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A functional strategy for classifying patients after traumatic spinal cord injury

MG Stineman*,[1], RJ Marino[2], A Deutsch[3], CV Granger[3] and G Maislin[4]

[1]*Department of Rehabilitation Medicine, University of Pennsylvania, Philadelphia, USA;* [2]*The Mount Sinai School of Medicine, New York, New York, USA;* [3]*State University of New York at Buffalo, SUNY South Campus, Buffalo, New York, USA;* [4]*Department of Medicine, University of Pennsylvania, Philadelphia, USA*

Objectives: To present a function-based strategy for classifying patients by expected functional outcomes measured as patients' performances at discharge on each of the 18 component items of the FIM™ instrument (previously known as the Functional Independence Measure).
Methods: Data included records from 3604 inpatients with traumatic spinal cord injury discharged from 358 rehabilitation units or hospitals in 1995. The function-based strategy assigned patients to four Discharge Motor-FIM-Function Related Groups defined by patients' admission performance on the motor-FIM items.
Results: The majority of patients whose motor-FIM scores at admission were above 30 were able to groom, dress the upper body, manage bladder function, use a wheelchair, and transfer from bed to chair, either independently or with supervision, by the time of discharge from inpatient rehabilitation. Most patients whose scores were above 52 attained independence in all but the most difficult FIM tasks, such as bathing, tub transfers, and stair climbing.
Conclusions: This classification scheme can be used to determine the degree to which patients' actual FIM outcomes compare to other individuals who had similar levels of disabilities at the time of admission to rehabilitation. The clinician can apply these 'FIM item attainment benchmarks' retrospectively in quality improvement, in guideline development, and in anticipating the types of post-discharge care required by clinically similar groups.

Keywords: spinal cord injury; rehabilitation; activities of daily living; outcome assessment

Introduction

The incidence of traumatic spinal cord injury (SCI) in the United States is estimated at 38 per million, with a projected 20% increase over the next decade.[1] The most common causes, in decreasing order, are motor vehicle accidents, falls, gunshot wounds, and diving accidents.[2]

In 1982 the American Spinal Injury Association (ASIA) developed standard for the neurological classification of traumatic spinal cord injury.[3] In addition to classifying the neurological level of injury, the ASIA standards incorporate a revised version of the Frankel classification that distinguishes among the neurologically complete ('A') and the three incomplete syndromes ('B', 'C' and 'D'). ASIA standards call for a standard assessment of patients' ability to perform daily activities to supplement impairment classification. The FIM™ instrument[4–6] is presented by the ASIA standards as an approach to such assessment.[7] Spinal cord injury at different neurological levels has been associated with clear differences in FIM functioning at discharge from inpatient rehabilitation.[8,9] Physical disabilities, as measured by the FIM motor sub-score, increase systematically with more cephalad neurological lesions.[8]

The purpose of this study was to present a function-based strategy for classifying SCI patients as a complement to the impairment-based ASIA standards. The function-based approach addresses the question: assuming patients' functional performances fall within particular ranges at admission to inpatient rehabilitation as established by the Discharge Motor FIM-Function Related Groups (DMF-FRGs),[10] what are expected performance levels at discharge? We anticipated that patterns of FIM achievement across groups of SCI patients with higher and lower initial FIM scores would be similar to patterns of recovery associated with injury to the more caudal and cephalad segments of the spinal cord, respectively.[8] The approach presented here is similar to that previously developed for stroke.[11]

Correspondence: MG Stineman, Department of Rehabilitation Medicine, University of Pennsylvania, Ralston-Penn Center, Suite 101, 3615 Chestnut Street, Philadelphia, PA 19104, USA

Methods

We hypothesized that DMF-FRGs, by identifying groups of spinal cord injured patients with more or less severe admission physical disabilities at admission to rehabilitation, could establish functional expectations at discharge relative to individual ADL, sphincter management, and mobility FIM tasks.

