measure (Keith, Granger, Hamilton, & Sherwin, 1987). Future research is pending to determine the relationships between outcomes assessed using the Toolbox and these other measures.

Despite these limitations, this detailed database of patient characteristics and outcomes has helped guide individual patient care, COE program assessment, continued quality improvement, admission criteria, family communication, research, and marketing of the specialty unit for the medical system. The assessment tools have been used in a retrospective medication study in the facility. In addition, the case managers often comment on the usefulness of data to paint a prognostic picture, based on real numbers from this facility, for family members as they determine how to best care for their loved one. As the utility and completeness of the Toolbox increase, it will provide useful data for additional research. Questions about age and gender differences in stroke outcomes remain and will be considered—along with other research questions—in future studies. Also, as the rehabilitation hospital incorporates new strategies in care delivery, patient outcomes will be consistently tracked as a result of new interventions in patient care.

Key Practice Points

1. Although patients who suffer a stroke and undergo intense rehabilitation generally make significant progress during the rehabilitation process, the mild and moderately affected groups make the greatest functional improvements.
2. Using the recommended standardized outcomes assessment measures in the Comprehensive Assessment Toolbox for Stroke provides facilities with valid and reliable data from which they can make patient care decisions, track quality of care, and use in marketing initiatives.
3. There are many assessment measures available for tracking stroke outcomes; however, to produce useful data and compliance for administration, measures need to be valid and reliable for the population, easy to execute, interpret, and understand, and time efficient to implement.

Conclusion

The implementation of the Comprehensive Assessment Toolbox for Stroke throughout a medical system is a challenging yet informative and beneficial initiative. Data from the Toolbox help clinicians make more informed predictions and decisions

about their patients. The use of the Toolbox may also help predict who will benefit from comprehensive stroke intervention through acute hospitalization and rehabilitation. It also provides solid outcome data for program assessment and continued development of the stroke center. Finally, it facilitates future research within the facility.

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