Initial Functional Independence Measure Score and Interval Post Stroke Help Assess Outcome, Length of Hospitalization, and Quality of Care

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Objective: This study tests the hypothesis that the rehabilitation hospital admission functional Independence Measure (FIM) score and interval post stroke can be used to define clinically relevant functional recovery goals, estimate length of stay, and compare quality of care. Background: The effects of time from stroke to rehabilitation unit admission on admission and discharge FIM scores, length of rehabilitation stay, and change in FIM score/day have not yet been reported. Methods: Analysis was based on prospectively collected data from patients admitted to an inpatient stroke rehabilitation unit with FIM scores ≤ 90 and an initial, unilateral, hemispheric, thrombotic, or embolic stroke who were fully independent without the use of an assistive device before their stroke. Patients with severe (admission FIM < 54) and moderate (admission FIM 54–90) stroke deficits were divided into cohorts based on interval from stroke to rehabilitation hospital admission: 0–2, 2–4, and 4–6 weeks. Results: Over a 17-month interval, 87 patients met selection criteria. Significant improvements were seen in total FIM scores for all. For those with moderate stroke, all three time cohorts reached a FIM score of 102 ± 2 SEM after 35 ± 2 days on the rehabilitation unit. Patients admitted within 2 weeks of a severe stroke reached a plateau FIM score of 72 ± 6 after 43 ± 3 days on the rehabilitation unit compared with the 2–4 week group (FIM = 57 ± 5 after 53 ± 4 days) and the 4–6 week group (FIM = 54 ± 10 after 40 ± 6 days). Complications increased with severity of stroke and delay in rehabilitation hospital transfer. Conclusions: Admission FIM score and interval from stroke to rehabilitation hospital admission can be used to set FIM outcome goals, predict length of rehabilitation hospitalization needed to meet those goals, and compare quality of care across institutions with different referral patterns. Our results provide a benchmark against which to compare less intense or shorter duration inpatient treatment options. Key Words: Functional outcome—Stroke rehabilitation—Cerebrovascular disease.

Based on over 534 stroke rehabilitation units participating in the Functional Independence Measure (FIM) Uniform Data Set, it is estimated that for patients with an initial stroke, the mean national admission and discharge FIM scores are 63 and 86. The average change in FIM score/day is 1.06, and the average length of stay on the rehabilitation unit is 22 days (1). These data are for all stroke admissions, irrespective of the location of stroke, its etiology, severity, interval from stroke onset to rehabilitation unit admission, or premorbid level of functional independence. Such data are of limited use in comparing a specific stroke rehabilitation unit with others who may have a different case mix and referral pat-
tern. These data are of even less value when planning the rehabilitation goals or estimating the expected length of stay for a specific patient.

Efforts to improve outcome prediction have grouped patients based on their admission FIM scores into high, medium, or low functioning groups (2,3). A more recent report has focused on age and initial motor and cognitive subscores of the FIM to predict outcome (4). These parameters were significantly related to rehabilitation hospital length of stay and frequency of discharge to home versus another institution and explained 53% of the variance in discharge motor FIM subscores.

Since FIM scores are expected to improve with time following stroke, it would be useful to know how the recovery curve is affected by the interval from stroke to rehabilitation unit admission. A patient admitted to a rehabilitation unit 5 days post stroke with a FIM score of 40 may have quite different outcome expectations than a patient admitted 3 weeks post stroke with the same score.

The development of normative outcome data following stroke had been advanced by the recognition that the more uniform the study population, the more reliable the outcome expectations (5). Patients with hemorrhagic stroke have double the mortality of those with ischemic lesions and should be analyzed separately (6). Those with bilateral hemispheric lesions or brainstem stroke are expected to do worse than those with unilateral hemispheric lesions and should not be included in the same normative data set. Those with second stroke and those who because of arthritic, orthopedic, cognitive, or cardiopulmonary limitations were not independent in the community before their stroke should also be analyzed separately (7).

The current study presents functional outcome recovery curves for patients who were independent in the community and who suffered an initial, unilateral ischemic, hemispheric stroke. Data are stratified for severity of stroke and interval from stroke to rehabilitation unit admission.

