Special issue article

Relationship of nursing education and care management inpatient rehabilitation interventions and patient characteristics to outcomes following spinal cord injury: The SCIRehab project

Joy Bailey[1,2], Marcel P. Dijkers[3], Julie Gassaway[4], Jane Thomas[5], Patricia Lingefelt[1], Scott E.D. Kreider[6], Gale Whiteneck[6]

[1]Shepherd Center, Atlanta, Georgia, GA, USA, [2]Emory University Hospital, Atlanta, Georgia, GA, USA, [3]The Mount Sinai School of Medicine, New York, NY, USA, [4]Institute for Clinical Outcomes Research, Salt Lake City, UT, USA, [5]Carolinas Rehabilitation, Charlotte, NC, USA, [6]Craig Hospital, Englewood, CO, USA

Objective: To investigate associations of nursing bedside education and care management activities during inpatient rehabilitation with functional, participation, and quality-of-life outcomes for patients with traumatic spinal cord injury (SCI).

Methods: In a prospective observational study, data were obtained by means of systematic recording of nursing activities by registered nurses (RNs), chart review and patient interview.

Results: Greater patient participation in nursing activities is associated with better outcomes. More time spent by RNs in coordination with other members of the care team, consultants and specialists, along with participation in physician rounds (team process) is associated with patient report of higher life satisfaction and higher CHART mobility at the one-year injury anniversary; more time providing psychosocial support is associated with higher CHART mobility and occupation scores and with greater likelihood of working or being in school at the anniversary. More time spent providing education about specific care needs is associated with several outcomes but not as consistently as might be expected.

Conclusion(s): Higher levels of patient participation in nursing care activities is associated with multiple better outcomes, and hence, nurses should promote active patient participation during all aspects of care and interactions between themselves and patients with SCI. Time spent providing psychosocial support of patients and their families should be evaluated to ensure that other necessary education or care management interventions are not minimized.

Note: This is the seventh of nine articles in the SCIRehab series.

Keywords: Spinal cord injuries, Rehabilitation, Rehabilitation nursing, Nursing education, Participation, Functional outcomes, Quality of life, Practice-based evidence, Pressure ulcers

Introduction

For newly injured patients with traumatic spinal cord injury (SCI), the rehabilitation team places much emphasis on education in order to bridge the anticipated deficit in patient knowledge regarding the impact of the disease. Patients must learn about the nature of their disease and master the skills necessary for self-care and community reintegration. An important role of rehabilitation nurses is to educate patients so that they are able to cope with the challenges of adjusting to this major life change. In a study of knowledge development in SCI, Thietje *et al.* found that at the time of discharge from rehabilitation, 22% of patients were found to have poor knowledge, 30% average knowledge, and only 47% had good knowledge about their illness.[1] May *et al.*[2] evaluated knowledge, problem-solving skills, and perceived the importance of learning various topics of 23 SCI patients admitted to a

Correspondence to: Gale Whiteneck, Craig Hospital, 3425 S. Clarkson St, Englewood, CO 80113. Email: gale@craig-hospital.org

DOI 10.1179/2045772312Y.0000000067

Canadian rehabilitation hospital, at admission, discharge, and 6 months after discharge. Patients consistently rated bladder, bowel, and skin care as the most important topics for which they sought information. May *et al.*[3] also identified these three areas as priorities for learning by patients with SCI; the participants expressed that, if not managed properly, bladder, bowel, and skin issues could become very problematic. This emphasizes the need for nurses to equip patients with requisite self-management skills.

In addition to grasping self-care management skills, patients must develop sound critical thinking skills in order to effectively cope with health challenges after discharge. This is particularly relevant for skin issues, as patients must learn to practice or direct others in pressure ulcer (PU) prevention measures, and, if lesions do develop, must understand what caused the lesions and how to prevent further damage. While SCI predisposes all patients to development of PUs, studies have identified certain risk factors for developing these ulcers, including education level, injury severity and financial resources.[4] Equipping the patient with effective problem-solving skills may help to reduce the impact of those predisposing factors and prevent PUs. An association between problem-solving abilities and PUs was reported in a study of 188 patients with new SCI. Elliott *et al.* tested the hypothesis that social problem-solving abilities would predict PU occurrence in the three years following discharge from inpatient rehabilitation. Using path analysis, they found that rational problem-solving skills at discharge predicted lower likelihood of PUs (−0.67), controlling for completeness of injury, gender, and age.[4] Education during rehabilitation may help with the attainment of effective problem-solving abilities, or at least provide the patient with the factual knowledge that is needed to resolve skin problems. Providing education about bladder and bowel management and skin customarily falls within the nursing domain while patients with SCI are in the acute rehabilitation setting, and there is evidence that the majority of the education that rehabilitation nurses deliver is dedicated to these topics.[2,5]

While there have been some studies examining relationships of patient characteristics and type/dose of educational intervention with outcomes in the nursing literature, these studies have focused in areas other than SCI rehabilitation, for example: postoperative care,[6] heart failure,[7,8] pain management,[9] and called for sound research into the outcomes of nursing patient education.[10]

As the population in general and with SCI ages, rehabilitation nurses incorporate concepts of disease prevention and wellness into the education process,[11] while simultaneously accommodating decreases in rehabilitation lengths of stay necessitating the use of available electronic education materials.[12] Hoffman, *et al.*, determined that ongoing life-time video education is effective in changing behavior related to high-risk complications for persons with SCI.[13] Other information and useable tools have been studied and made available in the literature;[12,14] however, Kruger[15] highlights the need for nurses to focus on measureable long-term benefits to determine the extent that patient education efforts contribute to health improvement. There is little knowledge about the dose of patient education delivered by nurses and the relationship between education and outcomes for persons with SCI; this study addresses this need.

The SCIRehab project is examining the relationships of the nature and quantity of treatment provided as part of inpatient SCI rehabilitation with outcomes at the time of discharge and at the 1-year injury anniversary. During the planning stages of this study, nurse leaders identified two areas (patient education and care management) of nursing intervention that were not documented in sufficient detail in the traditional nursing record and incorporated details of these interventions in the study's documentation. This is perhaps the largest study ever of its kind to focus primarily on SCI patient education and care management activities delivered by nurses in rehabilitation settings.

A preliminary publication on the first 600 traumatic SCI patients enrolled in the study reported that 50% of nursing care management time was devoted to psychosocial support while bladder and bowel management, medication, skin, and pain management consumed most of the nursing education time.[5] The purpose of this paper is to describe the associations of time spent by nurses on specific care management activities and education topics with outcomes at the time of rehabilitation discharge and at the anniversary of injury, in general, and specifically for patients who can be assumed to have greater needs for specific forms of nursing intervention.

Methods

The practice-based evidence research methodology used in the SCIRehab study has been described previously, including in the first article of this SCIRehab series.[5,16,17]

Study sample and facilities

The SCIRehab project enrolled patients with traumatic SCI who were 12 years of age or older, and were admitted to one of six participating facilities' SCI units for initial rehabilitation: 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 MedStar National Rehabilitation Hospital, Washington, DC. Enrollment began in the fall of 2007 (start dates differed by hospital) and concluded December 31, 2009. Local Institutional Review Boards approved the study and the patients gave their informed consent, or their parent/guardian did for patients who were younger than the statutory age of consent.