FIM™ instrument

LEVELS		
	7 Complete Independence (Timely, Safely) 6 Modified Independence (Device)	**NO HELPER**
	Modified Dependence 5 Supervision (Subject = 100%+) 4 Minimal Assist (Subject = 75%+) 3 Moderate Assist (Subject = 50%+) **Complete Dependence** 2 Maximal Assist (Subject =25%+) 1 Total Assist (Subject = less than 25%)	**HELPER**

	ADMISSION	DISCHARGE	FOLLOW-UP
Self-Care			
A. Eating	☐	☐	☐
B Grooming	☐	☐	☐
C. Bathing	☐	☐	☐
D. Dressing - Upper Body	☐	☐	☐
E. Dressing - Lower Body	☐	☐	☐
F. Toileting	☐	☐	☐
Sphincter Control			
G. Bladder Management	☐	☐	☐
H. Bowel Management	☐	☐	☐
Transfers			
I. Bed, Chair, Wheelchair	☐	☐	☐
J. Toilet	☐	☐	☐
K. Tub, Shower	☐	☐	☐
Locomotion			
L. Walk/Wheelchair	☐ W Walk C Wheelchair B Both	☐ W Walk C Wheelchair B Both	☐ W Walk C Wheelchair B Both
M. Stairs	☐	☐	☐
Motor Subtotal Score	☐	☐	☐
Communication			
N. Comprehension	☐ A Auditory V Visual B Both	☐ A Auditory V Visual B Both	☐ A Auditory V Visual B Both
O. Expression	☐ V Vocal N Nonvocal B Both	☐ V Vocal N Nonvocal B Both	☐ V Vocal N Nonvocal B Both
Social Cognition			
P. Social Interaction	☐	☐	☐
Q. Problem Solving	☐	☐	☐
R. Memory	☐	☐	☐
Cognitive Subtotal Score	☐	☐	☐
TOTAL FIM Score	☐	☐	☐

NOTE: Leave no blanks. Enter 1 if patient not testable due to risk

Figure 1 FIM℠ instrument

Data

Data included records of patients treated for SCI discharged in 1995 and submitted to the Uniform Data System for Medical Rehabilitation (UDSMR) from 358 comprehensive inpatient rehabilitation facilities.[6,12] All clinicians responsible for administering the FIM instrument at these facilities achieved at least 80% on a written examination designed to test coding competence. Patient records that were obviously miscoded or that were missing basic demographic variables, length of stay (LOS), or FIM scores, were deleted, leaving 4060 of the original 4630 patients with SCI. Because functional expectations in children differ from adults, the records of those under the age of 16 were excluded ($n=62$). Several types of cases were excluded because the patients did not complete inpatient rehabilitation. This included those admitted for evaluation only ($n=74$) and those discharged to an acute, chronic, or different rehabilitation hospital or who died ($n=268$). Finally, cases missing information on whether they primarily walked or used a wheelchair were removed ($n=52$). After those exclusions, 3604 cases remained and were used to establish FIM functional outcome benchmarks.

The FIM instrument (Figure 1) describes patients' performances in 18 functional status activities. Physical disability is expressed by patients' motor-FIM scores,[13] which describe performance levels in eating, grooming, bathing, dressing the upper body and lower body, toileting, bladder and bowel management, bed to chair transfers, toilet transfers, tub or shower transfers, locomotion, and stair climbing. Each item is scored on a seven-point scale where 1 indicates total assistance and 7 denotes complete independence. The patient's performance on each item can be summed to produce an aggregate score ranging from 13 to 91.[14] The remaining FIM items form a cognitive dimension and include information about patients' abilities to comprehend, express, interact socially, solve problems, and remember. Scores on this subscale range from 5 to 35.

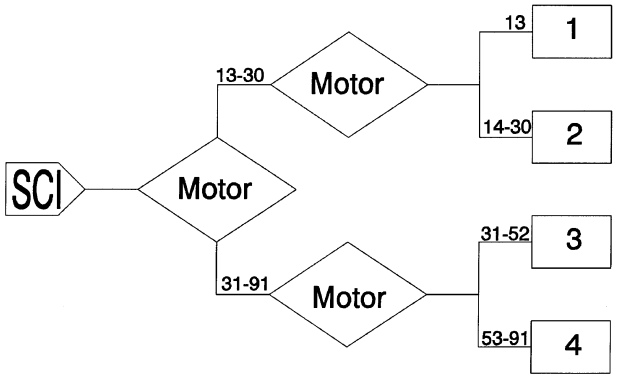

Figure 2 Discharge motor FIM-FRGs for traumatic spinal cord injury (SCI)

