The SCIR rehab project: treatment time spent in SCI rehabilitation

Occupational therapy treatment time during inpatient spinal cord injury rehabilitation

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Background: Occupational therapy (OT) is a critical component of the rehabilitation process after spinal cord injury (SCI), the constitution of which has not been studied or documented in full detail previously.

Objective: To describe the type and distribution of SCI rehabilitation OT activities, including the amount of time spent on evaluation and treatment, and to discuss predictors (patient and injury characteristics) of the amount of time dedicated to OT treatment activities.

Methods: Six inpatient rehabilitation centers enrolled 600 patients with traumatic SCI in the first year of the SCIR rehab. Occupational therapists documented 32 512 therapy sessions including time spent and specifics of each therapeutic activity. Analysis of variance and contingency tables/chi-square tests were used to test differences across neurologic injury groups for continuous and categorical variables.

Results: SCIR rehab patients received a mean total of 52 hours of OT over the course of their rehabilitation stay. Statistically significant differences among four neurologic injury groups were seen in time spent on each OT activity. The activities that consumed the most OT time (individual and group sessions combined) were strengthening/endurance exercises, activities of daily living (ADLs), range of motion (ROM)/stretching, education, and a grouping of 'therapeutic activities' that included tenodesis training, fine motor activities, manual therapy, vestibular training, edema management, breathing exercise, cognitive retraining, visual/perceptual training desensitization, and don/doff adaptive equipment. Seventy-seven percent of OT work occurred in individual treatment sessions, with the most frequent OT activity involving ADLs. The variation in time (mean minutes per week) spent on OT ROM/stretching, ADLs, transfer training, assessment, and therapeutic activities can be explained in part by patient and injury characteristics, such as admission Functional Independence Measure (FIM) score, neurologic injury group, and the medical severity of illness score.

Conclusion: OT treatment patterns for patients with traumatic SCI show much variation in activity selection and time spent on activities, within and among neurologic level of injury groups. Some of the variation can be explained by patient and injury characteristics. Almost all patients with SCI participated in strengthening/endurance and ROM/stretching exercises during OT treatment and these two activities are where the most time was spent when therapy provided in individual and group settings was combined. ADL work consumed the most time in individual therapy sessions.

Keywords: Activities of daily living, Spinal cord injuries, Rehabilitation, Occupational therapy, Paraplegia, Tetraplegia

Introduction

Occupational therapy (OT) is a key rehabilitation discipline the goal of which is to assist persons in recovering

function and facilitate a return to a productive and fulfilling life after spinal cord injury (SCI). Occupational therapists (OTs) evaluate a wide spectrum of life skills needed to function at home, at work, in school, in the community, and during leisure activities.¹ They select specific interventions to address identified patient needs; however, there is a

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paucity of evidence supporting the use of these interventions, or which interventions will specifically lead to the best outcomes after SCI. Furthermore, little is known about the factors that contribute to the selection of these interventions and the amount of time spent on selected interventions during a typical SCI rehabilitation stay. In order to understand which interventions lead to the best outcomes after SCI, they must be defined and quantified, which includes specification of the type of intervention or service, technique or approach, the devices utilized, the amount of time spent, and the degree of patient participation in the activity. The interventions and services that OTs provide during inpatient rehabilitation after SCI vary within and across centers and can be influenced by the experience of the therapist providing treatment, interactions between the therapist and person with SCI,² the severity of the SCI, co-morbidities, and other patient characteristics.^{3,4}

The SCIREhab project is a 5-year, multi-center investigation recording and analyzing the details of the SCI inpatient rehabilitation process and relating these details to inpatient discharge and first-year post-injury outcomes. As part of this study, OTs defined and quantified the activities/interventions they provided during inpatient rehabilitation after SCI. The study design and implementation of the practice-based evidence (PBE) methodology have been described previously.^{5,6} In general, the process of PBE involves quantifying the content and timing of services provided in the clinical setting to determine which of the treatments/services are associated with better outcomes, while controlling for patient characteristics, including the severity of the SCI, patient complications, and comorbid conditions. The SCIREhab project developed and used treatment taxonomies to capture information about each treatment/intervention provided by rehabilitation specialists in inpatient rehabilitation settings. The OT treatments taxonomy that is embedded in the SCIREhab point of care documentation system establishes a framework to capture a comprehensive description of OT activities within the SCI rehabilitation setting. It includes details associated with each activity. The objectives of this paper are to describe the types of OT treatments used at six SCI centers, to quantify the variations in time spent on OT treatment activities with patients with varying levels and completeness of injury, and to examine associations of patient and injury characteristics with time spent on common OT activities.

Methods

The introductory paper⁷ in this SCIREhab series describes the PBE research methodology^{5,6,8–11} along with the study's inclusion criteria, data sources, and

analysis plan. The project team included OTs and representatives from other rehabilitation clinical disciplines from six inpatient rehabilitation facilities (IRFs): Craig Hospital, Englewood, CO; Shepherd Center, Atlanta, GA; Rehabilitation Institute of Chicago, Chicago, IL; Carolinas Rehabilitation, Charlotte, NC; the Mount Sinai Medical Center, New York, NY; and National Rehabilitation Hospital, Washington, DC. Institutional review board approval was obtained at each center; patients who were 12 years of age or older and gave informed consent for study participation were enrolled. For patients under the age of 18 years, a parent or guardian provided consent.

Patient/injury and clinician data

The International Standards of Neurological Classification of SCI (ISNCSCI)¹² and its American Spinal Injury Association Impairment Scale (AIS) were used to describe the motor level and completeness of injury. Patients were placed into groups based on the neurologic level and completeness of injury. Patients with AIS classifications of A, B, and C were grouped together and separated by motor level to determine the first three categories: high tetraplegia (cervical levels 1–4), low tetraplegia (C5–C8), and paraplegia (T1 and lower). Patients with AIS D classifications were grouped together regardless of injury level to comprise the fourth category. These injury categories were selected because they were each large enough for analysis and created groupings thought to have relatively homogenous functional ability within groups and clear differences between the groups. The Comprehensive Severity Index (CSI®) was used to score the extent of each patient's SCI complications and other co-morbidities at the time of rehabilitation admission and over time within the center, based on the deviation from 'normal'.^{13–17} The higher the patient's CSI score, the further from normal ('the sicker') the patient was. The Functional Independence Measure (FIM®) was used to describe a patient's level of independence in motor and cognitive skills at rehabilitation admission and discharge; lower FIM scores represent lower functioning.^{18,19} Trained data abstractors collected patient information, including data related to injury and complications, from medical records. OTs who documented treatment data for the SCIREhab project completed a clinician profile that included their years of SCI rehabilitation experience at the start of the project.

OT treatment data collection

OTs at each participating SCIREhab center entered details about each OT treatment session into handheld

personal digital assistants (PDAs; Hewlett Packard PDA hx2490b, Palo Alto, CA) containing a modular custom application (PointSync Pro version 2.0, MobileDataforce, Boise, ID, USA) of the SCIRehab point-of-care documentation system that incorporated the OT taxonomy.²⁰ OTs documented the date and start time of each session, the number of minutes spent in each of 20 OT activities (including initial assessment by the therapist), activity-specific details, patient and family participation, and factors that limited participation in session activities. In addition to the 20 activities, OTs recorded the time patients spent in classes taught and clinics led by an OT, as well as the time that OTs spent participating in interdisciplinary team conferences during which patient goals and progress were discussed. Thus, there are a total of 23 activities included in Table 1; there are 21 activities in Table 2 because classes taught by OTs and OTs' participation in interdisciplinary conferencing are not provided during individual treatment sessions.

