CLASSIFICATION OF SCI REHABILITATION TREATMENTS

SCIRehab Project Series: The Physical Therapy Taxonomy

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Abstract

Background/Objective: Outcomes research is in need of a classification system of physical therapy (PT) interventions for acute traumatic spinal cord injury (SCI) rehabilitation in the United States. The objective of this study was to describe a taxonomy (system to categorize and classify interventions) to examine the effects of PT interventions on rehabilitation outcomes.

Methods: The SCIRehab study uses the rigorous observational practice-based evidence methodology to examine current treatment processes without changing existing practice. PT clinicians and researchers from 6 centers developed a taxonomy to describe details of each PT session.

Results: The PT taxonomy consists of 19 treatment activities (eg, bed mobility, transfers, wheelchair mobility, strengthening and stretching exercises) and supplementary information to describe the associated therapeutic interventions. Details that focus on patient assistance needs and family involvement are included as additional descriptors to help to describe and justify PT activity selection. Time spent on each activity is used as the measure of intensity.

Conclusion: The detailed PT taxonomy documentation process, which offers efficiency in data collection, is being used for all PT sessions with 1,500 patients with acute traumatic SCI at the 6 participating centers. It might be the first attempt to document the many details of the PT rehabilitation process for patients with SCI in the United States.

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This is the 3rd in a series of 9 articles describing The SCIRehab Project: Classification of SCI Rehabilitation Treatments.

INTRODUCTION

Physical therapy (PT) is an integral component of all spinal cord injury (SCI) rehabilitation programs (1,2). *The Guide to Physical Therapist Practice* published by the American Physical Therapy Association (1) describes preferred practice patterns to provide clinical guidelines “within which a physical therapist may select any of a number of clinical paths” or examination and treatment of an individual with “impaired motor function and sensory integrity associated with non-progressive disorders of the spinal cord,” including SCI (1). These guidelines, however, are based largely on expert opinion and lack strong evidence to support the types of PT treatments selected for treatment sessions or help to determine which of these are most effective for persons with various demographic backgrounds or levels and completeness of injury. Evidence is needed to guide

effective and efficient clinical decision-making and for advancing clinical and research programs (3).

Most available evidence speaks to focused interventions for very specific impairments and functional deficits. For example, there has been a recent influx of literature related to locomotor training for persons with incomplete SCI (4–12). Even with this literature, however, it remains unclear whether manual body weight support approaches are more beneficial than robotic approaches (or vice versa), if and when electrical stimulation should be incorporated into these treatment approaches (11), or whether there is a clinical algorithm that would be suitable for all persons with incomplete SCI (7). Although locomotor training for ambulation is receiving much attention, wheelchair mobility remains the primary mode of mobility for many persons with SCI and is largely unaddressed in research literature. There is even less literature regarding PT treatment interventions addressing bed mobility, transfer techniques, spasticity, pain management, and patient and family education.

Rehabilitation researchers and clinicians strive to evaluate the effectiveness of treatments objectively to provide evidence that can be used to facilitate better clinical decision-making. To evaluate treatments objectively, however, they need to be defined using a language and terminology that is agreed on by the clinicians documenting the treatments.

The concept that the physical therapy field would benefit from classifying rehabilitation strategies is not a new one. Livneh (13) attempted to classify rehabilitation interventions almost 20 years ago by domain (physical or psychosocial), intervention focus (person or environment), and environment (community or employment setting). Although the matrix defined by Livneh advanced the understanding of the relevance and necessity of rehabilitation taxonomies for clinical services as well as research, his taxonomy addressed rehabilitation interventions in general and not specifically for SCI. Furthermore, the environments addressed were limited to community and work environments and not the rehabilitation setting.

One way to begin to classify PT treatments is to use the International Classification of Functioning (ICF), which provides a framework and common language across all health care professionals for defining outcomes, as well as treatments, which are critical for a consistent, client-centered approach to rehabilitation (14). Treatments were, however, defined almost exclusively in terms of the outcomes (impairments, limitations, restrictions) they aimed to address and not in terms of anything the therapist does to improve patient functioning, such as applying heat or cold or moving a joint through its range of motion. Finger et al (15) established consensus on common areas of function and disability targeted by PTs in musculoskeletal, neurologic, and internal medicine specialties. The authors report that their findings were

supported by clinical expertise, as well as evidence, the two basic tenets of evidence-based practice. Although this study did not include treatments for persons with SCI and did not lead to an actual definition of the classified treatments, the attempt to classify treatments is a useful preliminary step in defining treatments necessary for optimizing recovery and function after SCI. The study of Finger et al also showed the usefulness of bringing physical therapists together to build consensus regarding PT practice.

van Langeveld et al (16) also used the ICF to develop a classification system of PT (as well as occupational and sports therapy) for SCI mobility and self-care rehabilitation. It has been tested for feasibility and validity in the SCI population in The Netherlands (16,17). The majority of the clinicians (PT, occupational therapy [OT], and sports therapy) involved in the study reached consensus with regard to the definitions and terminology put forward in the taxonomy and thought the tool was highly relevant to rehabilitation after SCI. van Langeveld et al also reported that, through the evaluation of the feasibility of using their classification system, they have started to elucidate the similarities and differences between the different disciplines (PT, OT, and sports therapy) in terms of focus in treatment and time spent in different treatments. Their studies provide preliminary evidence that a classification system will allow evaluation of the rehabilitation process within and across disciplines.