Statistical approach

The DMF-FRGs[10] for SCI were originally developed from the records of patients discharged in 1992. The DMF-FRGs were established in an estimation sample with predictive performance evaluated in a separate sample held back for validation. DMF-FRGs were defined specifically for SCI by recursive partitioning.[15] This statistical algorithm forms patient groups (FRGs) by creating binary splits among the predictor variables that most reduce the mean-squared error of the response (dependent) variable with respect to the independent variables. In developing the DMF-FRGs, the candidate independent variables were admission motor- and cognitive-FIM scores and age. The response variable was patient discharge motor-FIM scores. Admission motor-FIM score was the only variable found to be of sufficient importance to be selected for recursive splits.

Predictive ability of the SCI DMF-FRGs was evaluated by multiple linear regression, with motor-FIM discharge scores as the dependent variable and binary indicator variables corresponding to each of the FRGs as independent variables. The regression was cross-validated by predicting each patient's discharge score in the validation data set, correlating the predicted with the actual score, and, finally, squaring the correlation to indicate the percentage of variation explained.[16] There are four DMF-FRGs for SCI that distinguish among patients expected to be at relatively low, intermediate-low, intermediate-high, and high levels of functional independence by rehabilitation discharge. The DMF-FRGs explained 55% of the variance of patients' motor-FIM discharge scores.[10]

The taxonomy associated with the DMF-FRG system abbreviates the patient's impairment and FRG number. Lower FRG numbers signify more severe disabilities. For example, DMF-SCI-1 (further abbreviated as SCI-1 in this article) refers to the most severe group of SCI patients requiring total assistance in all of the 13 motor-FIM items at rehabilitation admission (Figure 2). Expected performance levels representing 'outcome attainment benchmarks' were established within FRG from the distribution of motor-FIM scores calculated from the records of 3604 patients discharged in 1995.

Outcome attainment benchmarks

Two types of functional outcome attainment benchmarks are provided for each FRG. The first establishes expected ranges of motor-FIM function at discharge and are referred to as 'motor-FIM score attainment benchmarks', and the second establishes expected ranges of performance on each of the 18 individual activities making up the motor- and cognitive-FIM and are referred to as 'FIM item attainment benchmarks'. For both benchmark types, interquartile performance ranges are established from the 25th and 75th percentile values for patients classified in each FRG.

Table 1 Characteristics of the spinal cord injured population ($n=3604$)

Variable	N	%
Admitted from		
Home	507	14.1
Board and care facility	7	0.2
Transitional living facility	1	0.0
Intermediate care facility	10	0.3
Skilled nursing facility	82	2.3
Acute hospital in same system	1014	28.2
Acute hospital in different system	1928	53.7
Chronic care facility	2	0.1
Rehab	20	0.6
Other alternative	8	0.2
Other	13	0.4
Race		
White	2598	72.7
Black	662	18.5
Asian	44	1.2
Native American	34	1.0
Hispanic	185	5.2
Other	51	1.4
Sex		
Male	2656	73.7
Female	948	26.3
Time since injury		
$\leqslant 2$ weeks	1539	43.0
>2 weeks to $\leqslant 4$ months	1393	38.9
>4 months to $\leqslant 6$ months	102	2.8
>6 months	548	15.3
Pre-event vocational status		
Employed	1494	42.0
Sheltered employment	8	0.2
Student	265	7.4
Homemaker	84	2.4
Unemployed	608	17.1
Retired due to age	601	16.9
Retired due to disability	501	14.1
Interruption during rehabilitation stay		
No interruption	3347	93.4
Interruption	235	6.6
Discharge setting		
Home	3141	87.2
Board and care facility	36	1.0
Transitional living facility	28	0.8
Intermediate care facility	38	1.1
Skilled nursing facility	299	8.3
Other alternative	18	0.5
Other	44	1.2
Marital status		
Single	1483	41.5
Married	1329	37.2
Widowed	281	7.9
Separated	72	2.0
Divorced	407	11.4
Living with at admission		
Alone	664	18.7
With family	2559	72.0
With friends	176	5.0
Attendant	22	0.6
Other	133	3.7
Living with at discharge		
Alone	256	7.9
With family	2722	84.3
With friends	113	3.5
Attendant	58	1.8
Other	81	2.5
Walking at discharge	1269	35.2
Admission class		
Initial rehabilitation	3072	85.2
Readmitted	532	14.8
Variable	N	*SD*
Age	42.7	19.4
Rehabilitation LOS	37.9	41.5
Admission FIM scores		
Admission motor	33.8	17.4
Admission cognitive	31.3	5.4
Discharge FIM scores		
Admission motor	57.0	21.6
Admission cognitive	31.3	5.4