Methods

Patient Selection

Data from all patients previously independent in the community without need of walking assist devices with initial unilateral ischemic hemispheric stroke admitted to an acute inpatient stroke rehabilitation unit with initial FIM scores < 90 were available for review. The study was conducted at Burke Rehabilitation Hospital, a nonprofit institution in the New York metropolitan area with a referral base encompassing three states. The diagnosis of stroke was based on the clinical history, neurologic examination, and neuroimaging studies that were available for each patient.

Patients were sorted into cohorts based on the interval from stroke to rehabilitation hospital admission (0–2, 2–4, and 4–6 weeks) post stroke. Two-week intervals were chosen because 14 days is the published national average interval from stroke to rehabilitation hospital admission.

Assessment Techniques

The number of complications occurring during the acute-care hospital stay were recorded based on information provided by the acute-care hospital discharge summary, transfer forms, and phone contact with the referring physician. The number of medical comorbidities was the sum of the patient's medical diagnoses that antedated their stroke.

FIM scores were recorded within 72 hours of admission and at team conference meetings every 10 days thereafter during the rehabilitation hospital stay (8). Final FIM scores were recorded within 72 hours of discharge.

FIM scores range from a minimum score of 18 to 126, representing best performance. Patient scores can be divided into the top third with mild deficits (scores > 90), moderate deficits (54 ≤ FIM score ≤ 90), and severe deficits (FIM score < 54). Similarly defined FIM cohorts have been described by Stineman and coworkers (4). Patients with mild strokes (admission total FIM scores > 90) were excluded because they are frequently discharged from the acute-care hospital to home or outpatient rehabilitation and are not routinely admitted to our unit.

FIM scores were generated prospectively by rehabilitation team members trained and standardized using Uniform Data Set (UDS) training material. They were not aware of the current prospective outcome protocol.

The number of days between FIM scores during the rehabilitation hospital stay was calculated and grouped into 2-week intervals dating from the time of stroke (i.e., 0–2 weeks, 2–4 weeks, 4–6 weeks, 6–8 weeks, etc.). If a patient had two or more FIM scores during the same 2-week interval, the latest FIM score was selected. If no FIM score was available for a particular time interval, usually as the result of a patient's being transferred back to an acute hospital for intercurrent medical complication, the last available FIM score from the previous interval was entered for the missing score. Less than 5% of assessment scores were missing. FIM efficiency was defined
as the change in FIM score from admission to discharge divided by the length of rehabilitation hospital stay. Patients transferred back to an acute-care hospital for medical complications and then returning for continued rehabilitation were counted as one rehabilitation admission. Time spent back in the acute-care hospital was not included in the rehabilitation hospital length of stay.

**Rehabilitation Program**

During the acute-care hospital stay all patients received physical, occupational, and speech therapy services as ordered by their private physicians. In most cases the therapy was provided in the patient’s hospital room on a general hospital ward. We were unable to reliably estimate the duration or frequency of therapist contacts with patients before their transfer to our inpatient rehabilitation unit.

Upon entering our inpatient stroke rehabilitation unit, patients were enrolled in one individual and one group physical therapy session, and one individual and one group occupational therapy session, each of approximately 45 minutes, five days per week. One individual physical therapy session and one individual occupational therapy session of approximately 30 minutes duration were given each Saturday; no formal therapy was scheduled for Sundays. Speech therapy and dysphagia therapy, as well as cognitive stimulation group recreational sessions, were ordered when needed. Nursing care on the rehabilitation unit was directed by certified rehabilitation nursing staff and their aides. Medical care and rehabilitation team leadership were provided by a physician who specialized in neurologic rehabilitation. Rehabilitation hospital discharge goals were based on the patient’s admission functional status, availability of home care support, and response to treatment.