Most of the OT activities in this analysis address the attainment or refinement of a unique and specific skill, such as transfers and bed mobility. However, the OT taxonomy includes three activities that include multiple components: activities of daily living (ADLs) (8 components), strengthening/endurance (15 components), and an all-encompassing category named 'therapeutic activities' (10 components) that, while distinct, are similar for treatment purposes.²⁰ The use of the term 'therapeutic activities' for one of the OT activities may be a bit puzzling since all activities are considered therapeutic; however, the included components do not fit easily into any of the other identified OT activities. Clinicians who developed the taxonomy deemed these components as integral to the process of rehabilitation for patients with SCI and, thus, did not think it appropriate to call them 'other', which could be interpreted as less important. These three multi-component OT activities are presented in Table 3.

To determine the approximate duration of each OT session, the numbers of minutes recorded for successive activities were combined. To ensure inter-rater reliability, each clinician was trained on use of the documentation system and tested quarterly. The project's site coordinators compared session entries with the facility's scheduling and/or billing records to assess data collection completeness and worked with clinicians to obtain documentation not contained in the documentation system.

Data analysis

Data reported here are for patients included in the SCIRehab project's first year of enrollment. The total

time spent in OT during each patient's rehabilitation was calculated by summing time spent in each documented OT activity for each day of the rehabilitation stay. However, because total time has a linear relationship with length of stay (LOS), the minutes of OT treatment per week was also calculated and used as the primary measure of intensity of OT delivered. Analysis of variance and contingency tables/chi-square tests were used to test differences across injury groups for continuous and categorical variables, respectively. (A *P* value less than 0.05 was considered statistically significant.)

Ordinary least squares stepwise regression models were used to identify patient and injury characteristics associated with time spent on OT activities; this was limited to those activities in which more than 30% of patients had received at least once. The strength of a regression model is determined by the R^2 value, which indicates the amount of variation explained by the significant independent variables. The type II semi-partial correlation coefficient reflects the unique contribution that each predictor variable adds to the total R^2 for the model after controlling for all other variables in the model.^{21,22} Parameter estimates indicate the direction and strength of the association between each statistically significant independent variable (predictor) with the dependent variable (outcome). The predictors used were gender, marital status, racial/ethnic group, traumatic SCI etiology, body mass index (BMI), English speaking status, third-party payer, pre-injury occupational status, CSI score, age, FIM score, experience level of the treating clinicians, and injury grouping. See Table 4 footnote for full details. Only if the predictors jointly explained more than 20% of the variance in the number of minutes per week for an OT activity are model details included here.

Results

Six hundred patients with traumatic SCI were enrolled in the SCIRehab project during the first year of data collection. Details of patient demographic and injury characteristics are presented for the sample as a whole and for each injury group separately in the first article of this SCIRehab series⁷ (Table 1). The sample was 81% male, 65% white, 38% married, 82% had a BMI of <30, and 65% were employed at the time of injury. The average age of patients was 37 years (standard deviation (SD) 17 years). Vehicular accidents were the most common cause of injury (49%), followed by falls (23%), sports-related etiologies (12%), and violent etiologies (11%), and the remaining 5% were classified as other. The mean rehabilitation LOS was 55 days (range

Table 1 OT activities – individual and group therapy combined: percent of patients receiving each type of activity, mean number of minutes per week, and mean total hours (SD), by neurological category of injury*

	Full SCIRehab sample (n = 600)	C1–C4 AIS A, B, C (n = 132)	C5–C8 AIS A, B, C (n = 151)	Para AIS A, B, C (n = 223)	AIS D (n = 94)
Any OT activity (%)	100.0	100.0	100.0	100.0	100.0
Minutes per week [†]	406.6 (113.5)	409.9 (104.2)	452.2 (99.2)	372.0 (119.6)	410.6 (107)
Total hours [†]	51.9 (35.5)	69.0 (37.9)	69.0 (37.3)	37.7 (24.0)	34.3 (28.2)
ADLs (%)	96.3	89.4	100.0	99.6	92.6
Minutes per week [†]	69.3 (58.1)	33.4 (34.9)	84.0 (64.6)	84.3 (59.9)	60.6 (44.0)
Total hours [†]	7.3 (6.3)	4.7 (4.7)	10.6 (7.6)	7.6 (5.6)	4.7 (4.5)
Airway/respiratory management (%)	6.3	17.4	6.6	1.8	1.1
Minutes per week [†]	0.3 (1.7)	1.0 (3.2)	0.2 (1.2)	0.1 (0.5)	0.0 (0.4)
Total hours [†]	0.1 (0.3)	0.2 (0.7)	<0.1 (0.2)	<0.1 (0.1)	<0.1 (0.1)
Assessment (%)	87.7	88.6	94.0	80.3	93.6
Minutes per week [†]	19.2 (20.2)	15.3 (11.8)	19.5 (12.9)	14.5 (14.6)	35.3 (36.2)
Total hours [†]	2.1 (1.8)	2.5 (2.1)	2.8 (2.0)	1.4 (1.4)	2.0 (1.5)
Assistive technology (%)	36.3	71.2	66.9	3.6	16.0
Minutes per week [†]	7.6 (15.5)	19.7 (23.0)	11.8 (15.2)	0.2 (1.1)	1.6 (5.7)
Total hours [†]	1.1 (2.5)	3.1 (3.9)	1.7 (2.2)	<0.1 (0.2)	0.1 (0.4)
Balance exercises (%)	59.8	40.9	59.6	71.7	58.5
Minutes per week [†]	10.2 (15.1)	3.6 (7.4)	6.5 (8.7)	16.0 (18.1)	11.9 (17.9)
Total hours [†]	1.2 (2.0)	0.7 (1.4)	1.1 (1.8)	1.8 (2.4)	1.1 (1.9)
Bed mobility (%)	56.0	33.3	73.5	67.7	31.9
Minutes per week [†]	5.4 (8.4)	1.8 (4.5)	8.0 (11.1)	7.0 (8.3)	2.4 (5.0)
Total hours [†]	0.7 (1.2)	0.3 (0.8)	1.1 (1.5)	0.8 (1.2)	0.2 (0.6)
Classes (%)	18.7	25.0	17.9	15.2	19.1
Minutes per week	2.3 (6.2)	2.6 (5.8)	1.9 (5.1)	2.4 (7.1)	2.4 (6.3)
Total hours [†]	0.3 (1.0)	0.7 (1.6)	0.3 (0.8)	0.2 (0.5)	0.2 (0.5)
Clinics (%)	5.0	9.1	5.3	2.7	4.3
Minutes per week [†]	1.4 (8.1)	2.1 (7.8)	2.7 (13.7)	0.3 (2.3)	0.6 (4.2)
Total hours [†]	0.3 (1.6)	0.5 (1.9)	0.5 (2.4)	0.1 (0.4)	0.1 (1.0)
Communication (%)	43.3	76.5	72.2	5.8	39.4
Minutes per week [†]	7.1 (12.5)	12.5 (14.0)	12.8 (15.4)	0.9 (4.8)	5.0 (10.6)
Total hours [†]	1.1 (2.2)	2.1 (2.5)	2.1 (2.9)	0.1 (0.7)	0.5 (1.2)
Community reintegration outings (%)	34.8	31.8	47.7	34.1	20.2
Minutes per week [†]	7.0 (17.1)	6.2 (17.8)	9.8 (21.4)	6.9 (15.5)	3.9 (10.5)
Total hours [†]	0.8 (1.8)	0.9 (2.0)	1.3 (2.4)	0.7 (1.4)	0.3 (0.6)
Education (%)	93.3	97.7	95.4	93.7	83.0
Minutes per week [†]	26.8 (23.0)	31.0 (27.9)	27.5 (18.6)	26.6 (22.6)	20.1 (21.5)
Total hours [†]	3.4 (3.9)	5.3 (6.0)	4.2 (3.9)	2.5 (2.1)	1.5 (1.9)
Equipment evaluation (%)	46.8	67.4	60.9	35.4	22.3
Minutes per week [†]	8.4 (14.4)	16.8 (20.1)	9.5 (13.6)	5.5 (10.8)	2.1 (5.6)
Total hours [†]	1.7 (3.6)	4.0 (5.6)	2.0 (3.3)	0.7 (1.7)	0.2 (0.7)
Home management skills (%)	68.7	41.7	70.2	83.4	69.1
Minutes per week [†]	15.5 (18.9)	6.7 (12.6)	13.9 (17.1)	19.9 (18.4)	19.7 (24.6)
Total hours [†]	1.9 (2.6)	1.4 (2.8)	2.4 (3.5)	1.9 (1.8)	1.5 (2.4)
Modalities (%)	50.3	65.2	77.5	24.2	47.9
Minutes per week [†]	11.4 (20.1)	20.2 (24.2)	17.1 (23.8)	2.2 (8.3)	11.9 (18.6)
Total hours [†]	1.5 (3.1)	2.8 (3.8)	2.4 (3.5)	0.3 (1.7)	1.2 (2.5)
Stretching/ROM exercises (%)	81.2	99.2	94.0	67.3	68.1
Minutes per week [†]	37.8 (45.6)	82.9 (56.5)	42.1 (38.2)	13.2 (20.6)	26.0 (32.0)
Total hours [†]	5.8 (9.1)	13.7 (11.9)	6.5 (7.7)	1.8 (5.7)	2.8 (5.4)
Interdisciplinary conferencing (%)	100.0	100.0	100.0	100.0	100.0
Minutes per week [†]	20.4 (15.9)	17.6 (9.0)	20.2 (14.9)	19.8 (15.5)	26.3 (23.0)
Total hours [†]	2.6 (2.2)	3.3 (2.4)	3.0 (2.3)	2.2 (2.0)	1.9 (1.9)
Skin management (%)	52.0	49.2	55.0	66.8	16.0
Minutes per week [†]	6.1 (11.6)	3.0 (5.8)	4.0 (7.3)	11.5 (15.9)	1.1 (3.7)
Total hours [†]	0.6 (1.1)	0.4 (0.7)	0.6 (0.8)	1.0 (1.4)	0.1 (0.3)
Splint/Cast fabrication (%)	29.3	40.9	60.3	3.6	24.5
Minutes per week [†]	2.8 (6.6)	3.9 (8.5)	5.8 (8.3)	0.3 (2.0)	2.3 (5.1)
Total hours [†]	0.5 (1.2)	0.7 (1.2)	0.9 (1.5)	0.1 (0.9)	0.2 (0.5)
Strengthening/endurance exercises (%)	97.3	95.5	98.7	97.8	96.8
Minutes per week [†]	92.4 (68.0)	77.3 (61.0)	93.5 (56.8)	93.8 (75.4)	108.7 (71.7)
Total hours [†]	12.1 (13.4)	12.9 (15.1)	16.2 (15.0)	10.1 (11.6)	9.4 (10.0)