Patient demographic/injury data

Demographic and injury data were abstracted from the patients' medical records. The International Standards of Neurological Classification of SCI and its American Spinal Injury Association Impairment Scale (AIS)[18] were used to describe the neurologic level and completeness of injury; the Functional Independence Measure (FIM®) served to describe a patient's functional independence in motor and cognitive tasks at admission.[19] The Comprehensive Severity Index (CSI®), which is a disease-specific measure of morbidity, was used to quantify medical severity throughout the rehabilitation stay.[20–22] Key patient characteristics used in the current analysis include age at the time of rehabilitation admission, gender, marital status, race, and ethnic group, employment status at injury, payer, primary language, and body mass index (BMI), categorized as overweight (BMI $\geq$ 30) or not. The highest-reported pain ratings (on a 0–10 numeric rating scale) were abstracted from the medical record for the first and last three days of the stay and every tenth day of the month in between; the average of these ratings is used here to characterize patients' mean high pain score for the stay. Additional injury-related characteristics included etiology of injury, ventilator use at rehabilitation admission, number of days that elapsed from date of spinal injury to rehabilitation admission, and whether or not the injury was work related.

Nursing education and care management data

A total of 549 registered nurses (RNs) at the six centers provided detailed information about education and care management (beyond what was documented in traditional nursing documentation) by entering data into handheld personal digital assistants or into a supplemental page that was added to the existing electronic medical record.[5,17] The amount of time spent 'bedside' on specific education topics (bladder management, bowel management, nutrition, medication, complications, skin, pain, respiratory issues, safety, and therapy carryover) was recorded, as were the nursing time dedicated to care management on the patient's behalf (psychosocial support, discharge planning and management, team process participation, and interdisciplinary conferencing) and the time that patients spent in formal SCI classes led by nursing. The RN's perception of the patient's level of participation in *all* nursing treatments and activities (not just education) during each shift was quantified using a modified version of the Pittsburgh Rehabilitation Participation Scale. The original version was developed for use by physical and occupational therapists and designed to measure patient effort and involvement in the course of therapy by defining a cluster of observable behaviors during nursing activities that serve as a surrogate for patient motivation.[5,23] The modified version includes a five-point scale: engaged, active, passive refused, not applicable (patient sleeping or off unit). The participation ratings for all nursing shifts were averaged to calculate a mean level of participation for each patient over the entire stay.

Clinician experience

Each RN who provided treatment completed a clinician profile, which asked for information about years of experience working in SCI rehabilitation, among other characteristics. The average experience of the RNs treating each patient was calculated by weighting the experience of each nurse by the number of hours of treatment he or she provided.

Outcome data

Outcome measures were obtained at the time of rehabilitation discharge and at the 1-year injury anniversary using structured interviews. These outcomes and the processes of obtaining them are described in detail in the first article in this SCIRehab series.[24] The SCIRehab study utilized data collected from National Institute on Disability and Rehabilitation Research SCI Model Systems patient interviews conducted at the one-year injury anniversary[25,26] and from an additional interview that supplemented this information. We contacted and interviewed 939 individuals or their proxies (91%) to collect some or all of the follow-up data. All interviewers were trained in the interview process and had experience conducting telephone surveys with individuals with SCI. Outcomes at the time of rehabilitation discharge include discharge location (home or elsewhere) and the discharge FIM motor score. All FIM data were Rasch-transformed to convert ordinal FIM scores into scores on a continuous interval scale, as described in the Whiteneck article in this series.[24] Outcome measures at the 1-year anniversary include the FIM motor score, the Physical

Independence, Social Integration, Occupation, and Mobility subscales of the Craig Handicap Assessment and Reporting Technique (CHART), a measure of participation in household, community and society,[27–29] the Diener Satisfaction With Life Scale,[30] depressive symptoms as measured by the Patient Health Questionnaire – brief (9 question) version (PHQ-9),[31] place of residence, whether the person was working or in school, presence of a PU, and re-hospitalization during the period from rehabilitation discharge to the anniversary interview.

Patient subgroups

We identified four groups of patients with special education needs during the rehabilitation process (bladder management, psychosocial issues, skin integrity/PU prevention, and pain management) for which nurses assume responsibility during rehabilitation stay. For each subgroup, we identified one or more outcomes that were particularly relevant to that group.

Patients were included in the bladder management subgroup if they were discharged from rehabilitation using intermittent catheterization as their primary method of bladder management. The outcome for this group was a change in method from intermittent catheterization to an indwelling catheter.

Psychologists assessed patients' level of anxiety and depression by asking the questions contained in a modified version (anxiety and depression items only and not somatic items) of the Brief Symptom Index-18 (BSI)[32,33] during the early phase of the rehabilitation process. Patients with higher than average symptoms of anxiety or depression (i.e. the T score for either component was 50 or higher) were considered to have needed more extensive psychosocial support from the RN. The outcome specific to this subgroup of patients was the PHQ-9 scale included on the 1-year interview.

Patients with impaired skin integrity (stage of a PU during rehabilitation was two or higher) constituted the third subgroup; the relevant outcome was the reporting of a PU at the 1-year injury anniversary.

We identified a fourth subgroup of patients with 'severe' pain during rehabilitation as defined by having a mean high pain score of 6.5 or higher. On the Form II interview, patients are asked to rate the usual level of their pain (using the 10-point pain scale) over the previous 4 weeks; this rating was used as the outcome measure for this group.

Data analysis

Ordinary least squares stepwise regression modeling was used to predict the selected discharge/1-year post-injury outcomes. Linear regression[34] was used for outcomes that are continuous and logistic regression for dichotomous outcomes.[35]

Independent variables were allowed to enter the stepwise regressions in three blocks: (1) all the patient and injury characteristics described in the patient and injury data section, (2) treatment variables that included length of rehabilitation stay and time RNs spent in the various nursing education and care management activities, and (3) rehabilitation center identity. For the latter block, dummy variables for each center (yes/no center A, yes/no center B, etc.) were used to assess to what degree variance in the outcome measures of interest that was not explained by either patient characteristics or treatment factors was explained by center-level variables.

For linear regressions, the adjusted R^2 is reported as an indicator of the total percentage variance in the outcome explained. Adjusted R^2 values indicate the strength of the model taking into account the number of predictors used, and range from 0.0 (no prediction) to 1.0 (perfect prediction); values that are closer to 1.0 indicate better models. For logistic regression, the Maximum re-scaled R^2 (Max R^2), also known as the Nagelkerke Pseudo R^2 or Cragg and Uhler's R^2, is reported as a measure of the strength of the model.[36] This value is scaled the same as the R^2 for linear regressions (0.0 to a maximum of 1.0) and reflects the relative strength of the predictive logistic model. Discriminative power of the logistic regression models was assessed by using the area under the receiver operator characteristic curve (c) to evaluate how well the model distinguished patients who did not achieve a specified outcome from patients who did. Values of c that are closer to 1.0 indicate better discrimination.

In each regression model, the adjusted R^2 (for linear regression) or the Max R^2 and c statistic (for logistic regression) are reported first for the model predicting the outcome with only patient characteristics included as independent (predictor) variables. Next, the same statistics are reported for the model using a combination of the same patient characteristics and nursing treatment variables. Finally, to determine the added impact of (unspecified) rehabilitation center differences, the dummy variables indicating the center where each patient was rehabilitated were added. The change in the adjusted R^2 or c statistic/Max R^2 when the block of treatment variables and then the block of center variables are added indicates the amount of additional explanation contributed by these characteristics.