Note: The sample size does not add up to 3604 in all cases because of missing data. Specifically, cases were missing from admitted from ($n=12$), race ($n=30$), time since onset ($n=22$), vocational status ($n=43$), interrupt ($n=22$), marital status ($n=32$), living with at admission ($n=50$), and living with at discharge ($n=374$)

These provide a range within which 50% of patients can be expected to function. An estimated length of stay (ELOS) is calculated for each FRG from the 1995 data based on the 25th and 75th percentile values of patients in each group. Because utilization patterns may vary across centers, the functional attainment benchmarks might not be reasonable for patients far outside those expected LOS ranges. Also, it may be necessary to adjust the functional outcome attainment benchmarks to accommodate changes in practice patterns over time or for different types of treating institutions.

Results

Characteristics of the patients with spinal cord injury used in forming the benchmarks are shown in Table 1. As expected, most came to rehabilitation from acute hospitals, the majority were male, and most had been employed before injury. Thirty-five per cent of patients were at least partially ambulatory at discharge. The remainder depended on wheelchairs for mobility. Table 2 describes patients grouped by levels of injury and whether the injury was complete. The non-specific impairment categories were missing specific information on level of injury. The UDSMR data set did not include sufficient data to assign ASIA motor and sensory levels.

Table 2 Levels and completeness of injury

	n	%
Specific impairments		
High tetraplegia (C1–4) complete lesions	143	4.0
High tetraplegia (C1–4) incomplete lesions	259	7.2
Low tetraplegia (C5–8) complete lesions	391	10.8
Low tetraplegia (C5–8) incomplete lesions	568	15.8
Paraplegia complete lesions	600	16.6
Paraplegia inccomplete lesions	534	14.8
Non-specific impairments (completeness level not specified)		
Tetraplegia	187	5.2
Paraplegia	286	7.9
Other	338	9.4
Non-specific	298	8.3
Total	3604	100.0

The SCI motor-FIM score attainment benchmarks and ELOS ranges are shown in Table 3, and the item attainment benchmarks are shown in Figure 3. The

Table 3 Function-based classification system

			Motor-FIM score attainment benchmark percentiles		
FRG	*%*	n	*Admission 25th–75th*	*Discharge 25th–75th*	*LOS 25th–75th*
SCI-1	15.3	550	13.0–13.0	16.0–34.0	39.0–85.0
SCI-2	33.8	1219	18.0–27.0	34.0–66.0	24.0–59.0
SCI-3	34.9	1257	35.0–45.0	59.0–76.0	15.0–34.0
SCI-4	16.0	578	56.0–69.0	73.0–82.0	8.0–19.0