Continued

Table 1 Continued

	Full SCIRehab sample (n = 600)	C1–C4 AIS A, B, C (n = 132)	C5–C8 AIS A, B, C (n = 151)	Para AIS A, B, C (n = 223)	AIS D (n = 94)
Therapeutic activities [†] (%)	68.8	83.3	93.4	39.9	77.7
Minutes per week [†]	26.5 (38.5)	26.2 (35.0)	37.8 (37.0)	8.1 (19.9)	52.7 (54.4)
Total hours [†]	3.6 (6.1)	4.3 (6.1)	5.9 (6.8)	1.1 (3.5)	4.8 (7.6)
Transfers (%)	83.5	72.7	84.1	93.7	73.4
Minutes per week [†]	16.2 (17.5)	6.6 (8.8)	14.2 (14.2)	24.7 (19.9)	12.8 (16.9)
Total hours [†]	1.6 (1.8)	1.0 (1.3)	1.9 (1.9)	2.2 (1.8)	0.9 (1.4)
Wheelchair mobility – manual (%)	43.5	18.9	45.7	65.9	21.3
Minutes per week [†]	6.0 (15.7)	0.7 (2.2)	4.2 (10.1)	12.3 (22.7)	1.6 (4.1)
Total hours [†]	0.6 (1.4)	0.1 (0.4)	1.6 (1.3)	1.1 (1.9)	0.2 (0.4)
Wheelchair mobility – power (%)	34.5	75.8	43.7	10.8	18.1
Minutes per week [†]	6.3 (13.7)	18.8 (21.0)	5.4 (9.7)	1.5 (7.0)	1.5 (4.2)
Total hours [†]	1.1 (2.7)	3.5 (4.7)	0.9 (1.4)	0.2 (0.7)	0.2 (0.5)

*Hours and minutes per week are calculated as averages over all 600 patients, not just based on those who did receive one or more sessions of a particular activity.

[†]Statistically significant difference in mean minutes per week or in total hours over LOS among neurological injury groups.

[‡]Therapeutic activities include fine motor activities, tenodesis training, manual therapy, vestibular training, edema management, breathing exercises, cognitive retraining, visual/perceptual training, desensitization, and don/doff adaptive equipment.

Table 2 OT activities – individual therapy only: percent of patients receiving each type of activity, mean number of minutes per week, and mean total hours (SD), by neurological category of injury*