**Data Analysis**

Categorical data were analyzed using the Chi-square statistic. Interval scale data were analyzed across patient cohorts using one-factor ANOVA. In order to compare the outcome of patient groups with different lengths of stay, the patient’s final FIM score was carried forward within each cohort until the end of the 13-week post-stroke study period. Comparison of FIM scores with time across cohorts was analyzed using the repeated measures ANOVA technique. Cohort comparisons were considered significantly different if the probability statistic was ≤ 0.05. Results are presented as the mean ± SEM whenever a variance is indicated. All statistical analyses were performed using StatView for Windows, version 4.57, Abacus Concepts Inc., Berkeley, CA.

**Results**

Of 373 total admissions over a 17-month interval, 87 patients met selection criteria. The rationale for excluding patients who were not previously living independently in the community, those with prior stroke, brainstem or bilateral stroke, or hemorrhage, is described earlier. The demographic features of the study population are presented in Table 1. All but one of the patients (who was admitted from home after a failed attempt at home care) were admitted directly from an acute-care hospital. The numbers of comorbid medical diagnoses were not significantly different for patient groups admitted at different intervals post stroke. Patients admitted farther post stroke had significantly more complications noted during their acute-care hospital stay. They also had a greater frequency of need for transfer back to acute-care while on the rehabilitation unit (See Table 1).

During inpatient rehabilitation, patients with moderate stroke (admission total FIM score 54-90) admitted at 0-2, 2-4, and 4-6 weeks post stroke reached a mean final FIM score of 102 ± 2 (Table 2). All three time cohorts showed equal improvements in FIM scores but took significantly longer to reach their goals the later they were admitted post stroke. FIM efficiency scores for each cohort decreased significantly with increasing interval from stroke to rehabilitation hospital admission (Table 2).

Patients with severe stroke (admission FIM scores < 54) showed a slower, more prolonged, and less complete recovery compared with those with moderate stroke (Table 2). Discharge mean total FIM scores for the three cohorts with severe stroke declined significantly with increasing interval post stroke (72 ± 6, 57 ± 5, and 54 ± 10). The changes in FIM scores were not significantly different when compared with those who had moderate stroke. Those with severe stroke required significantly longer to reach their discharge goals and had significantly lower FIM efficiency scores than did those with moderate strokes (Table 2).

The effect of cohort assignment on rate of improvement in FIM scores was tested using repeated measures ANOVA. Based on Figures 1 and 2 it appeared that there were three different recovery patterns: one for those with moderate strokes, a second for those with severe strokes in the 0-2 week cohort, and a third for those with severe strokes in the 2-4 and 4-6 week cohorts. These were collapsed into three separate groups. Repeated measures
Table 1. Demographic features and complication rate for study cohorts.

<table>
<thead>
<tr>
<th>Stroke Severity</th>
<th>Moderate</th>
<th>Moderate</th>
<th>Moderate</th>
<th>Severe</th>
<th>Severe</th>
<th>Severe</th>
<th>Statistical Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cohort</td>
<td>0–14 days</td>
<td>15–28 days</td>
<td>29–42 days</td>
<td>0–14 days</td>
<td>15–28 days</td>
<td>29–42 days</td>
<td></td>
</tr>
<tr>
<td>No. of patients</td>
<td>28</td>
<td>19</td>
<td>3</td>
<td>14</td>
<td>13</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>72 ± 2</td>
<td>74 ± 2</td>
<td>72 ± 9</td>
<td>75 ± 2</td>
<td>75 ± 2</td>
<td>74 ± 3</td>
<td>NS**</td>
</tr>
<tr>
<td>Males</td>
<td>12</td>
<td>8</td>
<td>2</td>
<td>5</td>
<td>6</td>
<td>5</td>
<td>NS*</td>
</tr>
<tr>
<td>Females</td>
<td>16</td>
<td>11</td>
<td>1</td>
<td>9</td>
<td>7</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Right Hemisphere (%)</td>
<td>9 (32)</td>
<td>11 (58)</td>
<td>1 (33)</td>
<td>10 (71)</td>
<td>7 (54)</td>
<td>3 (30)</td>
<td>NS*</td>
</tr>
<tr>
<td>Left Hemisphere (%)</td>
<td>19 (68)</td>
<td>8 (42)</td>
<td>2 (67)</td>
<td>4 (29)</td>
<td>6 (46)</td>
<td>7 (70)</td>
<td></td>
</tr>
<tr>
<td>Days from stroke to rehabilitation hospital admission</td>
<td>10 ± 0.4</td>
<td>21 ± 1</td>
<td>31 ± 1</td>
<td>11 ± 1</td>
<td>21 ± 1</td>
<td>36 ± 1</td>
<td></td>
</tr>
<tr>
<td>Mean no. of acute care complications</td>
<td>82 ± .25</td>
<td>1.32 ± .34</td>
<td>2.67 ± .89</td>
<td>1.5 ± .31</td>
<td>2.69 ± .70</td>
<td>4.1 ± .35</td>
<td>.0001**</td>
</tr>
<tr>
<td>Mean no. of comorbidities</td>
<td>3.43 ± .39</td>
<td>3.10 ± .40</td>
<td>4.00 ± 3.51</td>
<td>4.36 ± .39</td>
<td>3.15 ± .65</td>
<td>4.9 ± .74</td>
<td>NS**</td>
</tr>
<tr>
<td>Required transfer back to acute care No. (%)</td>
<td>3 (11)</td>
<td>2 (10)</td>
<td>1 (33)</td>
<td>0 (0)</td>
<td>3 (23)</td>
<td>5 (50)</td>
<td>.001*</td>
</tr>
</tbody>
</table>