For all outcome models, parameter estimates (for the patient/injury and treatment variables, but not for center) are reported, indicating the direction and

strength of the association between each independent variable and the outcome (dependent variable); the *P* value associated with each significant predictor is also reported as an indicator of statistical significance. In the linear regression models, semi-partial omega R^2s are reported, which indicate the proportion of the variance in the dependent variable that is associated uniquely with the predictor variable. In the logistic regression models, odds ratios (OR) are reported to indicate the magnitude of the association of the predictor variable with the dependent outcome. An OR of 2 indicates the outcome is twice as likely for each unit increase of the independent variable, and an OR of 0.5 indicates the outcome is only half as likely.

The results reported here for are for a 'primary analysis subset' – a randomly selected 75% (1032) of the patients of the SCIRehab full sample (1376 patients); the regression models developed in this subset were tested using the 'validation subset', which contained the remaining 25% of patients. (The models for the four subgroups of patients were not validated, because of the relatively small numbers of subjects involved.) For continuous outcomes the relative shrinkage of the original model's R^2 that included all patient and treatment variables as the predictors was determined by comparing it to the R^2 for the same outcome using the 25% sample and only the significant variables from the original model.[37] A shrinkage (relative difference in R^2) of <0.1 was considered to indicate a well-validated model. Validation was considered to be moderate when the shrinkage was between 0.1 and 0.2, and models were considered to be validated poorly if shrinkage was >0.2. For dichotomous outcomes the Hosmer Lemeshow (HL) goodness of fit test *P* value was calculated both for the original model and for its replication in the validation subgroup. Models validated well if the HL *P* value was >0.10 for both, which indicates no lack of fit in either model. Models were considered to validate moderately well if the HL *P* value was 0.05–0.10 for one or both models, indicating some evidence of lack of fit, and to validate poorly if the HL *P* value was <0.05 for one or both, which indicates a lack of fit in one or both the models.

Results

Patient characteristics

Patient demographic and injury characteristics are presented in Table 1 for the primary analysis subset (there were no significant differences between the primary analysis and validation subsets on any dependent or independent variables used in the regression models) and for each of the four subgroups identified as potentially having greater needs for nursing education. The sample was 81% male, 71% white, and 22% black, 38% married, mostly not obese (82% had a BMI of <30), and 66% were employed at the time of injury; 94% reported English as their primary language. The average age of subjects was 38 years, with a standard deviation (SD) of 17. Payer source was 64% private insurance, 11% worker's compensation, 18% Medicaid, and 7% Medicare. Vehicular crashes were the most common cause of injury (49%), followed by falls (25%), and sports and violence (11% each). The raw (i.e. untransformed) mean motor FIM score at admission was 23.5 (SD 11.3) and the cognitive score was 28.7 (SD 6.1). The mean Rasch-transformed motor FIM score at admission was 17.8 (SD 12.6) and the cognitive score was 73.6 (SD 18.1). A mean of 31.0 days (SD 27.8) had elapsed from the time of injury to the time of rehabilitation admission. The mean rehabilitation length of stay (LOS) was 55.7 days (SD 36.6).

Associations of nursing activities with outcomes for the entire sample

When time spent in each of the nursing education and care management activities (listed in Table 2) is combined with patient demographic and injury characteristics (listed in Table 1), associations of various activities with outcomes at rehabilitation discharge and at the 1 year injury anniversary are noted, as follows:

Discharge FIM motor score

Patient/injury characteristics yielded an adjusted R^2 of 0.65, indicating that these factors predict 65% of the variation in Rasch-transformed discharge motor FIM score (See Table 3). Patients with AIS A, B, or C injuries have lower motor FIM scores than patients with AIS D. Other predictors of lower scores include older age, higher medical severity (as measured by the CSI), longer time from injury to rehabilitation admission, and BMI ≥ 30. Admission motor FIM and having a work-related injury predict a higher score. The addition of hours of nursing bedside education and care management increases the adjusted R^2 to 0.70; longer LOS, higher patient participation scores, more experience in SCI rehabilitation by nurses providing care, and more time spent by them in bladder and safety education and promoting the team process are associated with higher scores. More time spent on respiratory, nutrition, and skin education is associated with lower scores. Adding rehabilitation center to the model increases the adjusted R^2 to 0.73.

Table 1 Patient and injury characteristics, overall and for four subgroups with special rehabilitation nursing needs*

Characteristic	Severe pain during rehabilitation, *n* = 213	Discharged with intermittent catheterization as bladder management technique, *n* = 471	High anxiety and/or depression during rehabilitation, *n* = 318	PU stage II or higher during rehabilitation, *n* = 275	SCIRehab analysis sample, *n* = 1032
Admission neurological injury group					
C1–4 ABC,%	28	19	27	41	29
C5–8 ABC, %	12	21	23	23	20
Para ABC, %	41	55	37	28	36
All Ds, %	19	6	14	7	16
Age at injury – years, mean (SD)	39.6 (15.9)	32.9 (14.3)	36.4 (15.2)	38.5 (16.3)	37.7 (16.7)
Gender, % male	77	85	81	83	81
Race/ethnicity					
White, %	66	71	78	71	71
Black, %	26	23	18	21	22
Hispanic, %	5	3	1	4	3
Other, %	3	3	3	5	5
Primary Language, % English	97	94	95	94	94
Payer					
Medicare, %	8	4	5	7	7
Medicaid, %	19	21	18	18	18
Private insurance/ pay, %	65	66	64	65	64
Worker's compensation, %	8	9	13	11	11
Marital Status at injury, Married, %	40	33	37	38	38
Education					
Less than high-school diploma, %	19	22	16	23	20
High-school diploma or GED, %	58	55	57	52	51
More than high-school diploma, %	22	23	27	23	25
Other/unknown, %	1	0	0	2	4
Employment status before injury					
Working, %	68	68	69	69	66
Student, %	10	19	16	12	15
Retired, %	9	3	6	7	8
Unemployed/Other, %	12	11	8	11	11
Injury etiology					
Vehicular, %	53	52	51	49	49
Violence, %	12	12	9	12	11
Sports, %	8	10	10	13	11
Fall or falling object, %	21	22	27	22	25
Other, %	7	4	2	4	4
Injury work related? % no	90	87	80	85	86
BMI at admission, % less than 30	83	84	84	82	82
Admission motor FIM – Rasch-transformed, mean (SD)	18.9 (12.9)	21.3 (10.9)	17.7 (12.2)	12.8 (12.2)	17.8 (12.6)
Admission cognitive FIM – Rasch-transformed, mean (SD)	75.1 (17.1)	76.9 (16.8)	72.5 (17.6)	71.0 (17.2)	73.6 (18.1)
Comprehensive Severity Index, mean (SD)	37.6 (27.7)	32.8 (27.7)	40.0 (32.3)	56.1 (34.9)	40.0 (31.6)
Days from injury to rehabilitation, mean (SD)	32.4 (30.4)	32.1 (27.7)	29.9 (23.7)	39.6 (31.3)	31.0 (27.8)

*Subgroups may overlap in membership, i.e. a patient may be included in two or more of the groups

Table 2 Nursing education, care management and other treatment factors, overall and for four subgroups with special rehabilitation nursing needs*