	Full SCIRehab sample (n = 600)	C1–C4 AIS A, B, C (n = 132)	C5–C8 AIS A, B, C (n = 151)	Para AIS A, B, C (n = 223)	AIS D (n = 94)
OT activities (%)	100.0	100.0	100.0	100.0	100.0
Minutes per week [†]	314.8 (96.0)	324.1 (82.1)	338.1 (96.1)	295.5 (100.1)	309.7 (95.4)
Total hours [†]	38.4 (22.8)	52.3 (24.0)	48.1 (20.2)	29.3 (17.3)	24.6 (18.8)
ADLs (%)	95.8	88.6	100.0	98.7	92.6
Minutes per week [†]	67.0 (57.3)	31.5 (34.1)	80.0 (63.8)	82.9 (58.8)	58.4 (44.1)
Total hours [†]	7.0 (6.1)	4.4 (4.4)	10.0 (7.6)	7.5 (5.5)	4.4 (4.2)
Airway/respiratory management (%)	5.8	16.7	5.3	1.8	1.1
Minutes per week [†]	0.3 (1.6)	1.0 (3.1)	0.2 (1.1)	0.1 (0.5)	0.0 (0.4)
Total hours [†]	<0.1 (0.3)	0.2 (0.6)	0.4 (0.2)	<0.1 (0.1)	<0.1 (0.1)
Assessment (%)	87.7	88.6	94.0	80.3	93.6
Minutes per week [†]	19.2 (20.2)	15.3 (11.8)	19.5 (12.8)	14.4 (14.6)	35.2 (36.2)
Total hours [†]	2.1 (1.8)	2.5 (2.1)	2.8 (2.0)	1.4 (1.4)	2.0 (1.5)
Assistive technology (%)	35.5	71.2	65.6	2.7	14.9
Minutes per week [†]	7.2 (14.9)	18.0 (21.7)	11.7 (15.2)	0.1 (0.5)	1.5 (5.6)
Total hours [†]	1.0 (2.1)	2.6 (3.1)	1.7 (2.2)	<0.1 (0.2)	0.1 (0.4)
Balance exercises (%)	56.0	35.6	53.0	70.4	55.3
Minutes per week [†]	9.1 (14)	3.2 (7.0)	5.1 (7.7)	14.4 (16.6)	11.1 (17.2)
Total hours [†]	1.1 (1.9)	0.6 (1.3)	0.9 (1.7)	1.6 (2.3)	1.0 (1.8)
Bed mobility (%)	55.3	33.3	71.5	67.3	31.9
Minutes per week [†]	5.3 (8.4)	1.7 (4.3)	7.9 (11.2)	6.9 (8.0)	2.4 (5.0)
Total hours [†]	0.7 (1.2)	0.3 (0.7)	1.1 (1.5)	0.8 (1.2)	0.2 (0.6)
Clinics (%)	5.0	9.1	5.3	2.7	4.3
Minutes per week [†]	1.4 (8.1)	2.1 (7.8)	2.7 (13.7)	0.3 (2.3)	0.6 (4.2)
Total hours [†]	0.3 (1.6)	0.5 (1.9)	0.5 (2.4)	0.1 (0.4)	0.1 (1.0)
Communication (%)	38.8	73.5	66.9	1.8	33
Minutes per week [†]	3.7 (7.1)	7.8 (9.8)	6.6 (7.9)	0.1 (0.7)	2.3 (4.3)
Total hours [†]	0.5 (1.0)	1.1 (1.3)	0.9 (1.1)	0 (0.2)	0.2 (0.4)
Community reintegration outings (%)	20.5	16.7	25.8	22.9	11.7
Minutes per week [†]	2.3 (6.4)	1.3 (4.4)	2.3 (5.7)	3.1 (7.6)	1.6 (6.6)
Total hours [†]	0.3 (0.7)	0.3 (0.7)	0.3 (0.8)	0.3 (0.7)	0.1 (0.4)
Education (%)	90.7	93.2	94.7	91.5	78.7
Minutes per week [†]	22.7 (21.2)	26.1 (25.5)	23.2 (17.3)	23.1 (21.1)	15.9 (19.6)
Total hours [†]	2.8 (3.2)	4.3 (4.7)	3.4 (3.1)	2.2 (2.0)	1.2 (1.5)

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Table 2 Continued

	Full SCIRehab sample (n = 600)	C1–C4 AIS A, B, C (n = 132)	C5–C8 AIS A, B, C (n = 151)	Para AIS A, B, C (n = 223)	AIS D (n = 94)
Equipment evaluation (%)	46.8	67.4	60.9	35.4	22.3
Minutes per week [†]	8.4 (14.4)	16.7 (19.9)	9.5 (13.6)	5.5 (10.8)	2.1 (5.6)
Total hours [†]	1.6 (3.5)	4.0 (5.5)	2.0 (3.3)	0.7 (1.7)	0.2 (0.7)
Home management skills (%)	61.0	31.1	55.6	80.3	66.0
Minutes per week [†]	10.4 (14.1)	2.9 (5.7)	5.9 (8.4)	15.8 (13.9)	15.4 (21.3)
Total hours [†]	1.1 (1.4)	0.6 (1.2)	1.0 (1.3)	1.5 (1.5)	1.0 (1.6)
Modalities (%)	48.5	64.4	73.5	23.3	45.7
Minutes per week [†]	9.7 (17.0)	17.8 (21.8)	13.5 (18.8)	1.8 (5.4)	10.7 (17.0)
Total hours [†]	1.2 (2.3)	2.4 (2.9)	1.8 (2.6)	0.2 (0.9)	1.1 (2.2)
Stretching/ROM exercises (%)	78.8	99.2	92.7	64.6	61.7
Minutes per week [†]	33.4 (41.1)	75.7 (48.8)	36.2 (34.2)	11.7 (19.9)	21.0 (29.3)
Total hours [†]	5.0 (8.1)	12.3 (10.4)	5.4 (6.1)	1.6 (5.6)	2.4 (5.1)
Skin management (%)	50.3	45.5	53.6	66.8	12.8
Minutes per week [†]	5.9 (11.4)	2.8 (5.8)	3.9 (7.2)	11.4 (15.6)	0.7 (2.4)
Total hours [†]	0.6 (1.0)	0.4 (0.6)	0.5 (0.8)	1.0 (1.4)	0.1 (0.2)
Splint/cast fabrication (%)	28.8	4.2	58.9	3.6	24.5
Minutes per week [†]	2.7 (6.4)	3.8 (8.5)	5.5 (7.7)	0.3 (2.0)	2.3 (5.1)
Total hours [†]	0.4 (1.2)	0.7 (1.2)	0.9 (1.5)	0.1 (0.9)	0.2 (0.5)
Strengthening/endurance exercises (%)	95.5	93.9	97.4	95.1	95.7
Minutes per week [†]	49.0 (40.3)	45.2 (40.3)	45.8 (36.4)	49.0 (37.9)	59.7 (49.4)
Total hours [†]	5.4 (4.5)	6.3 (4.9)	6.1 (4.6)	4.7 (3.8)	4.7 (4.7)
Therapeutic activities [‡] (%)	61.5	76.5	85.4	31.4	73.4
Minutes per week [†]	13.3 (19.1)	12.7 (16.2)	18.3 (18.3)	3.9 (9.2)	28.3 (27.6)
Total hours [†]	1.7 (2.8)	2.0 (2.5)	2.7 (3.0)	0.6 (2.0)	2.5 (3.3)
Transfers (%)	83.2	72.7	83.4	93.3	73.4
Minutes per week [†]	15.7 (17.1)	6.4 (8.7)	13.8 (14.1)	23.8 (19.3)	12.4 (16.6)
Total hours [†]	1.6 (1.7)	0.9 (1.3)	1.8 (1.9)	2.1 (1.8)	0.9 (1.4)
Wheelchair mobility – manual (%)	36.0	12.9	37.7	57.0	16.0
Minutes per week [†]	3.3 (9.2)	0.3 (0.9)	2.8 (7.2)	6.4 (13.2)	1.0 (3.2)
Total hours [†]	0.4 (0.9)	0.1 (0.2)	0.4 (1.0)	0.6 (1.1)	0.1 (0.3)
Wheelchair mobility – power (%)	30.0	72.0	39.7	6.7	10.6
Minutes per week [†]	4.5 (11.8)	14.3 (18.9)	4.0 (9.1)	0.7 (5.4)	0.7 (2.6)
Total hours [†]	0.8 (2.4)	2.9 (4.4)	0.6 (1.1)	0.1 (0.6)	0.1 (0.3)

*Hours and minutes per week are calculated as averages over all 600 patients, not just based on those who did receive one or more individual sessions of a particular activity.

[†]Statistically significant difference in mean minutes per week or in mean total hours per LOS among neurological injury groups.

[‡]Therapeutic activities include fine motor activities, tenodesis training, manual therapy, vestibular training, edema management, breathing exercises, cognitive retraining, visual/perceptual training, desensitization, and don/doff adaptive equipment.

Table 3 OT activities with multiple components/skill sets*

Strengthening/endurance	Therapeutic activities	ADLs
Sitting tolerance	Fine motor activity	Feeding
Manual resistance	Tenodesis training	Grooming
Strengthening/no equipment	Manual therapy	Bathing
Basic/low-tech equipment	Vestibular training	Upper body dressing
Gym machines	Edema management	Lower body dressing
Overhead slings/mobile arm support	Breathing exercise	Clothing management and hygiene for toileting
Neuromuscular re-education	Cognitive retraining	Bowel management
Arm ergometer	Visual/perceptual training	Bladder management
Motomed	Desensitization	
Participation sport	Don/doff adaptive equipment	
Video simulation/eyeToy™		
Yoga		
Pilates		
Standing frame/tilt table		
Wii™		

*Other OT activities address a unique or specific skill set.