Jette et al (18) developed a detailed system for describing the stroke rehabilitation process. They used a consensus building strategy that required repeated discussion over an extended period of time to develop definitions and parameters that described PT treatments and interventions delivered as part of the inpatient rehabilitation process after stroke. One of the outputs of this process was a detailed documentation form designed to capture information about the nature and intensity of PT interventions delivered during inpatient stroke rehabilitation. Clinicians at 6 centers used this form as part of a study examining the impact of stroke rehabilitation interventions on outcomes.

In summary, although some progress in developing PT treatment taxonomies is being made, they are not comprehensive for PT treatments used in SCI rehabilitation in the United States. Many SCI rehabilitation treatments remain largely unexamined, and data on the effectiveness of these treatments are needed. The few published evidence-based guidelines for making or implementing clinical decisions during SCI rehabilitation (19–22) are useful but limited in their scope in defining and documenting PT treatments routinely provided across the continuum of SCI rehabilitation (19–21). Several researchers have begun the process of developing classifications for physical therapy treatments, but to date, only the van Langeveld et al effort has focused specifically on SCI rehabilitation interventions.

SCIREHAB PROJECT

The PT taxonomy described in this article was produced as part of the SCIREhab Project, which is a 5-year research effort designed to determine which SCI rehabilitation interventions are associated most strongly with positive outcomes at 1 year after injury, taking into account underlying patient characteristics and diagnosed level/severity of injury. Over 2.5 years, 1,500 consecutively admitted initial rehabilitation patients with traumatic SCI consenting to participate will be enrolled at 6 centers. The first article in this series by Whiteneck et al (23) describes the application of the practice-based evidence (PBE) methodology in the SCIREhab study and sets forth the crucial importance of center-to-center practice differences for this research methodology (23). It also presents the SCIREhab hypotheses and research questions.

The second article in the series, by Gassaway et al (24), describes the iterative process used to develop discipline-specific treatment taxonomies (for PT, OT, social work, psychology, etc) and details those documentation elements that are common across disciplines in the SCIREhab project, such as patient assistance needs, patient/family involvement, and factors impacting a given treatment session.

The purpose of this article is to describe the PT taxonomy developed by a group of PTs at 6 centers in the SCIREhab project and to explain the elements that are included. Variations in practice among clinicians and centers are reflected in the array of PT activities in which patients participate and the therapeutic interventions that are associated with the activities.

PT TAXONOMY

PT lead clinicians in the SCIREhab project identified 19 activities performed with patients with SCI to be included in the PT taxonomy. Table 1 displays the documentation schema in which the taxonomy is embedded. Consistent with the format used by other SCIREhab disciplines, the PT first describes each session by type (group or individual), co-treatment with other disciplines if applicable, the extent to which the patient directs his/her care, and the level of involvement of the patient and family. Factors that may limit the session (pain, fatigue, respiratory status, etc) are identified. Then, the PT identifies 1 or more of the 19 PT-specific activities in which the patient participates during the session. Tables 2 to 15 contain the “taxonomy” portion of the documentation and show the details associated with each activity individually. Intensity is measured by the amount of time spent per activity. Time spent conducting assessment also is noted but is not considered part of the taxonomy, which is treatment focused.

Many of the 19 PT treatment activities are supplemented by information about the assistance a patient requires for the activity. Table 2 lists the adapted Functional Independence Measure (FIM) (25) options

for level of assistance (LOA) used in the PT activity descriptions. The use of adapted FIM descriptors to rate assistance needs consistently by all disciplines is described in the article of Gassaway et al (24). In the SCIREhab PT documentation, a finer delineation of assistance needs is obtained than would be captured with standard FIM application by associating assistance needs with components of each activity (eg, rolling, scooting, sit-to-stand) in the PT taxonomy rather than the FIM items as defined per the FIM manual (eg, transfers begin and end in the supine position) (26). If functional training (eg, transfers, range of motion) is reviewed with the patient and/or family without the patient actually performing or practicing the task, level of assistance is not applicable. Thus, Table 2 also contains “education only” options.

The 19 activities included in the PT taxonomy are presented in Tables 3 to 15 and are described below. Much treatment work is discipline specific (eg, OTs provide education and training for dressing and PTs assume sole responsibility for gait training). Other treatments, however, are less differentiated. Both disciplines work on transfers and bed mobility. At some facilities, OTs do the majority of wheelchair evaluation, prescription, and mobility training, whereas at other facilities, this work is done primarily by PTs. Overlapping roles among PTs and OTs in SCIREhab project facilities necessitated that the 2 disciplines work together to establish consistent treatment intervention descriptions that are applicable to both disciplines. Thus, the PT and OT taxonomy categories of bed mobility training, transfers, wheelchair (WC) mobility, equipment evaluation/prescription, and respiratory management follow similar frameworks (27). This consistency will facilitate data analysis by allowing the impact of transfer or bed mobility activities, for example, to be examined regardless of the discipline providing the training. In addition, cross-disciplinary consistency provides a similar frame of reference to clinicians of different disciplines when they discuss taxonomy development and documentation within their facilities and also gives clinicians a common language to aid in interpretation of findings.