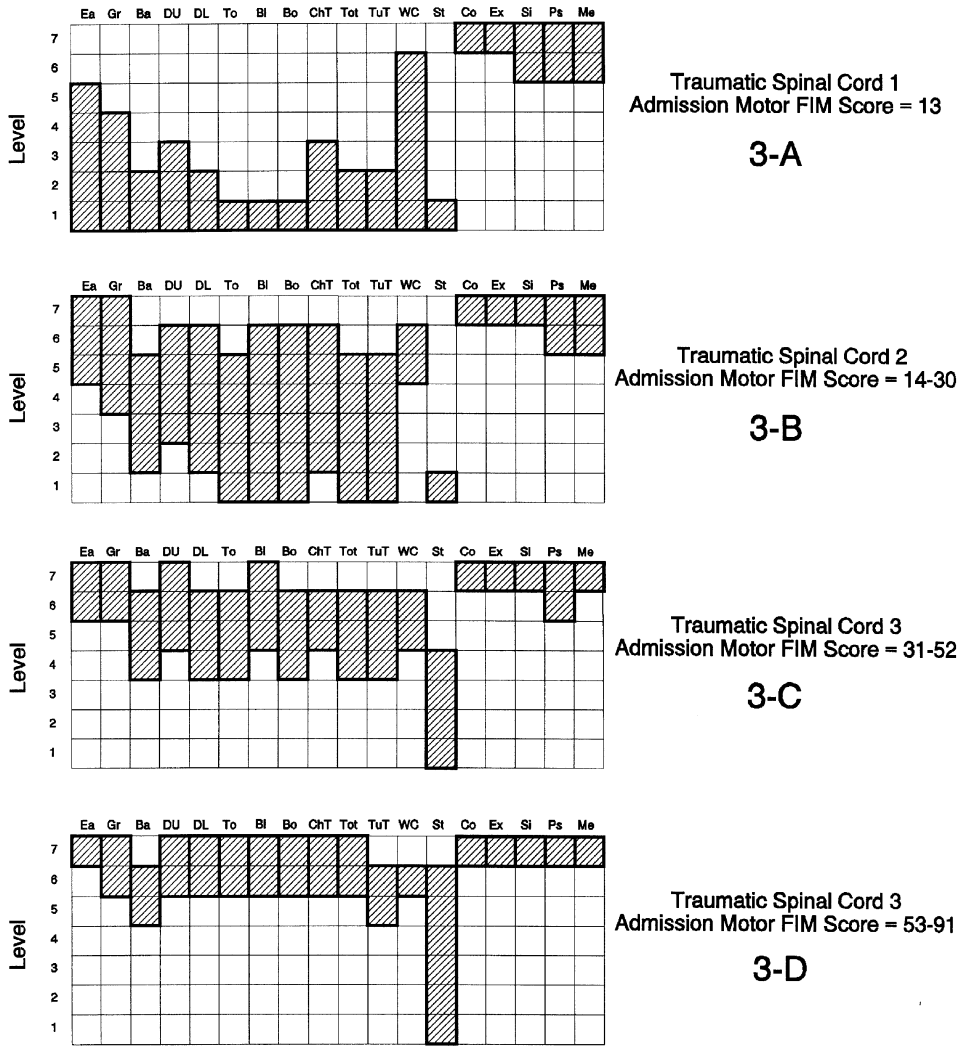

Figure 3 Task performance benchmarks displayed for SCI-1, SCI-2, SCI-3 and SCI-4. Ea-eating; Gr = Grooming; Ba = Bathing; DU = Dressing upper body; DL = Dressing lower body; To = Toileting; Bl = Bladder management; Bo = Bowel management; ChT = Bed to chair transfer; Tot = Toilet transfer; TuT = Tub transfer; W/WC = Walking/wheelchair management; St = Stair climbing; Co = Comprehension; Ex = Expression; Si = Social interaction; Ps = Problem solving; Me = Memory. 7 = Complete independence; 6 = Modified independence; 5 = Supervision; 4 = Minimal assistance; 3 = Moderate assistance; 2 = Maximum assistance; 1 = total assistance

LOS percentile and motor-FIM score attainment benchmarks are displayed in tabular ranges. The item attainment benchmarks are displayed on bar box plots consisting of a grid defining attainment levels for each of the 18 FIM activities along the x-axis. The grid begins with Level 1 – Total Assistance (at the bottom), and ends with Level 7 – Complete Independence (at the top). The item attainment ranges are displayed as shaded boxes forming bars on the grid, beginning with the 25th and ending with the 75th percentile values. At least 50% of all cases can be expected to have scores that fall within the shaded boxes (inclusive of the 25th and 75th percentile values). Twenty-five per cent of patients can be expected to have scores below the 25th percentile (below the boxes). No more than 25% of cases will be at or above the 75th percentile.