* Chi-square statistic
** One factor ANOVA

ANOVA showed that the effect of these collapsed cohort assignments on serial FIM scores was highly significant (p < 0.0001, F = 83.54), as was the effect of time post stroke on serial FIM scores (p < 0.0001, F = 149.71). The combined effects of collapsed cohort assignment and time post stroke on serial FIM scores were also highly significant (p = 0.007, F = 2.46).

Follow-up phone interviews were obtained for 61 of the 87 study patients or their caregivers at 3 ± 0.2 months post rehabilitation hospital discharge (Table 2). The percentage of patients lost to follow-up was not significantly different for those in the moderate versus the severe stroke deficit groups (24% vs. 38%, respectively).

Chi-square analysis showed the effect of cohort assignment on discharge disposition to be highly significant (p = 0.003). Of those with moderate stroke deficits 41 of 50 (82%) were discharged from the rehabilitation unit to home. Of those with severe stroke deficits 21 of 37 (57%) were discharged to home. The percentage of patients requiring intercurrent transfer back to acute-care was greatest for those with the longest interval from stroke onset to rehabilitation hospital admission (p = 0.001). This was true irrespective of stroke severity (Table 1).

Of those discharged from the rehabilitation hospital to home 41 of 46 were there at follow-up. The number of home-care failures was not significantly different for those with severe deficits compared with those with moderate deficits (13% vs. 5%). Of those discharged to skilled nursing facility (SNF)/subacute level care, 5 of 6 were there at follow-up. Only 1 of 6 patients transferred to SNF/subacute level of care was able to return home over the 3.1 ± 0.1 month follow-up interval.

Discussion

Table 2 lists outcome results for the study cohorts: discharge FIM, change in FIM, and FIM efficiency. These numbers are currently being used by hospital administrators and third-party payers to assess quality of care. It is apparent that patients with less severe stroke deficits who are in the rapid recovery phase post stroke will show the highest discharge FIM scores, the shortest length of stay, and the highest FIM efficiency. Such patients may be transferred from the medical ward to the rehabilitation unit within the same hospital for 1 to 2 weeks and then discharged to home or outpatient rehabilitation. Those with more severe deficits or more medical complications may be referred for extended rehabilitation at
### Table 2. Outcome results for study cohorts.