Bed Mobility

Training in bed mobility, defined as any type of movement on a bed, mat, and/or hospital bed, is an essential PT activity because it precedes transfers and is important for activities such as skin management and activities of daily living (eg, dressing, bathing; Table 3).

To describe bed mobility activities, therapists first identify bed mobility movement types. Rolling, scooting, and supine-to-sit skills are necessary for patients to perform activities of daily living (ADLs) while in bed. Caregivers learn and perform these movements for more dependent patients to complete routine care and to ensure proper skin management. For each movement type selected, the therapist indicates the surface on

Table 1. PT Activities and Session Variables

Session Level Variables	
Session Descriptors	Factors Impacting Session ^a
Type	Pain
Group as group ^b	Spasticity
Group as individual ^b	Involuntary bowel/bladder
Individual	Orthostasis
Co-treating discipline(s), if applicable	Autonomic dysreflexia
	Heterotopic ossification
Missed therapy information (if applicable)	Fatigue
Time missed (in minutes)	Contracture/deformity
Reason	Respiratory status
Refused	Active ventilator weaning
Patient not available/ready	Wound/wound vacuum
Equipment or therapist not available/ready	Medical complications—other
Medical complication	Bed rest
	Weight-bearing status
Patient/caregiver involvement	Surgical precautions
Patient participation scale	Orthoses
None	Halo
Poor	Behavioral issue
Fair	Cognitive issue
Good	Visual/hearing impairment
Very good	Cultural issues
Excellent	Positioning
Not applicable	Refused
Extent to which patient directed care	Equipment malfunction
Not applicable	Psychosocial support
All	In-room isolation
50% or more	Psychosocial support
Less than 50%	
None	Administrative information
Family or caregiver participation	Date
Not present	Start time
Observed session only	Patient name
Received verbal instruction	Therapist name
Demonstrated skill with assistance	
Demonstrated skill independently	
Activities ^{cd}	
Bed mobility (Table 3)	Endurance (Table 12)
Transfers (Table 4)	Musculoskeletal treatments/modalities (Table 13)
Wheelchair mobility – manual (Table 5)	Skin management (Table 14)
Wheelchair mobility – power (Table 5)	Wound care (Table 14)
Upright [activities] (Table 6)	Equipment evaluation/provision/education (Table 14)
Pre-gait (Table 7)	Complementary approaches (Table 14)
Gait (Table 8)	Airway/respiratory management (Table 14)
Range of motion/stretching (Table 9)	Aquatic exercises (Table 14)
Strengthening (Table 10)	Education not covered by other activities (Table 15)
Balance (Table 11)	

^a Clinicians may select multiple factors from this list.

^b Group as Individual allows for patient-specific information to be entered; when Group as Group is selected, only information applicable to all patients in the group can be entered, except for patient names (24).

^c Time spent on each activity is documented.

^d More than one activity may be documented for each session. Additional descriptors for each activity are specified in Tables 3–15.

Table 2. Options for Level of Assistance and Education Only Descriptors

Levels of Assistance	Education Only
Total assistance of >1 person	Patient education only
Total assistance of 1 person	Family/caregiver education only
Maximum assist	Patient/family/caregiver education only
Moderate assist	
Minimal assist	
Supervision	
Modified independent	
Independent	

which this movement is performed; various surfaces present different challenges for patients because of their density and resistance to movement. How long patients spend practicing skills on the mat before progressing to activities in bed, a more difficult surface, may affect the bed mobility learning curve and/or the final functional level attained. Level of assistance (Table 2) is captured for each bed mobility component.

The equipment used in performing any bed mobility activity is identified. Equipment choice can be indicative of the amount of caregiver support; less-assistive equipment can be used as patients become more proficient with the targeted bed mobility skill.

Transfers

To create a standard definition of transfers, PT and OT lead clinicians dissected transfer components, including surfaces involved, progressive steps through a transfer, and type of transfer (Table 4). Because therapists intuitively think about a transfer as 1 action back-and-forth between 2 surfaces (eg, getting into and out of a car is considered 1 action), a transfer was defined as a back-and-forth action between 2 surfaces. The PT and OT taxonomies incorporate the same definition of “transfer” and use a similar framework (27).

Table 4 lists common surfaces (Surfaces A and B) included in the PT taxonomy. Each surface is defined so that all clinicians work with common definitions when selecting the transfer surfaces. For example, “Chair” includes a standard furniture chair that may or may not have armrests. “Transfer bench” is a piece of bathing equipment that bridges the gap between the wheelchair and the bathing surface and has 2 legs in the bathtub and 2 legs outside it.