Table 4 Patient and injury characteristics associated with time (minutes per week) in OT activities^{*,†}

Total R^2	ROM/stretching		ADLs		Assessment		Transfers		Therapeutic activities [‡]	
	0.41		0.27		0.24		0.26		0.23	
Independent variable	Parameter estimate	Type II semi-partial R^2	Parameter estimate	Type II semi-partial R^2	Parameter estimate	Type II semi-partial R^2	Parameter estimate	Type II semi-partial R^2	Parameter estimate	Type II semi-partial R^2
Injury group: C1–C4 ABC	47.69	0.10	–42.20	0.08					–13.79	0.01
Injury group: C5–C8 ABC	12.81	0.01					5.43	0.01	26.07	0.05
Injury group: Para ABC					–13.74	0.06	14.39	0.12		
Injury group: AIS D			–29.16	0.03	8.33	0.02			12.86	0.10
Admission FIM motor score	–1.00	0.04			0.67	0.09			–0.38	0.01
Admission FIM cognitive score			–1.68	0.02						
Severity of illness score (CSI)	–0.17	0.01	–0.46	0.04			–0.10	0.04		
Age at injury	0.45	0.03			0.09	0.01			0.28	0.01
Traumatic etiology – vehicular			13.83	0.01						
Traumatic etiology – surgical complication			–26.01	0.01						
Payer – Medicaid							3.92	0.01		
Clinician experience			1.02	0.01			–0.41	0.02		
Race – black			9.96	0.01			3.73	0.01		
Race – Hispanic							–7.03	0.01		
Race – Other					–6.90	0.01				
Number of days from trauma to rehabilitation admission	0.18	0.01								
Ventilator use at rehabilitation admission			–24.70	0.01					–12.78	0.01
BMI <30							–5.72	0.01	–8.26	0.01
Employment status at injury – other [§]					10.98	0.01				
Language – English	13.65	<0.01								
Language – English sufficient for understanding									22.68	0.01

*The activities listed in Table 1 are included here only if total $R^2 > 0.20$ and if more than 70% of the patients received the treatment activity.

†Independent variables allowed into models: age at injury, male, married, race – white, race – black, race – Hispanic, race – other, admission FIM motor score, admission FIM cognitive score, severity of illness score (CSI), injury group – C1–C4 ABC, injury group – C5–C8 ABC, injury group – Para ABC, injury group – AIS D, clinician experience, traumatic etiology – vehicular, traumatic etiology – violence, traumatic etiology – falls, traumatic etiology – sports, traumatic etiology – medical/surgical complication, traumatic etiology – other, work-related injury, number of days from trauma to rehabilitation admission, BMI >40, BMI 30 – 40, BMI <30, language – English, language – no English, language – English sufficient for understanding, payer – Medicare, payer – workers' compensation, payer – private, payer – Medicaid, employment status at time of injury – employed, employment status at time of injury – student, employment status at time of injury – retired, employment status at time of injury – unemployed, employment status at time of injury – other, ventilator use at rehabilitation admission.

‡Therapeutic activities include fine motor activities, tenodesis training, manual therapy, vestibular training, edema management, breathing exercises, cognitive retraining, visual/perceptual training, desensitization, and don/doff adaptive equipment.

§employment status at injury 'other' subcategory includes retired, unemployed, homemaker, on-job training, sheltered workshop, and unknown.

2–259, SD 37, median 43). The mean total FIM score at admission was 53 (motor score of 24 and cognitive score of 29), and a mean of 32 days had elapsed from the time of injury to the point of rehabilitation admission.

Variation in treatment time

All 600 patients received OT services during inpatient rehabilitation. The OTs documented treatment details for 24 104 individual therapy sessions, 8160 group

sessions, and 248 education classes (for example, a home modification class led by OT). OTs also participated in 1175 team conferences to plan care for their patients. Of all OT work, 77% was provided during individual treatment sessions and 23% in groups. Table 1 depicts the percentage of patients who participated in each OT activity, and the time spent within each activity for all patients in the SCIREhab sample and separately for each injury group. Time is expressed as total hours over the full rehabilitation stay and as an average number of minutes per week for individual and group OT sessions combined. Also shown is the percentage of patients who received each activity. SCIREhab patients received a mean total of 52 hours (range 2–204, SD 36, median 42) of OT over the course of the rehabilitation stay. The calculated mean minutes per week was 407 (range 72–732, SD 114, median 417). The activities that consumed the most minutes per week for individual and group sessions combined were strengthening/endurance (23%), ADLs (17%), range of motion (ROM)/stretching (9%), education (7%), and therapeutic activities (7%). Statistically significant differences in time spent on each OT activity were seen among injury groups.

OT treatment during individual sessions

The majority (77%) of OT time, based on minutes per week, occurred in individual treatment sessions.

Table 2 depicts the mean number of total hours and minutes per week for each OT activity during individual therapy only. The most frequent individual OT session activity involved ADLs, which consumed 67 minutes per week or 21% of all individual therapy time. Fig. 1 displays the percentage of patients who received each OT activity during individual therapy sessions and the mean number of minutes per week spent on each activity for these patients only. For example, all patients were discussed in interdisciplinary conferencing for approximately 20 minutes per week per patient. OTs spent a mean of 20 minutes per week providing assistive technology training to the 36% of patients who received this activity. In contrast, 96% of patients participated in ADLs and they spent a mean of 70 minutes per week in this training.

The substantial variation in mean minutes per week spent on OT activities during individual therapy sessions is shown in Fig. 2. For ADLs the interquartile range (IQR) was 23–99 minutes per week (median 48), for strengthening/endurance the IQR was 20–71 (median 39), and for ROM/stretching the IQR was 2–51 minutes per week (median 18).

Table 5 separates the ADL category into specific subgroups, showing (similar to Tables 2 and 3) the percent of patients receiving each treatment, and mean total hours, and minutes per week by neurologic injury

Figure 1 OT activities in individual sessions: percent of patients receiving each and mean minutes per week among patients receiving that activity.

Figure 2 Variation in time spent (minutes per week) on OT activities during individual sessions (includes only the 10 activities that consumed the most time).

Table 5 OT ADL components – individual and group therapy combined: percent of patients receiving each type of service, mean number of minutes per week, and mean total hours (SD), by neurological category of injury*