<table>
<thead>
<tr>
<th>Stroke Severity</th>
<th>Moderate</th>
<th>Moderate</th>
<th>Moderate</th>
<th>Severe</th>
<th>Severe</th>
<th>Severe</th>
<th>Statistical Significance</th>
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<td>29–42 days</td>
<td></td>
</tr>
<tr>
<td>No. of patients</td>
<td>28</td>
<td>19</td>
<td>3</td>
<td>14</td>
<td>13</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Final Discharge Disposition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>25 (89)</td>
<td>15 (79)</td>
<td>1 (33)</td>
<td>9 (64)</td>
<td>7 (54)</td>
<td>5 (50)</td>
<td>.003*</td>
</tr>
<tr>
<td>SNF/Subacute</td>
<td>1 (4)</td>
<td>1 (5)</td>
<td>1 (33)</td>
<td>4 (29)</td>
<td>6 (46)</td>
<td>1 (10)</td>
<td></td>
</tr>
<tr>
<td>Acute care</td>
<td>2 (7)</td>
<td>3 (16)</td>
<td>1 (33)</td>
<td>1 (7)</td>
<td>0 (0)</td>
<td>4 (40)</td>
<td></td>
</tr>
<tr>
<td>Admission FIM (all patients)</td>
<td>74 ± 2</td>
<td>75 ± 2</td>
<td>73 ± 6</td>
<td>40 ± 3</td>
<td>35 ± 3</td>
<td>35 ± 4</td>
<td></td>
</tr>
<tr>
<td>Discharge FIM (all patients)</td>
<td>103 ± 2</td>
<td>100 ± 3</td>
<td>98 ± 11</td>
<td>72 ± 6</td>
<td>57 ± 5</td>
<td>54 ± 10</td>
<td>.0001**</td>
</tr>
<tr>
<td>Change in FIM (all patients)</td>
<td>29 ± 2</td>
<td>25 ± 2</td>
<td>25 ± 7</td>
<td>32 ± 5</td>
<td>23 ± 4</td>
<td>19 ± 7</td>
<td>NS**</td>
</tr>
<tr>
<td>Length of stay</td>
<td>33 ± 2</td>
<td>35 ± 3</td>
<td>40 ± 6</td>
<td>43 ± 3</td>
<td>53 ± 4</td>
<td>40 ± 6</td>
<td>.0015**</td>
</tr>
<tr>
<td>FIM Efficiency†</td>
<td>1.02 ± .11</td>
<td>.82 ± .09</td>
<td>.64 ± .18</td>
<td>.76 ± .12</td>
<td>.40 ± .07</td>
<td>.67 ± .28</td>
<td>.03**</td>
</tr>
<tr>
<td>Discharge FIM (only those with follow-up) N=61</td>
<td>105 ± 2</td>
<td>106 ± 2</td>
<td>105 ± 15</td>
<td>80 ± 8</td>
<td>60 ± 6</td>
<td>59 ± 15</td>
<td>.0001**</td>
</tr>
<tr>
<td>Follow-up FIM (3 mo. after discharge) N=61</td>
<td>116 ± 3</td>
<td>114 ± 4</td>
<td>117 ± 4</td>
<td>81 ± 10</td>
<td>66 ± 8</td>
<td>64 ± 17</td>
<td>.0001**</td>
</tr>
</tbody>
</table>

* Chi-square statistic  
** One factor ANOVA  
† The FIM efficiency was calculated for each patient. There was a trend for patients with the greatest change in FIM scores to have the shortest length of stay. Hence the entries listed are not equal to the mean change in FIM score divided by the mean length of stay for each respective cohort.

Free-standing rehabilitation units or to nursing home-based subacute rehabilitation units. Such referral biases can have significant effects on quality of care parameters and must be accounted for in order to make such outcome measures meaningful. Stratification of patients into severity of stroke based on admission FIM scores and interval post stroke at which they were measured provides a more useful basis of comparison.

Figures 1 and 2 show that for all time cohorts with either moderate or severe strokes the observed period of rapid improvement before reaching the plateau phase of the recovery curve is considerably longer than 22 days, the national average for length of rehabilitation hospital stay for stroke.

Figure 1 demonstrates that patients with moderate stroke-related functional deficits reached a "plateau" with FIM scores of 98 to 103 irrespective of the interval from stroke to rehabilitation hospital admission. The mean length of stay observed for all three time cohorts with moderate strokes was 35 days.