Common language also was sought to describe the various types of transfers performed. “Transfer board” is a transfer in which a patient uses a board to slide between 2 surfaces using upper extremity strength. “Pop-over with board” is a transfer in which a patient achieves some clearance of the buttocks when going between 2 surfaces; a transfer board is used to make the transfer easier when

Table 3. Bed Mobility

Movement Type ^a	Surface	Equipment
Rolling	Mat	None
Supine to/from Sit	Hospital bed ^b	Bed straps/chain loops
Scotting	Bed ^b	Rails
Positioning		Wheelchair
		Leg loops
		Pillows
		Draw sheet
		Trapeze

^a Each movement type is associated with a level of assistance or an education only descriptor (see Table 2).

^b Hospital bed is adjustable in height and head/foot position. Bed is standard, nonadjustable bed.

upper extremity strength is insufficient to pop the buttocks over the entire gap between the surfaces. “Pop-over without board” involves the clearance of the buttocks between 2 surfaces using upper body strength and proper technique to prevent shearing of the buttocks. The relative height (even or uneven) of transfer surfaces is an important measure of transfer skill progression and an indicator of ability to transfer to a variety of surfaces people may encounter in the community.

Wheelchair Mobility

PTs share the task of teaching WC mobility skills with OTs (27). Each discipline’s taxonomy captures important attributes of these skills as applicable to that discipline.

Distance is recorded for propulsion and wheelies. Distance categories similar to those used in the FIM (<50, 50–149, 150 feet), while familiar to clinicians, may not adequately show progress over time, especially early in the rehabilitation process when patients often are able to propel themselves only over short distances. Thus, the PT taxonomy includes more detailed distance increments (indicating the sum of all distances propelled during a session) to reflect smaller increments of progress during initial training (Table 5). The type of terrain traversed is captured for propulsion and wheelies, because propulsion over smooth or level terrain can be different compared with rough terrain.

PTs teach a patient (or caregiver) about the non-propulsion features of their wheelchair. For example, maintaining proper positioning in the WC (manual or power) helps with skin management, optimizes function, and prevents postural deficits. Management of doors, elevators, and curbs is important for community mobility in either type of chair. Management of power functions allows patients to position their drive controls properly (or direct someone else to do it). Patients who use a manual WC can be taught several methods to manage stairs, including bumping up and down the stairs on their buttocks out of the WC or bumping up and down in the

Table 4. Transfers

Surface A	Surface B	Even or Uneven Surface	Transfer Type ^a
Mat	Same list as for Surface A	Even surface	Transfer board
Bed(s)		Uneven surface	Pop-over with board
Wheelchair		Not applicable	Pop-over without board
Chair			Squat-pivot
Sofa			Stand-pivot
Toilet			Dependent with lift
Tub			Dependent without lift
Shower			Sit-to-stand
Bedside commode			Other
Elevated toilet seat			
Transfer bench			
Bath seat			
Rolling shower commode chair			
Vehicle			
Modified vehicle			
Floor			
Standing frame			
Standing			
Aisle seat			
Airline seat			
Other			

^a Each transfer type is associated with a level of assistance or an education only descriptor (see Table 2).

WC. Information on the number of steps patients negotiate is captured for both types of stair management.

Adaptive equipment often is used to increase the patient's independence with many WC mobility tasks (eg, a patient may be unable to propel a manual chair without using rim projections). Types of adaptive

equipment included in the PT taxonomy are limited to equipment used most commonly at the participating centers.

Level of assistance (Table 2) is captured for each WC mobility skill type (propulsion, stairs, positioning, etc) separately, because assistance needs can vary dramatical-

Table 5. Wheelchair Mobility (Power and Manual)

Skill Type ^a	Adaptive Equipment	Drive Type (Power Only)	Total Distance (feet) ^b	Surface/Terrain ^b
<u>Manual and power</u>	<u>Manual and power</u>	Power hand	0–10	Level
Propulsion/driving	None	Power head	11–50	Inclines
Positioning in chair	Dorsal wrist	Power sip-n-puff	51–100	Rough terrain
Wheelies	Splint	Power tongue	101–200	Not applicable
Door management	Other	Power chin	201–500	
Elevator		Power foot	501–1,000	
Curbs	<u>Manual Only</u>		>1,000	
	Gloves			
<u>Manual only</u>	Short opponens			
Stairs ^c	Tubing wrap			
Escalator	Rim projections			
Assembly/breakdown	Power assist			
Up righting	Stair rails			
<u>Power only</u>	<u>Power only</u>			
Power functions	Overhead sling			
Wheelchair management	Adaptive joystick			

^a Each skill type is associated with a level of assistance or an education only descriptor (see Table 2).

^b Documented for propulsion (both manual and power chairs) and wheelies (for manual wheelchairs only).

^c Number of steps (1–3, 4–11, >12) is documented and whether stair management is in or out of the chair.