ADLs – as separate activities	Full SCIRehab sample (n = 600)	C1–C4 AIS A, B, C (n = 132)	C5–C8 AIS A, B, C (n = 151)	Para AIS A, B, C (n = 223)	AIS D (n = 94)
Bathing (%)	66.3	49.2	66.2	75.8	68.1
Minutes per week [†]	12.8 (15.8)	5.2 (7.5)	10.2 (12.3)	18.9 (19.3)	13.2 (14.2)
Total hours [†]	1.1 (1.3)	0.6 (0.8)	1.1 (1.3)	1.5 (1.6)	0.8 (0.9)
Bladder management (%)	37.0	18.9	53.0	46.2	14.9
Minutes per week [†]	4.1 (9.0)	0.8 (3.0)	6.6 (11.4)	5.7 (10.1)	0.9 (3.2)
Total hours [†]	0.5 (1.0)	0.1 (0.4)	0.8 (1.5)	0.5 (0.9)	0.1 (0.3)
Bowel management (%)	23.0	6.1	23.8	39.0	7.4
Minutes per week [†]	3.8 (11.0)	0.3 (1.3)	4.7 (13.6)	6.5 (13.1)	0.7 (3.8)
Total hours [†]	0.4 (1.1)	0.0 (0.1)	0.6 (1.7)	0.5 (1.2)	0.1 (0.3)
Dressing lower (%)	85.3	61.4	87.4	96.4	89.4
Minutes per week [†]	25.5 (29)	6.9 (14)	26.3 (31.0)	39.4 (31.4)	17.4 (14.8)
Total hours [†]	2.6 (3.1)	1.0 (1.9)	3.3 (3.8)	3.7 (3.0)	1.4 (1.5)
Dressing upper (%)	79.7	62.1	90.1	83.4	78.7
Minutes per week [†]	7.6 (8.6)	3.9 (5.7)	11.0 (10.7)	7.0 (7.3)	8.5 (8.7)
Total hours [†]	0.8 (1.0)	0.5 (0.7)	1.4 (1.4)	0.7 (0.7)	0.6 (0.8)
Feeding (%)	49.2	68.2	84.1	13.5	51.1
Minutes per week [†]	7.1 (12.6)	10.6 (14.4)	13.0 (15.3)	0.7 (2.9)	7.8 (12.8)
Total hours [†]	1.0 (1.8)	1.7 (2.3)	1.7 (2.1)	0.1 (0.3)	0.8 (1.8)
Grooming (%)	65.2	57.6	91.4	50.7	68.10
Minutes per week [†]	6.2 (8.8)	5.0 (7.1)	10.7 (10.8)	2.6 (4.1)	9.3 (11.0)
Total hours [†]	0.7 (1.0)	0.7 (1.0)	1.4 (1.4)	0.2 (0.4)	0.7 (0.9)
Toileting/clothing management and hygiene (%)	35.3	15.2	27.8	48.9	43.6
Minutes per week [†]	2.3 (4.7)	0.7 (2.7)	1.6 (4.2)	3.5 (5.6)	2.8 (4.6)
Total hours [†]	0.2 (0.5)	0.1 (0.4)	0.2 (0.5)	0.3 (0.6)	0.2 (0.3)

*Hours and minutes per week are calculated as averages over all 600 patients, not just based on those who did receive one or more sessions of a particular activity.

[†]Statistically significant difference in mean minutes per week or in mean total hours per LOS among neurological injury groups.

group. The majority of ADL time (individual and group sessions combined) was allotted to lower body dressing (38%), based on mean minutes per week. Other components of ADLs consumed less time (percentage of total ADL minutes per week): bathing (19%), upper body dressing (11%), feeding (10%), grooming (9%), bladder management (5%), bowel management (5%), and toileting (3%).

Patient and injury characteristics predict treatment time

Patient and injury characteristics associated with the amount of time (minutes per week) spent on specific OT activities are presented in Table 4; the only activities reported are those where more than 70% of patients received the treatment involved and R^2 values were greater than 0.20. The parameter estimate indicates the strength and direction (how much (more or less) time was spent (in minutes per week)) of the association between each independent variable with the dependent variable. The type II semi-partial R^2 value signifies the percent of unique contribution that the independent variable contributes to the total R^2 for the model. The model with the most predictive power was for time spent on ROM/stretching, in which 41% of the variation in time spent was explained by patient, injury, and clinician characteristics ($R^2 = 0.41$). The strongest predictor was injury group: C1–C4 ABC, which explained 10% of the total variance (semi-partial $R^2 = 0.10$), and the parameter estimate was 47.69, which indicated that patients in this group received an average of nearly 48 minutes per week more of ROM/stretching than patients in the other injury groups. The parameter estimate for the independent variable of admission FIM motor score was -1.00 , which indicated that for each increase in FIM motor score, patients received 1 less minute per week of ROM/stretching and the semi-partial R^2 (0.04) indicated that this was the second largest explanatory variable. Older age, injury group C5–C8 ABC, more days from injury to rehabilitation admission, and English speaking were associated with more time spent on ROM/stretching (positive parameter estimates), while the only other variable (in addition to motor FIM score) associated with less time was the severity of illness (CSI) score (negative parameter estimate).

The model predicting time spent in ADLs shows that 27% of the variation in time spent was explained by the patient, injury, and clinician characteristics included in the model. Injury group C1–C4 was again the strongest predictor, contributing 8% of the explained variance (semi-partial $R^2 = 0.08$); the negative parameter estimate

indicates that approximately 42 fewer minutes of ADL work was done with this group as compared to the other injury groups. CSI score was the next strongest predictor and explained 4% of the variance (semi-partial $R^2 = 0.04$); the parameter estimate was -0.46 , which indicates that for each additional severity point, 0.46 fewer minutes were spent. Therefore, a patient with a severity score of 100 would be predicted to receive 46 fewer minutes per week of ADL training (parameter estimate of -0.46×100) than a patient with CSI score of 0.

The R^2 for the model predicting time spent in transfer training is 0.26. Injury group Para ABC was the strongest predictor (semi-partial $R^2 = 0.12$) of more OT time. The strongest predictor for more time spent in therapeutic activities ($R^2 = 0.23$) was injury group AIS D (semi-partial $R^2 = 0.10$). Injury group C5–C8 ABC and older age also were associated with more time in therapeutic activities; higher admission FIM motor score was associated with less time.

Discussion

This analysis of the data collected in the SCIRehab study provides insight into the use of OT treatment activities and time spent with patients with varying levels of SCI.

Individual and group treatment

On average, each SCIRehab patient spent 407 minutes per week participating in OT; 23% of this time occurred in group sessions. While individual therapy provides intensive one-on-one patient interaction and allows for treatments tailored specifically to each patient's needs, group sessions are a valuable therapeutic tool that may help patients establish friendships and adjust emotionally through support from their peers. OTs and other patients participating in group work may also create healthy competition, encouraging patients (or other patients) to work harder on repetitive tasks. The focus of group work is often on preparatory activities, which may help maximize patient participation in functional work during individual OT sessions.^{23,24}

Strengthening/endurance

Therapeutic strengthening/endurance activities are commonly delivered in both individual and group therapy sessions. The significant amount of time spent on therapeutic strengthening/endurance activities may be attributed to the broadness of this category with the inclusion of 15 distinct components in the OT taxonomy (as outlined in Table 1),²⁰ and to the role these components serve as predecessors for the advancement of functional status. For example, increasing sitting

tolerance is essential prior to working on dressing, bathing, wheelchair skills, and other ADLs completed in the seated position. Mobile arm supports are used to support the distal weight of the arm so that the upper extremity can be strengthened; this improves activity tolerance and gross motor control, which is beneficial in preparation for advancing grooming or self-feeding techniques for patients with tetraplegia. Previous research has shown that strengthening exercises and strategies (e.g. arm ergometry, resistance training, and use of mobile arm supports) improve the overall performance of functional daily activities and quality of movement in patients with and without SCI.^{25–31} Neuromuscular re-education and manual resistance techniques also facilitate achieving an optimal level of motor recovery prior to introducing adaptations and assistive technology. These findings seem to support the concept that focusing on strengthening activities in OT is an important step in achieving functional tasks.

ADL training

OTs focus on ADL training almost exclusively during individual therapy as opposed to group therapy, which is understandable considering the private nature of most of the activities and the need for personal attention to address individual patient needs.

Patients with levels of injury distal to C5 have greater functional strength than patients with injuries at C1–C4, and therefore they spend a higher percentage of their OT time working on ADL training (18 and 23%, respectively) than patients with high tetraplegia (8%). In order to achieve greater independence with ADLs, repetition is imperative to optimize independence and hone techniques. Individuals with paraplegia do not require as much time to learn grooming, self-feeding, and upper body dressing as the higher injury groups; however, they tend to focus much time on bowel and bladder management, bathing, and lower body dressing in various environments (e.g. sitting in a wheelchair or in bed).