Characteristic	Severe pain during rehabilitation, *n* = 213	Discharged with intermittent catheterization as bladder management technique, *n* = 471	High anxiety and/or depression during rehabilitation, *n* = 318	PU grade II or higher during rehabilitation, *n* = 275	SCIRehab analysis sample, *n* = 1032
Length of rehabilitation stay – days, mean (SD)	49.8 (29.6)	48.0 (26.9)	55.5 (34.5)	71.6 (46.3)	55.7 (36.6)
RN experience – years (SD)	5.0 (2.9)	5.3 (2.7)	5.6 (3.2)	5.2 (2.6)	5.45 (3.0)
Patient participation score – nursing, mean (SD)	3.2 (0.3)	3.1 (0.3)	3.2 (0.3)	3.2 (0.3)	3.2 (0.3)
Nursing activities – hours (SD)					
Bladder education	3.5 (3.9)	4.8 (3.7)	4.4 (3.7)	4.2 (3.5)	3.9 (3.4)
Bowel education	3.7 (3.2)	4.2 (3.2)	4.0 (3.3)	3.9 (3.6)	3.7 (3.2)
Complications education	1.5 (1.7)	1.8 (1.9)	2.4 (2.3)	2.8 (2.9)	2.1 (2.3)
Medication education	2.9 (2.3)	3.1 (2.3)	3.3 (2.3)	3.6 (3.0)	3.1 (2.4)
Nutrition education	1.0 (1.6)	1.0 (1.4)	1.2 (1.4)	1.4 (1.8)	1.1 (1.4)
Pain education	4.4 (3.8)	3.4 (2.9)	3.9 (3.2)	3.9 (3.8)	3.4 (3.2)
Respiratory education	1.5 (5.1)	0.8 (2.1)	1.0 (2.6)	2.0 (5.1)	1.2 (3.3)
Safety education	1.5 (1.9)	1.5 (1.7)	1.5 (1.5)	1.6 (2.3)	1.4 (1.7)
Skin education	3.4 (3.2)	3.8 (3.6)	4.0 (3.3)	5.8 (4.6)	3.8 (3.5)
Therapy carryover education	0.1 (0.3)	0.3 (0.7)	0.4 (0.7)	0.4 (0.8)	0.5 (0.7)
Psychosocial support	4.8 (7.4)	5.0 (5.7)	6.5 (7.6)	6.5 (8.4)	5.6 (6.8)
Team process	0.4 (0.9)	0.5 (0.9)	0.9 (1.6)	1.1 (2.0)	0.7 (1.4)
Discharge planning/ management	0.7 (0.8)	0.8 (0.8)	1.0 (1.0)	1.0 (1.6)	0.9 (1.1)
Classes (led by RNs)	0.5 (1.5)	0.9 (2.2)	1.2 (2.1)	1.8 (3.4)	1.3 (2.5)
Interdisciplinary conference	2.3 (2.3)	2.4 (2.7)	3.2 (3.3)	4.5 (4.7)	3.2 (3.5)

*Subgroups may overlap in membership, i.e. a patient may be included in two or more of the groups

FIM motor score at anniversary

Patient characteristics, nursing treatment variables, and rehabilitation center explain 54% of the variation in the motor FIM scores 1year after injury (Table 3). Patient characteristics explain most of this: injury group is the strongest predictor (patients with AIS D have higher scores); a higher rehabilitation admission motor FIM score also is predictive of a higher motor FIM at the injury anniversary. Higher age, higher admission cognitive FIM scores, higher medical severity during rehabilitation, and longer time from injury to rehabilitation admission are associated with lower scores. The addition of treatment variables adds slightly more explanatory power ($R^2 = 0.53$): higher patient participation scores, and more time spent in safety education are associated with higher functioning at the first anniversary, while more hours spent on respiratory issues predict lower independence. Adding rehabilitation center to the model produced a marginal increase ($R^2 = 0.54$).

Discharge destination

Most patients (89%) were discharged home (Table 4). Patient and treatment predictors of discharge to home (c statistic = 0.82, Max $R^2 = 0.28$) include: higher admission motor FIM, being married prior to injury, more nursing time spent in discharge planning and management, and in nutrition education. Patient variables associated with lower likelihood of discharge to home include higher age, higher medical severity (CSI), and Black and Hispanic race/ethnicity. The addition of rehabilitation center increases the c statistic marginally to 0.85.

Residence at injury anniversary

The regression model for residential location at the one-year injury anniversary shows weak patient and treatment predictors (c statistic = 0.71, Max $R^2 = 0.12$) (Table 4). Patients who spoke English and received more education regarding complications were more

Table 3 Prediction of motor FIM* at discharge and 1 year post injury

	Motor FIM* at discharge			Motor FIM* at 1 year		
Observations used		1030			858	
Step 1: Patient (Pt) characteristics: adj. R^2		0.65			0.51	
Step 2: Pt characteristics + treatments: adj. R^2		0.70			0.53	
Step 3: Pt characteristics + treatments + center identity: adj. R^2		0.73			0.54	
Independent variables**	Parameter estimate	*P* value	Semi-partial omega^2	Parameter estimate	*P* value	Semi-partial omega^2
Neurological group		<0.001	0.053		<0.001	0.083
C1–4 ABC	−11.768	<0.001	—	−26.891	<0.001	—
C5–8 ABC	−9.103	<0.001	—	−21.433	<0.001	—
Para ABC	−3.896	<0.001	—	−16.888	<0.001	—
All Ds (reference)	0.000	—	—	0.000	—	—
Admission FIM* motor	0.409	<0.001	0.061	0.532	<0.001	0.030
Admission FIM* cognitive				−0.087	0.010	0.003
Comprehensive Severity Index	−0.031	0.002	0.003	−0.084	<0.001	0.008
Days from trauma to rehabilitation admission	−0.043	<0.001	0.008	−0.122	<0.001	0.019
Age at injury	−0.076	<0.001	0.008	−0.183	<0.001	0.013
Injury is work related	1.561	0.012	0.002			
BMI ≥30	−1.682	0.003	0.002			
Rehabilitation length of stay	0.034	<0.001	0.004			
Clinician experience – RN	0.278	<0.001	0.004			
Patient participation score – nursing	4.782	<0.001	0.010	6.516	0.002	0.005
Nursing hours on specific education topics						
Bladder	0.319	<0.001	0.004			
Nutrition	−0.590	0.001	0.003			
Respiratory care	−0.393	<0.001	0.008	−0.729	<0.001	0.008
Safety	0.444	0.007	0.002	1.221	0.001	0.006
Skin	−0.282	0.001	0.003			
Nursing hours on specific care management topics						
Team process	0.632	<0.001	0.003			

*Motor and cognitive FIM were Rasch-transformed.

**All patient and treatment variables listed in Tables 1 and 2 were allowed to enter the models. Only statistically significant predictors are reported here; a missing variable name means that the variable did not predict any of the outcomes in this table; a blank cell means that the variable was not a significant predictor for the outcome examined.