Table 6. Upright^a

Surface	Upright
Tilt table	0–30
Standing frame	31–60
Bed(s)	61–90
Chair	Not applicable
Stall bars	
Bed in full chair position	
Other	

^a The education only descriptor (Table 2, column 2) is documented for the upright activity.

ly from 1 WC skill to another. For example, a patient may be independent in WC propulsion but require maximum assistance for up-righting the WC after tipping backward.

Upright

The upright category consists of interventions meant to increase a patient’s tolerance of the upright position and to normalize blood pressure regulation (Table 6). Bed, bed in full chair position (ie, adjusting the bed so that the patient’s head is up and his/her legs are down), and chair are types of equipment used primarily to increase a patient’s tolerance of the upright sitting position, whereas the tilt table, standing frame, and stall bars promote increased tolerance of the standing position.

The approximate degree of upright is recorded to indicate a patient’s tolerance of the upright position. LOA is not a priority in this activity, although education is captured, because it is important for patients and families to be aware of the importance of upright activities and to be able to assist with set-up and use of the equipment.

Pre-Gait

Pre-gait activities are defined as any work such as strengthening or balance training to prepare the patient for more advanced ambulation skills and future gait activity. Information captured for pre-gait activities in the PT taxonomy include LOA and equipment used, such as assistive devices, standing frame, orthoses, and mirrors (Table 7).

Gait

Independent ambulation is perhaps the most important outcome for patients with an incomplete or a low level of spinal injury. Table 8 shows the complex detail for gait training included in the PT taxonomy. Selecting the surface type used for gait training prompts for additional details. If ambulation is performed on even or rough surfaces, the distance ambulated and the number of trials at each distance is captured. Distance categories used for gait have the same gradations as those used for WC mobility (Table 5), although the therapist takes into consideration a patient’s need for seated rests by

Table 7. Pre-Gait^a

Equipment
None
Parallel bars
Standing frame
BWS
Mirror
Orthoses
Assistive devices
Stall bars
Other

^a A level of assistance or an education only descriptor (Table 2) is documented for the pre-gait activity.

indicating how many trials were completed at each distance. If “stairs” is the surface, the number of steps is captured. LOA is recorded for each surface separately because a patient’s functional independence may be different depending on surface type. Type of terrain (surface) and independence in that terrain may indicate whether a patient can ambulate in the home or is safe for community ambulation, which typically would be over more rough and varied terrain.

Equipment for ambulation ranges from basic assistive devices (as may be used for joint stabilization or upper extremity support) to high-tech specialized ambulation equipment (eg, robotic-assisted body weight support [BWS] systems). When BWS is used during a gait activity, the therapist records additional information about the type of assistance provided. “Manual assistance” may require hands-on assistance of up to 3 clinicians, whereas “robotic assistance” would require only set-up and monitoring by the therapist. “No additional assistance” is an option, because a patient may need only the unweighted support for effective ambulation training.

Range of Motion/Stretching

After SCI, a patient requires greater range of motion (ROM) in certain joints and muscle groups to allow for adapted movements. On the other hand, less than normal flexibility in some muscle groups may be beneficial (eg, long finger flexors to allow for tenodesis grip or lower back extensors to allow for greater stability in short and long sitting). Table 9 shows the selections for the involved body parts and specific interventions used in the ROM activity. “Intervention” includes the type of range of motion treatment delivered or treatments that facilitate ROM. A lower extremity ergometer, which is used in specialized SCI centers but may not be available in general PT facilities, is included as an intervention to allow for closer examination of its impact on ROM/flexibility. Manual/orthopedic treatment and thermal agents, which can be used in conjunction with either passive or active ROM activities, are included to

Table 8. Gait

Surface ^a	Equipment	Joint Stabilized	Joint Side	Distance (feet) ^b	BWS Assistance ^c
Even	None	None	Right	0–10	Manual assist
Ramps/inclines	Parallel bars	Hip	Left	11–50	Robot assist
Curbs	Treadmill	Knee	Bilateral	51–100	No assistance
Rough	Body weight support	Ankle		101–200	
Stairs ^d	(BWS) ^c	Foot		201–500	
	Cane	Ankle/foot		501–1,000	
	Crutches	Knee/ankle/foot		>1,000	
	Walker				
	Functional electrical stimulation				
	Bioness				
	Stair rails				
	Other				

^a A level of assistance or an education only descriptor (Table 2) is documented for each surface on which gait training is performed.

^b Distance and number of attempts at each distance are documented for even and rough surfaces only.

^c When BWS is selected, the type of foot-placement assistance (robot, human, or none) and walk time also are recorded.

^d Number of steps (1–3, 4–11, >12) is documented for stairs.

determine whether better results are achieved with use of these strategies compared with simple stretching.