Patients with motor complete (AIS A or B) high tetraplegia most likely would not focus on practicing ADL skills, as they may lack the necessary strength to perform them. Instead, therapy tends to be focused on *directing* care by others rather than the *performance* of the ADLs. Family training sometimes takes the place of direct patient training with this injury group. The inclusion of patients with AIS C in the C1–C4 injury group may account for most of the time reported as spent on ADL training (33 minutes per week), as these patients may be able to begin ADL training as muscle

strength increases or function begins to return. Completion of ADLs and interfacing with the environment often involves use of assistive technology and devices that facilitate communication for patients with high tetraplegia. For these patients, developing communication capabilities often is more important than practice/performance of functional skills, such as ADLs, because it is the ability to communicate with caregivers, peers, and others in the community that provides a sense of independence with personal care needs. A high percentage (77%) of the C1–C4 injury group participated in OT sessions that included communication training. Assistive technology often is necessary to facilitate communication; a similarly high percentage (72%) of patients in this group participated in OT sessions that focused on assistive technology. While the initial assistive technology evaluation and equipment set-up are performed during individual sessions, practice of these skills is done in both individual and group therapy to allow for repetitive practice.

Predicting time spent on specific OT activities

Patient and injury characteristics explained some of the variation in time spent on common OT activities, where the standard for ‘common’ was that more than 70% of patients participated in the activity at least once. The model predicting time spent in ROM/stretching activities was the most powerful with 41% of variance explained by select predictors. The strongest predictor of more time spent on ROM/stretching was the C1–C4 ABC injury group (semi-partial $R^2 = 0.10$). Other factors also were associated with more time spent: C5–C8 injury group, older age, more days from trauma to rehabilitation admission, and English speaking. The strongest predictor of less time spent (negative parameter estimate) was the admission FIM motor score (semi-partial $R^2 = 0.04$). The only other predictor of less time spent on ROM/stretching was a higher CSI score. This parallels findings reported in Table 1 where it is noted that 99.2% of the high-tetraplegia (C1–C4) injury group received stretching/ROM and spent 83 minutes per week on average performing these activities, which is significantly higher than for the other injury groups.

A similar phenomenon holds true in other prediction models. Patients with high tetraplegia, lower admission FIM motor scores, and higher medical severity (CSI) scores spent less time in functionally oriented activities, such as transfers and ADLs. Deconditioning happens quickly with patients who are severely ill and immobile due to the loss of motor and/or sensation distal to the level of injury. Therapy often is geared at preventing

contractures and maintaining strength, which typically involves ROM/stretching and strengthening exercises rather than work on more functional tasks.

Obesity also seems to relate to time spent in transfers and therapeutic activities. In these models, patients who were not obese spent significantly less time than patients with a BMI $>30 \text{ kg/m}^2$, although the predictive power is weak (semi-partial $R^2 = 0.01$) and the reduction in time is approximately 6–8 minutes per week. Mastering transfers may consume more time for obese patients due to difficulties moving body weight from one surface to another. More time spent on therapeutic activities is more challenging to understand due to the assortment of activities (fine motor, tenodesis, manual therapy, etc.) included in this group. English language proficiency also plays a role in time spent on therapeutic activities; patients who have enough knowledge of the English language to understand conversation (not their primary language) may indicate that additional time and repeated instruction are needed for complete understanding of the progressive steps in these functional skills.

While patient demographic and injury characteristics explain some of the variation in time spent on common OT activities, other factors may also influence the type and amount of inpatient OT rehabilitation treatment provided to patients with traumatic SCI. Prospective payment system requirements for post-acute settings, other insurance restrictions, family support, LOS, availability and accessibility of discharge destination, and local practice patterns of the rehabilitation center may play a role in determining the intensity of OT treatment. For example, IRFs must comply with the '3-hour rule' embedded in the Inpatient Rehabilitation Facility Prospective Payment System used by the Center for Medicare and Medicaid. This rule requires that patients admitted to an IRF receive at least 3 hours of intensive therapies per day (made up of OT, PT, and/or speech therapy) at least 5 days per week.³²

We conducted regression analyses to examine patient and injury characteristics associated with time spent in therapy during rehabilitation. We followed the typical PBE analytic strategy of not including center variables because the goal was not to compare one center to another, but to identify underlying differences in patient and injury characteristics that help explain treatment variation. Understanding the underlying differences may be more informative and may facilitate application of the findings to centers beyond those that participated in the study. We acknowledge, however, that there may be additional center-specific factors that may influence the amount of time spent on OT activities. When center identities (using dummy

coding) were allowed to enter the regression models reported here for functional training (ADLs, transfers, and therapeutic activities), the explanatory power increase ranged from 0.10 to 0.20. For ROM/stretching, the increase in explanatory power was 0.04. The combination of patient, injury, and center effects explained 32–47% of the variance in OT treatment intensity, leaving the majority of the variance unexplained, which bodes well for PBE methodology. The significant variation in time spent should prove useful in the eventual effort to correlate interventions with key patient outcomes.

Treatment overlap with other rehabilitation clinical disciplines

SCI rehabilitation is a multi-disciplinary process and treatment responsibilities may be shared among the treating disciplines. For example, OTs share some common treatment areas with physical therapists (PTs). The SCIRehab OT and PT taxonomies were developed so that shared activities were defined and described in a manner to be complementary while allowing each discipline to focus on and describe work done in relation to discipline-specific goals. Activities where OT and PT may overlap include equipment evaluation, bed mobility, wheelchair skills training, transfers, and therapeutic exercises of strengthening, endurance, ROM/stretching, and balance. Examining treatment time involving only OTs in these areas may not provide a complete picture of total care provided. For example, OTs spent a mean of 16 minutes per week providing transfer training, but when you combine this OT time with the time physical therapists spent providing similar transfer training, the total time patients spent practicing transfers was 72 minutes per week. Power wheelchair mobility training can be within the realm of PT only, OT only, or a combination of the two disciplines. Time was divided fairly evenly; OTs spent 9 minutes per week and PT spent 10 minutes per week on power wheelchair mobility training.³³

Another area of shared responsibility may be in bowel and bladder management training. This is an area in which OTs are trained to provide care, but in many rehabilitation centers, including five of the six SCIRehab centers, the bulk of training responsibility lies within the realm of nursing. Our findings show that 37% of study patients received bladder management training from OTs (mean time 4 minutes per week over all 600 patients) and 23% of the patients received bowel training from OTs (mean time 34 minutes per week). Nursing provided bladder management training to 97% of patients and bowel management training to 98% of patients.³⁴

Limitations

SCIRehab centers were selected to participate based on their willingness, geographic diversity, and expertise in treatment of patients with SCI and provide variation in setting, care delivery patterns, and patient clinical and demographic characteristics. The centers are not a probability sample of the rehabilitation facilities that provide care for patients with SCI in the United States and, therefore, time reported on specific activities may not be generalizable to all rehabilitation centers. It is also important to note that data reported in this investigation were derived from supplemental documentation that clinicians completed in addition to their required clinical documentation. While a variety of efforts were made to maximize completeness of documentation, including cross-checking with billing records and clinical documentation of therapy delivered and communications with clinical staff, it is expected that some treatment activities that occurred are not represented in the research data set.

Conclusions

Almost all patients with SCI participated in strengthening/endurance and ROM/stretching exercises during OT treatment, and these two activities consumed the most time when therapy provided in individual and group settings was combined. When examining therapy provided in individual settings only, ADL work consumed the most time and the most common ADL component was lower body dressing. Significant differences were seen in time spent among injury groups for all OT activities when examining both total time spent and a calculated number of minutes per week. Some of this variation could be explained by patient and injury characteristics.