Table 4 Prediction of discharge location, place of residence and likelihood of working or being in school at one year post injury anniversary

Outcome	Discharged to home			Reside at home at one year			Work/School at one year		
Observations used	1030: yes = 916, no = 114			877: yes = 827, no = 50			855: yes = 235, no = 620		
Step 1: Patient (Pt) characteristics: c/Max R^2	0.79/0.21			0.59/0.03			0.81/0.32		
Step 2: Pt characteristics + treatments: c/Max R^2	0.82/0.28			0.71/0.12			0.82/0.35		
Step 3: Pt characteristics + treatments + center identity: c/Max R^2	0.85/0.33			0.74/0.13			0.83/0.36		
Independent variables*	Parameter estimate	Odds ratio	*P* value	Parameter estimate	Odds ratio	*P* value	Parameter estimate	Odds ratio	*P* value
Neurological group							—	—	<0.001
C1–4 ABC							−1.592	0.203	<0.001
C5–8 ABC							−0.740	0.477	0.022
Para ABC							−0.239	0.787	0.381
All Ds (reference)							0.000	—	—
Admission FIM motor – Rasch-transformed	0.050	1.052	<0.001						
Comprehensive Severity Index	−0.011	0.989	0.002						
Days from trauma to rehabilitation admission				−0.010	0.990	0.009			
Age at injury	−0.044	0.957	<0.001				−0.025	0.975	0.003
Marital status is married	0.794	2.211	0.002						
Race	—	—	<0.001				—	—	0.030
All other minorities	−0.699	0.497	0.113				−0.713	0.490	0.070
Black	−0.858	0.424	<0.001				−0.538	0.584	0.032
Hispanic	−1.545	0.213	0.002				**	**	**
White (reference)	0.000	—	—				0.000	—	—
Occupation status at injury							—	—	0.000
Unemployed/other							−0.814	0.443	0.032
Student							1.772	5.885	0.000
Retired							−0.711	0.491	0.211
Working (reference)							0.000	—	—
Highest education achieved									0.001
High school							0.142	1.153	0.618
College							0.899	2.457	0.006
<12 Years/other/unknown (reference)							0.000	—	—
Primary language is English				1.078	2.938	0.020			
Primary payer							—	—	0.001
Medicare							−1.019	0.361	0.111
Medicaid							−0.762	0.467	0.006
Worker's compensation							−0.947	0.388	0.007
Private insurance/pay (reference)							0.000	—	—
Rehabilitation length of stay				−0.016	0.984	<0.001			
Patient participation score-nursing							1.104	3.017	0.002

Continued

Table 4 ***Continued***

Outcome	Discharged to home			Reside at home at one year			Work/School at one year		
Nursing hours on specific education topics:									
Complications				0.408	1.504	<0.001			
Nutrition	0.195	1.215	0.042				−0.342	0.710	<0.001
Respiratory care				−0.065	0.937	0.048			
Nursing hours on specific care management topics									
Discharge planning/management	0.801	2.227	<0.001						
Psychosocial support							0.034	1.035	0.027

*All patient and treatment variables listed in Tables 1 and 2 were allowed to enter the models.
Only statistically significant predictors are reported here; a missing variable name means that the variable did not predict any of the outcomes in this table; a blank cell means that the variable was not a significant predictor for the outcome examined.
**Hispanic combined with all other minorities.

likely to be residing at home. Longer duration from trauma to rehabilitation admission, longer rehabilitation LOS, and more time spent by nurses providing respiratory education predict residence other than in a private home. The addition of rehabilitation center increases the *c* statistic marginally from 0.71 to 0.74.

Working/in school after injury

Higher scores on the modified Pittsburgh Rehabilitation Participation Scale are associated with a higher likelihood of working or being in school (OR = 3.0) at the first anniversary; those with a college education are 2.5 times as likely to be back at work or school as the reference group, unknown/<12 years education (see Table 4). Other predictors include level of injury (patients with tetraplegia are less likely to be productive in this manner than patients with AIS D injuries), race (Blacks and other minorities are less likely to be at work/in school), age (older patients are less likely to be productive), and prior employment status (those unemployed before injury are less likely and those who were students are more likely to be working or in school). More time that nurses spend providing psychosocial support is associated with more participation in work or school at the anniversary, but nutrition education hours predict not working or being in school, as does having Medicaid or workers compensation as the payer. Patient and treatment variables together predict a moderate amount of variance (Max R^2 is 0.35), which hardly improves ($R^2 = 0.36$) when center is added as a predictor.

Social participation

Table 5 shows regression models to predict scores on the four dimensions of the CHART: Physical Independence ($R^2 = 0.44$), Social Integration ($R^2 = 0.15$), Occupation ($R^2 = 0.28$), and Mobility ($R^2 = 0.32$). Various patient and injury variables are significant predictors of one or more of these four CHART dimensions. Patients who are older and are Black (White is the reference group) have lower scores in all or most dimensions; those who are married have higher scores. Males have lower Occupation scores than females; patients with workers compensation as their payer type have lower Physical Independence scores; patients with Medicaid have lower Social Integration and Mobility scores. Injury group and admission motor FIM score also are significant predictors. Greater patient participation during nursing activities is associated with higher scores in three dimensions. More total time spent by nurses providing psychosocial support is associated with higher Occupation scores; more time in skin

Table 5 Prediction of social participation

Outcome	CHART: Physical Independence			CHART: Social Integration			CHART: Occupation			CHART: Mobility		
Observations used		855			829			844			842	
Step 1: Patient (Pt) characteristics: adj. R^2		0.41			0.12			0.24			0.27	
Step 2: Pt characteristics + treatments: adj. R^2		0.44			0.14			0.27			0.32	
Step 3: Pt characteristics + treatments + center identity: adj. R^2		0.44			0.15			0.28			0.32	
Independent variables*	Parameter estimate	*P* value	Semi-partial omega^2	Parameter estimate	*P* value	Semi-partial omega^2	Parameter estimate	*P* value	Semi-partial omega^2	Parameter estimate	*P* value	Semi-partial omega^2
Injury group	—	<0.001	0.027				—	0.010	0.007	—	0.001	0.010
C1-4 ABC	−26.160	<0.001	—				−15.063	0.001	—	−10.777	<0.001	—
C5-8 ABC	−13.024	0.001	—				−6.842	0.127	—	−6.773	0.017	—
Para ABC	−4.907	0.127	—				−5.956	0.105	—	−7.232	0.002	—
All Ds (reference)	0.000	—	—				0.000	—	—	0.000	—	—
Admission FIM motor-Rasch-transformed	0.854	<0.001	0.028	—	—	—	0.770	<0.001	0.025	0.310	0.001	0.009
Admission FIM cognitive – Rasch-transformed				0.098	0.011	0.006						
Comprehensive Severity Index	−0.155	<0.001	0.009									
Days from trauma to rehabilitation admission	−0.265	<0.001	0.035							−0.095	<0.001	0.010
Traumatic etiology	—	0.013	0.006				—	0.024	0.006			
Medical/surgical/other	−9.705	0.071	—				−9.908	0.110				
Violence	−3.393	0.369	—				−9.714	0.016				
Sports	−10.950	0.002	—				3.106	0.434	—	—	—	—
Fall	−2.655	0.316	—				−5.504	0.064				
Vehicular (reference)	0.000	—	—				0.000	—	—			
Age at injury	−0.249	0.002	0.005	−0.314	<0.001	0.026	−0.434	0.000	0.014	−0.477	<0.001	0.040
Gender is male							−7.555	0.011	0.005			
Marital status is married				8.711	<0.001	0.029	8.162	0.003	0.007	4.402	0.011	0.004
Race	—	0.020	0.005	—	0.015	0.008				—	0.016	0.006
All other minorities	−9.401	0.047	—	−0.402	0.898	—				−4.665	0.177	—
Black	−6.531	0.018	—	−4.807	0.004	—				−5.614	0.002	—
Hispanic	5.189	0.401	—	−7.857	0.072	—				−1.924	0.689	—
White (reference)	0.000	—	—	0.000	—	—				0.000	—	—
Occupation status at injury				—	<0.001	0.020	—	0.010	0.007	—	0.001	0.010
Unemployed/other				−7.277	0.002	—	−2.092	0.590	—	−5.007	0.043	—
Student				0.759	0.739	—	10.908	0.006	—	7.003	0.005	—
Retired				9.439	0.003	—	−9.845	0.055	—	1.154	0.738	—
Working (reference)				0.000	—	—	0.000	—	—	0.000	—	—
Highest education achieved	—	0.004	0.006				—	<0.001	0.012	—	0.001	0.011
High school	7.444	0.006	—				2.297	0.480	—	2.148	0.290	—
College	10.599	0.001	—				12.526	0.001	—	8.317	0.001	—
<12 Years/other/unknown (reference)	0.000	—	—				0.000	—	—	0.000	—	—
Primary language is English							13.767	0.007	0.005	12.326	0.001	0.009
Primary payer	—	0.017	0.005	—	0.015	0.008				—	0.042	0.004
Medicare	−8.449	0.065	—	−5.088	0.125	—				1.076	0.764	—