Strengthening

After SCI, muscular strength is impacted by many variables, including, but not limited to, neurologic injury, deconditioning, previous strength levels, age, comorbidities, pain, and patient motivation. After SCI, patients require greater upper body strength to compensate for loss of trunk and lower body strength; PTs use a variety of approaches and equipment to help patient gain strength. Table 10 includes equipment ranging from “basic equipment” (eg, balls, bands, hand weights), to “gym machines” (eg, weight machines), to high-tech equipment that SCI patients currently find attractive. The latter category (eg, robotic or electronically assisted devices) typically is available in only a few of the more specialized SCI rehabilitation centers. Brand names were used only for specialized/high-cost equipment that currently does not have many variations (eg, Bioness). Brand names are not included for general robotic or electronically assisted

devices because of the variety of currently available brands and the continual changes in PT equipment.

Recording of the prone position was included because of potential benefits for the musculoskeletal system and functional mobility. Effects of other body positions were not felt to offer enough significance to merit inclusion.

Specific rehabilitative treatment techniques such as proprioceptive neuromuscular facilitation and neurodevelopmental treatment were not included in the PT taxonomy because of the general practice of integrating multiple therapeutic styles into treatment sessions. The usefulness of these data would be limited by an inability to ensure that the therapists were fully trained in the application of these techniques or used them in accordance with the philosophy underlying neurodevelopmental treatment or proprioceptive neuromuscular facilitation.

Balance

The PT documents time spent on balance training to gain independence with functional movements despite impairments in sensation and motor function. Table 11 shows the type of information about balance activities included in the PT taxonomy. Static and dynamic activities are identified separately, and clinicians record the various body positions and equipment used during each treatment session. “Basic equipment” is low cost and easily obtainable, such as balance boards or exercise balls. A “balance system” has a unique ability to modify visual, vestibular, and somatosensory functioning through a variety of exercises. The brand names Nintendo Wii (Nintendo of America, Inc, Redmond, WA) and Playstation EyeToy (trademark of Sony Computer Entertainment, Europe) are included specifically

Table 9. Range of Motion /Stretching^a

Body Part	Intervention
Upper extremity	Self ROM
Lower extremity	Passive ROM
Cervical region	Active ROM
Thoracic region	Active assist ROM
Lumbar/sacral region	Thermal agents
	Manual/orthopedic treatment
	Lower extremity ergometer

^a The education only descriptor (Table 2, column 2) is documented for the ROM/stretching activity.

Table 10. Strengthening^a

Equipment	Position
No equipment	Prone
Active assist	Other position
Manual resistance	
Robotic equipment	
Functional electrical stimulation bike	
Arm ergometer	
Lower extremity ergometer/bike	
Treadmill	
Gym machines	
Basic/low-tech equipment	
Bioness	
Neuromuscular electrical stimulation	
Biofeedback	
Gravity eliminated sling	
Other	

^a The education only descriptor (Table 2, column 2) is documented for the strengthening activity.

because they may be the first examples of a “toy” being integrated as a rehabilitation tool.

Endurance

The PT taxonomy includes an endurance activity to capture cardiovascular and muscular conditioning. Equipment choices are similar to those for strengthening, with the addition of “overground locomotion,” which documents performance of an activity with the intention of increasing time and/or distance rather than working on specific biomechanical skills of ambulation or wheelchair propulsion. The Nintendo Wii and Playstation EyeToy, which help to increase endurance and balance, also are included here (Table 12).

Musculoskeletal Treatments/Modalities

Table 13 depicts musculoskeletal treatments and modalities that may be used to manage secondary complications that can occur after SCI. Currently, there is little evidence to support why a PT might choose to use a specific modality and/or musculoskeletal treatment for a

Table 11. Balance^a

Equipment	Type	Position
No equipment	Static	Short-sit
Balance system	Dynamic	Long-sit
Basic equipment		Wheelchair sit
Wii		Tall kneeling
EyeToy		Quadruped
		Half kneeling
		Standing
		Other

^a A level of assistance or an education only descriptor (Table 2) is documented for the balance activity.

Table 12. Endurance^a

Equipment
No equipment
Robotic equipment
Functional electrical stimulation bike
Arm ergometer
Lower extremity ergometer/bike
Treadmill
Gym machines
Basic/low tech equipment
Bioness
Neuromuscular electrical stimulation
Over ground locomotion
Other

^a The education only descriptor (Table 2, column 2) is documented for the balance activity.

patient with SCI; in the PT taxonomy, each is associated with a specific indication, such as using biofeedback for pain or spasticity management.

The following 6 PT activities are presented in Table 14.

Skin Management

Many SCI centers follow a skin care program to prevent pressure ulcers or to manage existing wounds. Activities and therapy interventions that often are used when managing or preventing skin problems after SCI are included in the Skin Management section of the PT taxonomy (Table 13); this mirrors the skin management section of the OT taxonomy.

Wound Care

Several centers participating in the SCIR rehab study have medical units and/or specialized clinicians to care for patients needing wound care, whereas other centers transfer these patients to a medical/surgical acute care hospital. The PT taxonomy includes only information

Table 13. Musculoskeletal Treatments/Modalities^a

Type	Indication
Manual orthopedic treatment	Pain management
Myofascial techniques	Spasticity management
Neural tension (nerve glides)	Neuromuscular re-education
Thermal agents	Positioning
Electro-modalities	Edema management
Ultrasound	
Taping	
Biofeedback	
Casting/splinting	
Vibration techniques	

^a The education only descriptor (Table 2, column 2) is documented for the musculoskeletal treatment/modalities activity.