For example, in SCI-2 (Figure 3B), the 25th percentile value for bathing is 2 and the 75th percentile is 5. This indicates that at least half of patients in that group can be expected to have a discharge score of 2, 3, 4 or 5 for bathing. At least 25% of patients can be expected to have a score of 1, and no more than 25% a score above 5. When a bar is formed by only one shaded box, then the 25th and 75th percentile are the same, indicating little variability in expected discharge performance. If the single box falls at Level 1, as is the case for many motor-FIM items in DMS-SCI-1 (Figure 3A), then at least 75% of patients will be totally unable to perform the task. Conversely, if the single box is at 7, than at least 75% of patients can be expected to achieve full independence.

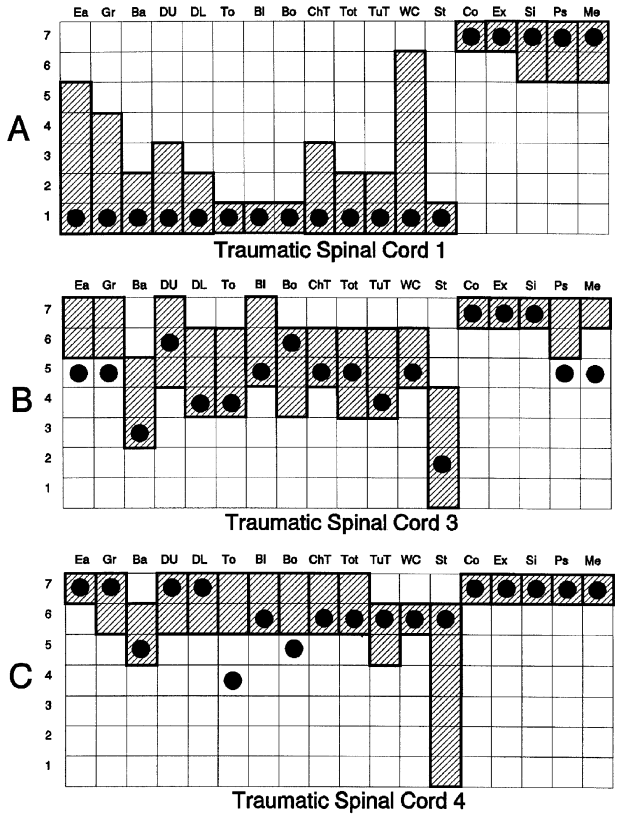

Figure 4 Task performance benchmarks for three individual patients classified into FRGs. Key: see Figure 3

Case histories

To illustrate potential applications of the benchmarks to clinical practice, three cases were selected at random from records present in the database (all personal identifiers were stripped). An FRG was assigned to each of the three cases (see Figure 4). Each patient's actual discharge functional status score was plotted on the benchmark bar as a dark circle.

The first case example (Figure 4A) was of a 22-year-old man with complete high-level tetraplegia with a motor-FIM score of 13 at admission. His motor-FIM score places him in SCI-1. His rehabilitation LOS was 11 days, which was unusually short according to his FRG (ELOS = 39 – 85 days) benchmarks (see Table 3), and his motor-FIM score at discharge was 13, indicating that he made no gains measurable by the FIM instrument. His outcomes fell below the expected range for the SCI-1 motor-FIM score attainment benchmark. His item performances were correspondingly in the lower range.

The second patient was a 84-year-old women with incomplete high-level tetraplegia who had a motor-FIM score of 39 at admission (3-B). Her motor-FIM score placed her in SCI-3. Her LOS was 52 days, which was unusually long according to her FRG (ELOS = 15 – 34 days) benchmarks. Her motor-FIM score at discharge was 59, which fell within the expected SCI-3 range. Most of her individual FIM discharge scores fell within the expected performance ranges, except that she had unusual deficits at discharge in eating, grooming, problem solving, and memory.

The third patient (3-C) was a 22-year-old male with complete paraplegia. His motor-FIM score was 53 at admission, placing him in SCI-4. His rehabilitation LOS was 14 days, which was within the expected range of his FRG (ELOS 8 – 19 days). His discharge motor-FIM score was 78, which was within range for his expected score attainment (Table 3). FIM item attainment outcomes were within the expected ranges, except for residual problems in toileting and bowel management.