Continued

Table 5 *Continued*

Outcome	CHART: Physical Independence			CHART: Social Integration			CHART: Occupation			CHART: Mobility		
Medicaid	0.254	0.927	—	−5.625	0.003	—				−5.677	0.005	—
Worker's compensation	−9.586	0.005	—	−1.634	0.470	—				−0.214	0.931	—
Private insurance/pay (reference)	0.000	—	—	0.000	—	—				0.000	—	—
Clinician experience – RN	0.841	0.017	0.003									
Patient participation score – nursing				11.996	<0.001	0.024	16.307	<0.001	0.012	11.692	<0.001	0.015
Nursing hours on specific education topics:												
Bowel							0.898	0.040	0.003	1.062	<0.001	0.013
Complications	1.738	0.001	0.006									
Nutrition										−1.328	0.026	0.003
Respiratory care	−0.994	0.002	0.006				−0.843	0.018	0.004	−0.940	<0.001	0.013
Skin							−1.130	0.005	0.006			
Class provided by RNs	1.432	0.005	0.005									
Nursing hours on specific care management topics:												
Psychosocial support							0.827	<0.001	0.014			
Team process										1.700	0.001	0.008

*All patient and treatment variables listed in Tables 1 and 2 were allowed to enter the models.
Only statistically significant predictors are reported here; a missing variable name means that the variable did not predict any of the outcomes in this table; a blank cell means that the variable was not a significant predictor for the outcome examined.

education is associated with a lower score. More time spent in respiratory education is associated with lower scores for all dimensions except for Social Integration. The R^2 for the four models increases by 0.02 to 0.05 with the addition of nursing treatment variables, and the addition of rehabilitation center variables increases the R^2 by 0.01, at most.

Mood state and life satisfaction

Patient and injury characteristics, nursing education and care management time, and rehabilitation center are not strong predictors of depressive symptomatology after injury, as measured by the PHQ-9 ($R^2 = 0.09$ after all blocks have been entered) or of life satisfaction ($R^2 = 0.11$) (Table 6). Higher PHQ-9 score (depressive symptomatology) is predicted by more days until rehabilitation admission, higher age, unemployed prior to injury, work-related injury, and receipt of more nursing education hours focusing on pain. A better mood state (lower score) is predicted by male gender, high BMI, and more bowel education hours. Judgments that life is satisfying (higher SWLS score) are predicted by a higher Motor FIM score on admission to rehabilitation, and more RN time spent on team process. Lower life satisfaction is associated with having high tetraplegia or paraplegia A, B, C, higher age, being unemployed at the time of injury, and Medicaid as sponsor.

Re-hospitalization

Greater medical severity during rehabilitation, longer time from trauma to rehabilitation admission, and having Medicaid as the primary payer are associated with occurrence of re-hospitalization; higher admission motor FIM, being male and being a student, and having a longer rehabilitation LOS are associated with lesser likelihood of re-hospitalization (Table 7). Patients who are judged to expend more effort during nursing treatments and those with whom nurses spend more time reinforcing therapy procedures are less likely to be re-hospitalized, but those who receive more skin education hours, more likely. Prediction of this outcome is not very strong (c statistic = 0.71; Max $R^2 = 0.16$); the addition of center variables has little additional explanatory effect.

Pressure sore

Persons with Medicare (7% of the total sample interviewed) as the rehabilitation payer are over 2.7 times as likely to report a PU at the time of the injury anniversary as are patients with private insurance (reference group). For persons who had Medicaid as payer (18%) there was no significantly greater likelihood of having

Table 6 Prediction of mood state (PHQ-9) and life satisfaction (SWLS)

	Mood state			Life satisfaction		
Observations used		808			743	
Step 1: Patient (Pt) characteristics: adj. R^2		0.07			0.09	
Step 2: Pt characteristics + treatments: adj. R^2		0.08			0.09	
Step 3: Pt characteristics + treatments + center identity: adj. R^2		0.09			0.11	
Independent variables*	Parameter estimate	*P* value	Semi- partial omega^2	Parameter estimate	*P* value	Semi- partial omega^2
Neurological group				—	0.001	0.016
C1-4 ABC				−2.872	0.008	—
C5-8 ABC				−0.417	0.685	—
Para ABC				−2.160	0.010	—
All Ds (reference)				0.000	—	—
Admission FIM motor – Rasch-transformed				0.084	0.010	0.007
Days from trauma to rehabilitation admission	0.021	<0.001	0.014			
Age at injury	0.029	0.033	0.004	−0.099	<0.001	0.020
Gender is male	−0.925	0.037	0.004			
Employment status at injury	—	<0.001	0.020	—	0.025	0.008
Unemployed/other	2.253	<0.001	—	−2.480	0.007	—
Student	−0.428	0.456	—	0.740	0.431	—
Retired	−0.912	0.242	—	0.525	0.688	—
Working (reference)	0.000	—	—	0.000	—	—
Injury is work related	1.247	0.013	0.006			
BMI ≥30	−1.683	<0.001	0.015			
Primary payer				—	0.007	0.011
Medicare				1.819	0.187	—
Medicaid				−2.075	0.005	—
Worker's compensation				−1.570	0.080	—
Private insurance/payer (reference)				0.000	—	—
Nursing hours on specific education topics						
Bowel education	−0.176	0.004	0.008			
Pain education	0.213	0.001	0.012			
Team process				0.432	0.022	0.005

*All patient and treatment variables listed in Tables 1 and 2 were allowed to enter the models.
Only statistically significant predictors are reported here; a missing variable name means that the variable did not predict any of the outcomes in this table; a blank cell means that the variable was not a significant predictor for the outcome examined.

a PU than for those in the reference group (Table 7). Other predictors of having pressure sores include higher medical severity score during rehabilitation (OR = 1.01), longer duration from injury to rehabilitation admission (OR = 1.01), and being unemployed prior to injury (OR = 1.77). Having payer type of workers compensation and being retired prior to injury is associated with less reporting of pressure sores. Nursing care factors and center identity add minimally to the percent of variation explained by patient demographic and injury factors.

Validation of the models for the entire sample

Linear regression models that validated well (relative shrinkage <0.1) include: motor FIM at discharge and at 1-year anniversary and CHART Physical Independence and Social Integration. Models for CHART Occupation and Mobility validated moderately well (relative shrinkage 0.1–0.2). Two models validated poorly (relative shrinkage >0.2): those for PHQ-9 depressive symptomatology and for life satisfaction. For dichotomous outcomes almost all models validated well (HL *P* value >0.1 for both): the only exception was residence location at the anniversary, which showed lack of fit (HL *P* value <0.05 for one or both models).