Table 14. Other Activities

Activity	Intervention Types	
Skin management ^a	Weight shift/Pressure relief—lateral Weight shift/Pressure relief—forward Weight shift/Pressure relief—tilt/recline Weight shift/Pressure relief—push-up	Pressure mapping Skin inspection Skin care/safety Prone tolerance
Wound care	Dressing changes Electrical stimulation Infrared Pulse diathermy Pulsed wound irrigation Selective sharp debridement	Soft tissue/scar management Positioning Ultrasound Ultraviolet Wound vac set-up Other
Equipment evaluation/provision/education ^b	Wheelchair assessment/prescription Wheelchair fitting Mat evaluation for seating Transfer device Ambulation device Standing device	Orthotics Bathing equipment Toileting equipment Beds Cushion/backrest
Complementary approaches	Yoga Pilates Tai Chi Aromatherapy	Relaxation techniques Imagery Other
Airway/respiratory management ^b	Chest physical therapy Respiration therapeutic exercise Suctioning Coughing	
Aquatic exercises ^a	Strengthening Flexibility Endurance Balance	Gait Pain relief Respiration Spasticity management

^a A level of assistance or an education only descriptor (Table 2) is documented for this activity.

^b An education only descriptor (Table 2, column 2) is documented for this activity.

about services rendered while the patient is on the rehabilitation unit.

Equipment Evaluation/Provision/Education

PTs document time spent on evaluation, fitting, and education specific to the provision of equipment. “WC assessment/prescription” includes measuring and prescribing the proper WC, educating the user and caregiver about

the advantages and disadvantages of various chair types, and trials of different chairs. “WC fitting” includes adjustment of the chair to facilitate optimal positioning and function. The PT documents only actual time spent completing the tasks listed and excludes time spent writing letters of medical necessity and prescriptions. The total time required to complete the procurement of equipment is significant and is a source of frustration for clinicians,

Table 15. Education Not Covered by Other Activities (Tables 3–14)

Topics	Overlap With Functional Activity?	Patient Level of Understanding	Family Level of Understanding
Community resources	Yes	Not applicable/not present	Not applicable/not present
Home modifications—home visit	No	Verbalizes understanding	Verbalizes understanding
Home modifications—meeting		Additional teaching needed	Provides return demo correctly
SCI general education/medical issues		No evidence of learning	Additional teaching needed
Sexuality			No evidence of learning
Transportation			

patients, and third-party payers. However, these tasks are completed outside of direct patient care and, while they have implications for workload and departmental staffing patterns, they do not affect the quality or quantity of patient care. In some centers, OTs have primary responsibility for evaluating WCs, transfer devices, and equipment for bed, bathing, and toileting; thus, this activity is included in both discipline's SCIRehab taxonomies.

Complementary Approaches

The PT taxonomy includes complementary medicine approaches: yoga, Pilates, Tai Chi, aromatherapy, relaxation techniques, and imagery. These interventions may be used to enhance relaxation, impact flexibility, and manage pain.

Airway/Respiratory Management

The airway/respiratory management activity in the PT taxonomy, which is the same for the OT taxonomy, includes chest physical therapy, respiratory exercises, suctioning, and coughing interventions. Teaching airway management techniques to the patient and/or family without actual patient participation is documented as "education only."

Aquatic Exercise

The aquatic section is included in the PT taxonomy to glean information on how a pool may be used for therapeutic intervention and for what reasons. In theory, a patient may be able to participate more actively in activities such as therapeutic exercise or strength training in an aquatic setting because of the inherent buoyancy and support not available in land-based environments.

The PT taxonomy captures activities performed in a swimming pool that focus on functional activities and therapeutic exercise. Categories include strengthening, flexibility, gait, endurance, and balance. The therapist also indicates the reason aquatic therapy is used: pain relief, respiratory management, and/or spasticity management. The overall LOA for the entire aquatic session is noted.

Education Not Covered by Other Activity Areas

Education is considered an integral part of functional work and not included separately for functional activities in the PT taxonomy. However, education also may be provided in the absence of functional task work. For example, the PT may educate the patient and/or family about home modifications needed to accommodate the patient's level of injury. Education also may overlap with an unrelated functional activity. During a range of motion session, for example, the PT may educate the patient or family on other aspects of care such as skin management or nutrition. Thus, the education activity is the only PT selection that includes a field to indicate whether the work overlapped with another functional

activity. If yes, the time documented for the education does not contribute to the total session time.

DISCUSSION

Development of a comprehensive PT treatment taxonomy required inclusion of the many variations in PT practice from therapist to therapist and from center to center within the SCIRehab centers. A consensus building process, both among PTs and among discipline groups, was used to define the essential elements of the PT treatment taxonomy; areas requiring the majority of time in discussion were determining which functional skills to include, defining common language for skills in areas that overlapped with other disciplines, deciding how to capture patient and caregiver education, and reaching consensus about how to measure patient assistance needs. The process for choosing the detailed treatment information and issues requiring cross-discipline consensus are discussed in the article of Gassaway et al (24).