The plateau shown in Figure 1 is probably not artifactual, as our discharge plans were not dependent on reaching a predetermined FIM goal. Patients with moderate strokes were discharged from our inpatient unit to receive home, outpatient, or SNF/subacute rehabilitation when it was clinically apparent to their therapists that their functional gains had begun to plateau. One could argue that those leaving the inpatient unit might have continued to make gains had their discharge been delayed. This is probably not the case since follow-up phone interviews with the patient's caregiver indicated that even with additional therapy, further functional gains over the ensuing 3 ± 0.1 months were minimal (10 FIM units).

Of those patients with moderate stroke deficits discharged home, 41 of 46 (89%) were still there at the time...
of follow-up phone contact $3 \pm 0.1$ months later. For patients with moderate stroke living with a caregiver, a target FIM score of 98–103 seems to be a valid goal, indicating a level at which supervised home care can be effectively maintained. Patients at this functional level who live alone may require $4–8$ hours of home health aide assistance but must be cognitively intact with good safety awareness to ensure their safety the remaining $16–20$ hours per day. Those at this functional level with stroke-related cognitive impairment who live alone may require nursing home placement because of their need for 24-hour supervision for safety. Our data suggest that a more prolonged stay on the rehabilitation unit of up to 42 days is unlikely to be associated with functional gains sufficient to allow them to live alone.

Figure 2 indicates that patients with severe stroke have significantly different outcome goals than the group with moderate stroke, and that the goals are successively lower, the longer the interval from stroke to rehabilitation unit admission. Figure 2 suggests that a FIM score of $72 \pm 6$ is a reasonable outcome goal for patients with severe stroke who are admitted to the rehabilitation unit within $2$ weeks of stroke. They are expected to reach their FIM discharge goal after about $43 \pm 2$ days on the rehabilitation unit.

Figure 2 and Table 2 show that patients admitted from $2–4$ weeks after a severe stroke have a discharge FIM goal of $57 \pm 5$. They may take $53 \pm 4$ days on the rehabilitation unit to reach this goal. Those admitted $4–6$ weeks after a severe stroke have a FIM target score of $54 \pm 10$. They have the most limited outcome goal, and if they are to reach it will do so within $40 \pm 6$ days of admission to the rehabilitation unit.

One might question the value of inpatient rehabilitation for patients with severe stroke admitted $4–6$ weeks post stroke. These patients, however, show significant

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**Figure 1.** Total FIM scores ± SEM for patients with moderate stroke (rehabilitation hospital admission FIM scores 54–90). Patient cohorts are defined by the interval post stroke at which they were admitted to the rehabilitation unit. To compare the outcome of patient groups with different lengths of stay, the patient's final FIM score was carried forward within each group until the end of the 13 week post-stroke study period. Time points in this figure are based on interval post stroke, not on length of stay on the rehabilitation unit. FIM scores for patients transferred back to acute care because of intercurrent problems were carried forward within their respective cohort until they returned to the rehabilitation unit.
FIM gains during their inpatient rehabilitation hospital stay, thus lessening the burden of home-care assistance needed. Because their goals are limited (FIM score of 54 ± 10), treatment is also focused on helping caregivers adjust to the patient's dependency needs and learn patient-care assist techniques for management of bowel, bladder, bathing, skin care, transfer, and walking deficits. Home health aide assistance and home-care equipment needs are assessed and set in place. The value of the rehabilitation unit experience for this group of low-level patients and their families is supported by the fact that at follow-up 20 of 23 were still being successfully managed at home.

There is a significant effect of delay in rehabilitation hospital admission on discharge FIM scores for those with severe strokes but not for those with moderate strokes. This phenomenon has been noted by others and has been used as an argument for the efficacy of rehabilitation in preventing or reversing secondary stroke-related complications. This issue is clouded by the fact that the delay in rehabilitation unit admission may be due to more severe stroke with cerebral edema, suppression of sensorium, need for nonoral feeding, aspiration pneumonia, urinary retention, urinary tract infection, venous thromboembolic complications, and so forth. Our data indicate that patients with delayed onset to rehabilitation hospital admission continue to have more frequent and severe complications than those admitted 0–2 weeks after stroke (Table 1).