Results for subgroups

Bladder management technique change in patients discharged on intermittent catheterization

Of the 552 patients who were discharged from rehabilitation using intermittent catheterization, 417 provided information about their bladder management technique at the time of the 1-year anniversary. The majority of these patients (81%) did not change to indwelling catheter use; 90 patients (19%) did. Patient characteristics did not predict whether patients reported having an indwelling catheter at the time of the 1-year anniversary. The only significant intervention factor was more time in classes provided by RNs (*c* statistic = 0.63, Max $R^2 = 0.08$); more time in classes was associated with less likelihood of reporting a change from intermittent catheterization to indwelling catheter. The *c* statistic increased to 0.67 with the addition of rehabilitation center identity (Max R^2 increased to 0.14) (data not shown).

Table 7 Prediction of rehospitalization and pressure sore at one-year anniversary

Outcome:	Re-hospitalized			Pressure sore at one year		
Observations used	949: yes = 343, no = 606			935: yes = 128, no = 807		
Step 1: Patient (Pt) characteristics: c/Max R^2	0.66/0.10			0.69/0.09		
Step 2: Pt characteristics + treatments: c/Max R^2	0.71/0.16			0.70/0.10		
Step 3: Pt characteristics + treatments + center identity: c/Max R^2	0.71/0.18			0.71/0.13		
Independent Variables*	Parameter estimate	Odds ratio	*P* value	Parameter estimate	Odds ratio	*P* value
Admission FIM motor – Rasch-transformed	−0.019	0.982	0.008			
Comprehensive Severity Index	0.016	1.016	<0.001	0.012	1.012	<0.001
Days from trauma to rehabilitation admission	0.008	1.008	0.005	0.009	1.009	0.004
Gender is male	−0.454	0.635	0.014			
Employment status at injury	—	—	0.005	—	—	0.006
Unemployed/other	0.167	1.182	0.479	0.570	1.769	0.044
Student	−0.794	0.452	<0.001	−0.355	0.701	0.258
Retired	−0.037	0.963	0.912	−1.164	0.312	0.035
Working (reference)	0.00	—	—	0.00	—	—
Primary payer	—	—	0.016	—	—	0.033
Medicare	0.617	1.854	0.069	0.987	2.684	0.021
Medicaid	0.533	1.704	0.006	0.188	1.206	0.454
Worker's compensation	0.342	1.407	0.172	−0.627	0.534	0.119
Private insurance/pay (reference)	0.00	—	—	0.00	—	—
Rehabilitation length of stay	−0.015	0.985	<0.001			
Patient participation score – nursing	−0.714	0.490	0.009	−0.788	0.455	0.030
Skin education hours	0.059	1.061	0.009			
Therapy carryover education hours	−0.307	0.735	0.017			

*All patient and treatment variables listed in Tables 1 and 2 were allowed to enter the models.
Only statistically significant predictors are reported here; a missing variable name means that the variable did not predict any of the outcomes in this table; a blank cell means that the variable was not a significant predictor for the outcome examined.

Depressive symptomatology in patients with emotional distress during inpatient rehabilitation

There were 410 patients with higher-than-average anxiety or depression during rehabilitation; 318 of them (78%) provided information about depressive symptoms at the anniversary by completing the PHQ-9. In addition to the patient characteristics listed in Table 1, the BSI depression and anxiety T scores were considered as independent (predictor) variables. The most predictive was the BSI depression T score: more depressive symptoms predicted a higher PHQ-9 score a year later. Older age was also associated with higher PHQ-9 scores; being retired (as compared to working) and being obese were associated with less depressive symptomatology. The adjusted R^2 when only patient characteristics were considered as independent variables was 0.06. No nursing education or care management treatments were significant predictors. The addition of rehabilitation center identity increased the R^2 only slightly, to 0.07 (data not shown).

Pressure ulcers among patients with skin integrity issues during hospitalization

There were 308 patients (30% of the total) with at least one Stage II or higher PU during rehabilitation. The regression model for reporting a PU at the 1-year anniversary among these patients was weak; the *c* statistic when including only patient variables was 0.64; longer duration from the time of injury to rehabilitation admission was associated with greater likelihood. No nursing education or care management services were significant predictors; the addition of rehabilitation center identity increased the *c* statistic to 0.69 (data not shown).

Pain in patients with severe pain during rehabilitation

There were 213 patients (21%) for whom the mean high pain score during rehabilitation was considered severe (6.5 or higher on the 10-point numeric rating scale) and who gave a response to the follow-up interview question about pain. The regression model predicting the pain score at the anniversary of injury was weak; the adjusted R^2 is only 0.05. The only two significant predictors were more time spent in nutrition education by RNs and a higher participation score in nursing activities. The addition of rehabilitation center added only another 0.01 (data not shown).

Discussion

Education provided by the nursing staff is assumed to be important for SCI patients to understand their condition and acquire the skills necessary for functioning after discharge from rehabilitation; however, no studies have

been published that quantify relationships between nursing education interventions and outcomes. The nurse researchers in this study examined the impact of nursing education on patient outcomes at discharge from SCI inpatient rehabilitation and at 1 year post-injury.

Several nursing education and care management variables were correlated with patient outcomes. More experience in SCI rehabilitation by nurses providing care and more time spent by them in bladder and safety education were associated with higher FIM scores at discharge; other researchers have reported relationships between nursing experience and the content of the information they impart to patients and that with experience came more comfort with teaching.[38] More time spent on respiratory, nutrition, and skin education was associated with lower FIM scores. Higher FIM scores at 1 year were associated with more nursing time spent on safety education, while more time spent on respiratory education was associated with lower FIM scores. The higher score's associations with dependent variables are expected, and associations of lower scores with respiratory education are understandable as patients receiving respiratory education are likely sicker and perhaps ventilator dependent. Thus, receipt of respiratory education appears to function as a marker of patient status. Against a background of insufficiently strong patient need indicators, amount of nursing efforts may not have a statistically significant association, and may even appear to have a negative association with patient outcome variables.

More nursing time spent on psychosocial support was associated with a greater likelihood of persons returning to work or school, while more hours spent on nutrition education was predictive of lesser likelihood of return to work/school. Nursing education and care activities were associated with higher CHART scores in three areas. More time spent by nurses in providing psychosocial support was associated with a higher CHART Occupation score, while more time in skin education was associated with a lower score. This may be mere chance or it could be that nurses spend more time with the patients with skin problems that may ultimately create barriers to occupational activities.

The level of patient participation in nursing activities (modified Pittsburg Rehabilitation Participation Score) was an estimate of the degree to which the patient participated in all aspects of care during a nursing shift. Perhaps not surprisingly, higher levels of participation were associated with multiple outcomes (higher FIM and CHART scores, less re-hospitalization, and fewer pressure sores at 1-year post injury). Specific areas in which patients were more engaged during the shift were not identified, so making suggestions of where nurses are to work to better engage patients would be speculative. However, nurses should be cognizant of the importance of encouraging active participation in areas that might be considered less desirable or exciting by patients, such as learning bowel management techniques, as well as areas in which the patient may be more interested, such as mobility training.

More time spent in respiratory education was associated with lower scores in all CHART dimensions except for Social Integration; again, it is likely that patients who have compromised respiratory systems need more nursing education, with the extent of their disability possibly affecting their ability to function independently.