The taxonomy presented here is similar in some ways to the system described by van Langeveld et al (16); however, the developmental work of van Langeveld et al coincided with our taxonomy development and, because it was published only recently, was not available as a template for this study. Both classifications share a common goal of providing detailed information on rehabilitation interventions used in SCI rehabilitation and include many of the same mobility and self-care activities, such as dressing, eating, walking, transfers, and wheelchair mobility. There are, however, a number of differences between the 2 taxonomies, as well as the process used to develop them. The classification system of van Langeveld et al was developed using the Delphi approach, whereas SCIRehab used an informal process that included face to face meetings and weekly teleconferences followed by a trial of the taxonomy by clinicians at each center (as described in the 2nd article in this series) (24). The structure and terminology of the 2 classification systems also differs. The system of van Langeveld et al was developed using the ICF model and terminology and includes 28 categories divided among 3 major levels (basic functions, basic activities, and complex activities). The SCIRehab taxonomy was not developed with specific reference to the ICF and begins with 19 activity categories under which interventions are documented. Although the full list of interventions is not shown in the publications of van Langeveld et al, a review of the published examples suggests that the 2 taxonomies also differ in the level of detail provided about certain activities. For example, intervention descriptions listed under the walking-related categories in the classification of van Langeveld et al provide information on the settings in which walking is performed (indoors, outside, in water) but do not specify devices used during walking (such as walkers or crutches) or the use of joint stabilization (17). Furthermore, the taxonomy developed for SCIRehab is supplemented by additional descriptors, such as session

type (individual vs group), that are not available in the classification system of van Langeveld et al.

Development of a comprehensive PT taxonomy to classify treatments provided at 6 centers presented several challenges. Assistance needs typically are not considered a part of taxonomy but are an important descriptor of what occurs during therapy. Therapists rely on patient assistance needs to help plan appropriate activities for a treatment session and thus wanted it included as an additional descriptor for each PT activity. Patients may need to spend more time to achieve proficiency on activities for which they need more assistance than on activities that they can perform independently or with minimal assistance. SCIRehab project's PTs agreed it was essential to obtain consensus on whether to assign a level of assistance at the activity level (eg, bed mobility) or at the skill level within an activity (rolling or scooting). Assignment at the activity level may decrease documentation burden on therapists but also potentially decreases useful detail of information gathered. Three areas where this is especially apparent are bed mobility, uneven transfers, and gait. A number of bed mobility components, each of which might require different levels of assistance, need to be mastered to perform the complete task of getting out of bed. For uneven surface transfers, a patient may require more assistance getting in/out of a vehicle than getting in/out of bed. During ambulation, a patient may require more assistance to walk on rough terrain vs on even terrain, or different intensities of body weight support may be used for gait training. Thus, PTs reviewed each activity included in the taxonomy and determined whether it was appropriate to identify assistance needs at the activity level or the skill level within the activity.

Another challenging aspect in developing the PT taxonomy was how to include the multifaceted education that PTs provide to patients with an SCI; it is an inherent component of all PT functional activities, yet also can be done separately from or overlap with other functional work. To describe the education provided, make using the taxonomy efficient, and have the session documentation reflect only actual treatment time, the PT documentation system uses a combination of approaches. First, "patient education" is considered a fundamental component of all functional tasks performed, and therefore, is not included separately. If the caregiver is present and receives education while the patient performs the functional activity, the caregiver's understanding of this activity is captured. However, education about functional tasks may be provided without the patient actually performing the task. Options for "education only" of the patient and/or family/caregiver were added to the level of assistance category to better describe these sessions when education is the primary intent. This seemed logical because, if the patient does not practice a task, no physical assistance would be necessary. Second, a separate taxonomy category was

created to capture education about topics unrelated to specific functional activities (eg, home modification, transportation). These topics are integrated into many sessions and believed to be integral components of PT care. Finally, an option was created to capture session information when education about 1 topic was occurring while overlapping with another functional activity (eg, education about dysreflexia provided while performing assisted ROM). This provided the means of including the education without having the amount of time spent on this overlap count toward the time spent with the patient during the PT session.

The SCIRehab PT treatment taxonomy was developed to provide a common and rigorous system to allow all PTs at all SCIRehab centers to communicate details about PT treatments provided, which will then be associated with outcomes after SCI. As rehabilitation centers move toward or continue to develop existing electronic documentation systems, however, the PT taxonomy may serve as a template with a level of detail that allows effective clinical communication, supports reimbursement for services, aids quality improvement activities, and facilitates the conduct of most observational research by reducing or eliminating the need to collect additional data to supplement the medical record. The true value of the comprehensive detail included in the PT taxonomy will become apparent in future phases of the SCIRehab project when associations between treatments and outcomes, while controlling for patient differences, can be identified.

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