From our observational data, one can project "optimal FIM outcome goals" and an "optimal length of stay" needed to reach these goals for each study cohort. For our patients with moderate strokes, Figure 1 suggests that the optimal FIM outcome goal is 98–103 over a 35-day rehabilitation hospital stay. From a discharge planning perspective, one might suggest that patients could be sent home sooner with suboptimal scores, anticipating that less expensive home or outpatient rehabilitation might allow the patients to reach the same final level of function, although perhaps over a longer interval of time. FIM scores above 90 indicate that patients generally require only supervision or set-up for their self-care, mobility, and
safety within the home. This might represent an appropriate discharge goal for patients who live with a retired spouse who is always available. Accepting this outcome goal for patients with moderate strokes would produce a significant reduction in length of stay. The 0–2 week cohort reached this level after 20–22 days. The 4–6 week cohort required 26–28 days. These lengths of stay are consistent with the data for patients with moderate stroke deficits reported by Stineman and coworkers, who stratified patients by FIM motor subscore, FIM cognitive subscore, and age (groups 4 through 7 using their classification). They do not provide follow-up information concerning how many patients were still at home or final FIM scores at 3 or 6 months after stroke. Such data are of obvious importance when comparing the outcome of institutions with different lengths of stay.

Figure 2 suggests that patients with severe strokes in the 0–2 week cohort have an optimal FIM outcome score of 72 ± 6 after a mean length of stay of 43 ± 3 days on the rehabilitation unit. This corresponds to a need for minimal assistance with all of the 18 FIM self-care, mobility, and cognitive items. From a discharge planning perspective, one might consider sending patients home earlier while still requiring moderate assistance for all 18 items of the FIM scale. This would correspond to a FIM score of 54. If patients were to be discharged at this level, their length of stay could be reduced to 23 days. However, the slope of the recovery curve is linear at this point, with patients having achieved only half of their optimal recovery. Our data suggest that a longer rehabilitation hospital stay of 43 ± 3 days is probably justified. This group might be compared with Stineman and colleagues group 1 with a discharge FIM score of 57 to 88 with a median length of stay of 36 days.

Figure 2 shows that patients with severe strokes in the 2–4 and 4–6 week cohorts have the poorest outcome expectations (final FIM scores of 55 ± 10) and the longest lengths of stay (46 ± 5 days). Inspection of the recovery curves for these patients indicates that most of the recovery that occurs takes place within the 28 days of admission to the inpatient unit. Our observed length of stay of 46 days seems unjustified. The median length of stay for a comparable group of patients (group 2) described by Stineman and colleagues was 28 days. Since Stineman and colleagues did not report follow-up data, it is not known whether a shorter length of stay will have an adverse effect on follow-up FIM scores or on the ability of family members to maintain patients at home.

At present there is a growing impetus for rehabilitation units to match or exceed national FIM efficiency norms of 1.06 FIM units per day. Our data indicate that selection of patients with moderate stroke-related impairment within the first 2 weeks post stroke would optimize this statistic. To the extent that a rehabilitation unit serves a different patient population, either those with more severe strokes or those with prolonged acute-care hospital stay, the FIM efficiency scores and length of rehabilitation hospital stay will suffer. Other quality assurance statistics such as number of rehabilitation complications and need for acute-care transfer will also increase. These consequences are probably inherent in the patient population being served rather than in quality of care. Our data support the need to describe patient outcome statistics in terms of functional deficit and interval post stroke at which the functional deficits were recorded.

Because of our small sample size (87 patients), the statistical power of our analysis techniques may have underestimated differences across study cohorts. The statistical differences found are, however, clinically robust. Our data represent proof of concept, with further validation awaiting a larger study population across multiple institutions.

In conclusion, our data represent observational norms for setting rehabilitation outcome goals and estimating the interval of time needed to reach those goals for patients with different stroke severity and interval from stroke to rehabilitation hospital admission. Our data are applicable to patients with initial unilateral hemispheric ischemic stroke who were independent in the community before their stroke. Our results provide a benchmark against which to compare less intense or shorter duration inpatient treatment options.

References