Discussion

As a graphic expression of outcome, the bar box plot benchmarks characterize the expected levels and variability of performance for groups of SCI patients who present with similar degrees of disability. Motor-FIM score attainment benchmarks express overall severity of physical disability, while item attainment benchmarks profile the particular activities for which patients are expected to require assistance. Functional status profiles were presented as far back as 1983 by Harvey and Jellinek[17] as visual aids for patients,

family, and staff to display progress during rehabilitation. The item attainment benchmarks build on this approach by providing case-mix (severity) adjusted expectations for each FRG. The motor-FIM score and item attainment benchmarks can be used as quality indicators for CQI, within clinical guidelines and in anticipating post-rehabilitation discharge needs for groups of similar patients by comparing expected outcome patterns to patients' actual achievements.

While ASIA classification provides outcome expectations relative to impairment, the FRGs yield expectations relative to initial function. Groups of individuals who present to rehabilitation totally dependent in all 13 motor-FIM tasks (SCI-1) will likely continue to require care in all activities at rehabilitation discharge, although some will be able to manage a wheelchair independently and make gains in eating and grooming. Those with motor-FIM scores at admission ranging from 14 to 30 (SCI-2) have the most variable outcomes, with benchmarks spanning from total dependence through complete independence for several items. Many of those patients will be able to eat and use a wheelchair independently or with supervision. In addition to those achievements, patients with admission scores from 31 to 52 (SCI-3) are expected to function in the minimal assistance through modified independence ranges in the remaining items, except in stair climbing, where most remain dependent. Patients with motor-FIM scores above 52 (SCI-4) will usually be independent in all skills, except some who will have residual difficulties with bathing, tub transfers, and stair climbing.

The sequence of recovery displayed across the motor-FIM items in spinal cord injured people grouped by more and less severe levels of disability at admission to rehabilitation (shown here) is similar to the sequence of recovery in people grouped by level of neurological injury.[8] Patients who present either with the highest level complete lesions or with the most severe disabilities tend to recover only in activities, such as eating and grooming, that depend on function of the most cephalad spinal cord segments. In contrast, those with the lowest level lesions or the least severe disabilities tend to recover all motor-FIM activities except those such as stair climbing and tub transfers that rely on the most caudal segments of the cord. Deficits in the cognitive-FIM items in general would suggest a comorbid condition, since SCI would not be expected to cause problems in those areas.

The benchmarks provide impairment-specific patterns adjusted for severity. Patterns of recovery, as expressed by SCI item attainment benchmarks, differ from stroke, for example, in ways that are expected clinically. Unlike SCI, in stroke bowel and bladder management were among the first activities recovered and cognitive and communication problems remained prominent.[11] Locomotion in SCI is difficult to interpret, because the FIM scale combines walkers and wheelchair users. The high variability of locomotion skills in SCI-1, for example, may reflect differences in financial access to power mobility, rather than differences in underlying pathology.

The limited functional gains achieved by SCI-1 patients suggests that these patients' extreme disabilities may render their achievements below the measurement floor of the FIM instrument. Benchmarks from FRGs might be enhanced by supplementing the FIM with items specifically designed to detect the more subtle functional achievements of patients with high-level tetraplegia. The quadriplegia index of function[18,19] and the Spinal Cord Independence Measure[20] are examples of such indices. At the other extreme, the inclusion of instrumental activities of daily living (IADLs) would provide a reasonable supplement to the assessment of outcomes in those with less severe lesions.

FIM item attainment benchmarks might prove useful in anticipating the types and amounts of care required by patients assigned to various FRGs. Burden of care, measured as patient–nurse contact time over a 24 h period, is strongly related to patients' motor-FIM measures.[21] Moreover, minutes of care, including paid and unpaid help provided per day to spinal cord injured persons post acute rehabilitation, are strongly related to FIM scores.[22] By providing further knowledge about expected patterns of recovery, item performance benchmarks can provide more specific information (than FIM scores) about long-term care needs for distinct groups of people. For example, according to our study, no more than 25% of people assigned to SCI-2 at admission are expected to be able to toilet by discharge without the supervision or assistance of a second person, while most will be able to propel a wheelchair a minimum of 150 feet.