The inclusive nature of the PBE methodology allows us to gain an understanding of the full realm of SCI rehabilitation. This approach provides an opportunity to examine the relationship of therapeutic activities and interventions with patient outcomes and will contribute to the search of best practice in SCI rehabilitation.

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References

- 1 American Occupational Therapy Association. Occupational therapy practice framework: domain and process. *Am J Occup Ther* 2002;56(6):609–39.
- 2 Barclay L. Exploring the factors that influence the goal setting process for occupational therapy intervention with an individual with spinal cord injury. *Austr Occup Ther* 2002;49:3–13.
- 3 National Institute of Neurological Disorders and Stroke. Spinal cord injury: hope through research; 2003 [accessed 2010 Sep 1]. Available from: http://www.ninds.nih.gov/disorders/sci/detail_sci.htm.
- 4 American Occupational Therapy Association. Living with spinal cord injury (SCI); 2007 [accessed 2010 Aug 28]. Available from: <http://www.aota.org/Consumers/consumers/Health-and-Wellness/SCI/35189>.
- 5 Gassaway J, Whiteneck G, Dijkers M. SCIRehab: clinical taxonomy development and application in spinal cord injury rehabilitation research. *J Spinal Cord Med* 2009;32(3):260–9.
- 6 Whiteneck G, Dijkers M, Gassaway J, Jha A. SCIRehab: new approach to study the content and outcomes of spinal cord injury rehabilitation. *J Spinal Cord Med* 2009;32(3):251–9.
- 7 Whiteneck G, Gassaway J, Dijkers M, Charlifue S, Backus D, Chen D, et al. SCIRehab: inpatient treatment time across disciplines in spinal cord injury rehabilitation. *J Spinal Cord Med* 2011;34(2):135–50.
- 8 Horn S, Gassaway J. Practice-based evidence study design for comparative effectiveness research. *Med Care* 2007;45(Suppl 2):S50–7.
- 9 DeJong G, Hsieh C, Gassaway J, Horn S, Smout R, Putman K, et al. Characterizing rehabilitation services for patients with knee and hip replacement in skilled nursing and inpatient rehabilitation facilities. *Arch Phys Med Rehabil* 2009;90(8):1284–96.
- 10 Gassaway J, Horn S, DeJong G, Smout R, Clark C, James R. Applying the clinical practice improvement approach to stroke rehabilitation: methods used and baseline results. *Arch Phys Med Rehabil* 2005;86(12 Suppl 2):S16–33.
- 11 Horn S, DeJong G, Ryser D, Veazie P, Teraoka J. Another look at observational studies in rehabilitation research: going beyond the holy grail of the randomized controlled trial. *Arch Phys Med Rehabil* 2005;86(12 Suppl 2):S8–15.
- 12 Marino R, editor. Reference manual for the international standards for neurological classification of SCI. Chicago, IL: American Spinal Injury Association; 2003.
- 13 Horn S, Sharkey S, Rimmasch H. Clinical practice improvement: a methodology to improve quality and decrease cost in health care. *Onc Issues* 1997;12(1):16–20.
- 14 Horn S, Sharkey P, Buckle J, Backofen J, Averill R, Horn R. The relationship between severity of illness and hospital length of stay and mortality. *Med Care* 1991;29(4):305–17.
- 15 Ryser D, Egger M, Horn S, Handrahan D, Ghandi P, Bigler E. Measuring medical complexity during inpatient rehabilitation following traumatic brain injury. *Arch Phys Med Rehabil* 2005;86:1108–17.
- 16 Averill R, McGuire T, Manning B, Fowler D, Horn S, Dickson P, et al. A study of the relationship between severity of illness and hospital cost in New Jersey hospitals. *Health Services Res* 1992;27(5):587–617.
- 17 Clemmer T, Spuhler V, Oniki T, Horn S. Results of a collaborative quality improvement program on outcomes and costs in a tertiary critical care unit. *Crit Care Med* 1999;27(9):1768–74.
- 18 Fiedler R, Granger C, Russell C. UDS(MR)SM: follow-up data on patients discharged in 1994–1996. Uniform data system for medical rehabilitation. *Am J Phys Med Rehabil* 2000;79(2):184–92.
- 19 Fiedler R, Granger C. Functional independence measure: a measurement of disability and medical rehabilitation. In: Chino N, Melvin J, (eds.) *Functional evaluation of stroke patients*. Tokyo: Springer-Verlag; 1996. pp. 75–92.

- 20 Ozelie R, Sipple C, Foy T, Cantoni K, Kellogg K, Lookingbill J, *et al.* SCIREhab: the occupational therapy taxonomy. *J Spinal Cord Med* 2009;32(3):283–96.
- 21 Stevens J. Partial and semipartial correlations; 2003 [Accessed 2010 Feb 10]. Available from: www.uoregon.edu/~stevensj/MRA/partial.pdf.
- 22 Stevens J. Intermediate statistics: a modern approach. 2nd ed. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.; 1999.
- 23 Ballinger C, Ashburn A, Low J, Roderick P. Unpacking the black box of therapy – a pilot study to describe occupational therapy and physiotherapy interventions for people with stroke. *Clin Rehabil* 1999;13(4):301–9.
- 24 Gauthier L, Dalziel S, Gauthier S. The benefits of group occupational therapy for patients with Parkinson's disease. *Am J Occup Ther* 1987;41(6):360–5.
- 25 Atkins M, Baumgarten J, Yasuda Y, Adkins R, Waters R, Leung P, *et al.* Mobile arm supports: evidence-based benefits and criteria for use. *J Spinal Cord Med* 2008;31(4):388–93.
- 26 DiCarlo S. Effect of arm ergometry training on wheelchair propulsion endurance of individuals with quadriplegia. *Phys Ther* 1988; 68(1):40–4.
- 27 Hunter G, McCarthy J, Bamman M. Effects of resistance training on older adults. *Sports Med* 2004;34(5):329–48.
- 28 Turbanski S, Schmidtbleicher D. Effects of heavy resistance training on strength and power in upper extremities in wheelchair athletes. *J Strength Cond Res* 2010;24(1):8–16.
- 29 Jacobs P. Effects of resistance and endurance training in persons with paraplegia. *Med Sci Sports Exerc* 2009;41(5):992–7.
- 30 Holviala J, Sallinen J, Kraemer W, Alen M, Häkkinen K. Effects of strength training on muscle strength characteristics, functional capabilities, and balance in middle-aged and older women. *J Strength Cond Res* 2006;20(2):336–44.
- 31 Kloosterman M, Snoek G, Jannink M. Systematic review of the effects of exercise therapy on the upper extremity of patients with spinal-cord injury. *J Spinal Cord Med* 2009;47(3):196–203.
- 32 Centers for Medicare and Medicaid Services. Medicare benefit policy manual. Chapter 1, Section 110. 2010 [accessed 2010 Sep 25]. Available from: <http://www.cms.hhs.gov/Manuals/IOM/list.asp>.
- 33 Taylor S, LaBarbera J, McDowell S, Zanca J, Natale A, Mumma S, *et al.* SCIREhab: physical therapy treatment time during inpatient spinal cord injury rehabilitation. *J Spinal Cord Med* 2011; 34(2):151–63.
- 34 Rundquist J, Gassaway J, Bailey J, Lingefelt P, Reyes I, Thomas J. SCIREhab: nursing bedside education and care management time during inpatient spinal cord injury rehabilitation. *J Spinal Cord Med* 2011;34(2):207–17.