The LOS quartiles (Table 3) suggest ranges for which the particular FRG outcome benchmark values listed can be expected to be most valid. It is reasonable to assume that if LOS were longer outcome benchmark achievements would be higher, although this assumption would need to be tested. Assuming a sufficiently large number of patient records, benchmarks could be calculated for shorter and longer stays adjusting for case mix. Also, benchmarks might be established for services of alternative intensities or for those provided in different settings. Benchmarks might be used to study how outcomes differ among those treated through different protocols or in different settings. For example, outcomes in general facilities might be compared to outcomes of model SCI centers. An alternative approach would use SCI-FRGs to establish score and item attainment benchmarks at set times post injury, rather than at discharge. This would facilitate follow-up assessment across the full service continuum, but would require a totally different approach to data collection than is currently prevailing in large data sets like the UDSMR.

Functional or other outcomes can be studied either with impairment-based or function-based classification, depending on the questions being addressed and

the availability of data. Classification by impairment (ASIA) links neurological findings to eventual functional consequences. A trained examiner can complete a neurological examination of the acutely injured patient before it is clinically safe to assess functional status. On the down side, motor recovery may continue for many months, highlighting the difficulty of early neurological classification.

Classification by function (SCI-FRGs) links patients' severities of initial disabilities to expected burden of care at some future time. Compared to ASIA impairment ratings, classification by FRGs requires information only about patient's motor-FIM functions at admission to rehabilitation. However, functional status assessment can be distorted by hospitalization when procedures limit opportunities for self care. Thus, care must be taken in evaluating function, particularly in the acute setting. Also, the FIM instrument does not appear to sensitively gauge changes in function in those with the most severe SCI.

The impairment-based ASIA and function-based FRG approaches might be used in tandem to establish patterns of expected recovery that, particularly in combination, could have important research or clinical applications. Outcome assessment across both approaches would further facilitate comparison of the prognostic capacities of both and enhance clinical interpretation. If patients' achievements in particular FIM items are below par for both ASIA standards and SCI-FRG classification, it would add credence to the interpretation that outcomes were sub-optimal. If patients' achievement in a FIM task was below par for only one of the systems, there would be some, but less convincing, evidence of the outcome being unusual. As the FRG benchmarks stand, they represent a tool that might be used retrospectively to address patient outcomes.

Examples of interpretations of FRG-adjusted FIM outcome patterns for the cases presented in Figure 4 are as follows: Patient 4-A's FIM attainments were in the low end of expected, and LOS was short. Could this patient have made some gains with a longer stay, or were clinician assumptions about limited functional potential reasonable? Clinicians might review findings to see if additional comorbidities or sociological factors outside the FRGs could have explained the low outcomes. Such issues would be addressed retrospectively by the treatment team's discussions for quality improvement purposes.

Despite Patient 4-B's extreme age, she made gains that were comparable to others with similar clinical profiles but required a longer time period to do so. FRG benchmarks indicate unusual difficulties in problem solving and memory. Did she exhibit excess anxiety that might have influenced cognitive functions secondarily? Could these cognitive problems have explained her longer than usual LOS? Were her cognitive deficits pre-morbid, or did she also suffer concomitant brain injury that might not have been picked up? The cognitive FIM items generally show a ceiling effect in the SCI population,[23] except among those with the highest tetraplegic injuries[9] who are more likely to have concomitant brain trauma.

Patient 4-C's FIM item discharge scores were fairly typical of others with complete paraplegic lesions. Outpatients goals might reasonably focus on his toileting and bowel management, where his outcomes were below the attainment benchmark for SCI-4.

Virtually all patients in our sample could be assigned an FRG because UDSMR requires that all FIM items be completed. In contrast, patients could not be assigned an ASIA class based on UDSMR data alone. Use of another data source with different data, collection requirements, such as model systems data might have allowed simultaneous classification of patients by ASIA grades and FRGs. This would facilitate direct comparison of FRG benchmarks to those developed by ASIA grade. In any event, health status measures will never be precise enough to be used rigidly in decision making. We recommend the retrospective analysis of populations, but not prospective use of the SCI benchmarks for individual patients until more is known about them.

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