While we examined several aspects of nursing interventions for this study, we focused on four areas where SCI patients may have challenges when they return to living in the community; these areas were bladder management, emotional distress, skin integrity, and pain.

Bladder management

For patients with SCI, appropriate bladder management is necessary for both physiological and quality-of-life issues. Intermittent catheterization is the method recommended for bladder management in the SCI patient with neurogenic bladder. It avoids buildup of large urine volumes that may increase pressure and lead to long-term complications such as hydronephrosis, bladder and renal calculi, and autonomic dysreflexia.[39] According to the Centers for Disease Control, intermittent catheterization is thought to be associated with less frequent urinary tract infections and is the method recommended for bladder management by persons with SCI.[40] Supported by this and other evidence, the SCI rehabilitation nurses teach and encourage patients to utilize this method for bladder management if at all feasible. While most participants retained intermittent catheterization as their method of bladder management, 19% reported having switched to an indwelling catheter. There are several possible explanations for patients abandoning the advised intermittent catheterization method of bladder management. First, preferences related to quality of life, such as involuntary voiding on clothing, or lack of privacy in public bathrooms, might have led to patients choosing what could be a more convenient alternative to intermittent catheterization. Second, lack of dexterity, inability to position adequately to find the meatus or increased spasticity might have made it difficult for patients to be independent with catheterization. Third, urologists might have recommended indwelling catheters for medical reasons including temporary

management of PUs. In this study, we surmised that nursing education during the rehabilitation stay would impact on bladder management outcomes after discharge. We found a statistically significant association between classes taught by nursing and the percentage of participants who maintained intermittent catheterization as their method for bladder management; however, there were no associations between hours of nursing bedside education and changes away from intermittent catheterization as the method of management.

Emotional distress

In the previous report on this study[4] we found that nurses spent approximately 50% of their education/care management time providing patients with psychosocial support. However, in the current analysis there was no apparent association of this intervention with the presence of depression symptoms as we had anticipated, although there was some association between psychosocial support and patients returning to work/school. Even in the subgroup that displayed higher than average anxiety or depression during inpatient rehabilitation, no relationship with psychosocial support provided by nursing was seen.

However, while statistical significance was not attained for this measure, the necessity for nurses to devote time to patient psychosocial needs cannot be diminished. During rehabilitation, when the need for emotional support is high, it is important for nurses to build trust and rapport so that patients become ready and more comfortable with exchanges during education sessions that address intimate subjects such as sexuality and bowel and bladder training. Notwithstanding, nurse clinicians might consider whether time spent in psychosocial support might be at the expense of other beneficial clinical activities.

Skin integrity

Because of diminished mobility and sensory impairment, persons with SCI must diligently observe certain routines in order to preserve skin integrity. Consistent with findings in the literature, SCIRehab nurses spent an appreciable amount of time educating patients about skin care issues and procedures; however, we found no association between the amount of time spent on education and PU prevalence at 1 year post-injury, except that more skin education was associated with more re-hospitalization. This finding is counterintuitive as one would expect that greater amounts of time dedicated to skin education would increase patient awareness and be associated with more compliance with skin impairment prevention measures, resulting in fewer PUs. Even among the subgroup of patients who had a grade II or more serious PU during rehabilitation, and therefore could be considered to be at high risk for PUs, the hours of relevant education were not associated with the presence of a PU 1 year later. If Medicaid as payer serves as proxy for income status, our findings are counter to those reported by Saunders *et al.*[4] who found relationships of lower income with higher incidence of PUs; our data showed no higher incidence of PUs for those with Medicaid insurance. However, there is a degree of consistency in the fact that payer type of workers compensation predicted lesser incidence of pressure sores and unemployment prior to injury predicted greater likelihood of having PUs.

Pain

Chronic pain is reported by most SCI patients.[41] We examined pain as an outcome measure because it affects quality of life and pain control is a high priority for persons with SCI. We expected that nursing pain management education might be associated with patients' report of pain experience after rehabilitation. However, we found limited association between pain at one-year post injury and the time nurses spent on educating their patients about pain management. The association of higher patient participation scores (in nursing activities) with less reporting of pain at the anniversary may be an indicator that patients who are more engaged in the rehabilitation process may assimilate education and other pain control strategies better and thus, be better able to control their pain after the transition to community living.

In summary, although nurses spend an appreciable amount of time teaching and/or providing care management advice with their patients at the bedside, the associations of time spent on specific components of education and care management with key outcomes were not as we expected. It could be that, interventions from nurses during the rehabilitation phase may have limited association with patient outcomes because the highly catastrophic, life-changing and immediate nature of the injury renders patients unready to learn, as they may not have come to terms with the impact of their injury at this early stage. Manns *et al.*[42] reported readiness to learn as a major barrier to learning for the newly injured patient and called for future nursing interventional studies to target strategies that address this area.

Limitations

Nurses identified that the quantification of education and care management activities they provide is deficient

in traditional documentation practices, and thus developed a supplemental documentation strategy to capture this information. Documentation of these activities on a PDA or a supplemental page in current electronic documentation systems was a new process, which added time that nurses had to spend in documentation activities. Only RNs collected the data, so education and care management by nursing care technicians was not quantified. Although data collection was standardized across sites, with periodic reliability assessments, and efforts were made to ensure a complete dataset, it is possible that not all education and care management activities provided during each nursing shift are represented in the dataset. There also remains the possibility of some variability in the way nurses documented a given activity. For example, psychosocial support is a broad category and there may have been lack of clarity in definition and interpretation. Documentation of much time providing psychosocial support may have been an indicator of need (patients with psychological issues) that was not well controlled for by the patient variables measured. Lastly, our documentation did not address the quality of teaching and care management, but focused on the hours RNs spent on these activities.

Conclusions

Higher levels of patient participation and engagement in nursing activities are related to better outcomes in most domains studied. These findings suggest that nurses should work to promote and enhance active patient participation during all interactions among nursing staff and patients with SCI. While time spent providing psychosocial support of patients and their families was associated with several outcomes, the proportion of time devoted to this activity should be evaluated to ensure that other necessary education or care management interventions are not minimized.

Acknowledgements

The contents of this paper were developed under grants from the Department of Education, NIDRR grant numbers H133A060103 and H133N060005 to Craig Hospital, H133N060027 to The Mount Sinai School of Medicine, H133N060009 to Shepherd Center, and to Carolinas Rehabilitation.

References

1 Thietje R, Giese R, Pouw M, Kaphengst C, Hosman A, Kienast B, *et al.* How does knowledge about spinal cord injury-related complications develop in subjects with spinal cord injury? A descriptive analysis in 214 patients. Spinal Cord 2011;49:43–8.
2 May L, Day R, Warren S. Evaluation of patient education in spinal cord injury rehabilitation: Knowledge, problem-solving and perceived importance. Disabil Rehabil 2006;28(7):405–13.
3 May L, Day R, Warren S. Perceptions of patient education in spinal cord injury rehabilitation. Disabil Rehabil 2006;28(17): 1041–9.
4 Saunders L, Krause L, Peters B, Reed K. The relationship of pressure ulcers, race and socioeconomic conditions after spinal cord injury. J Spinal Cord Med. 2010;33(4):3878–3895.
5 Rundquist J, Gassaway J, Bailey J, Lingefelt P, Reyes I, Thomas J. Nursing bedside education and care management time during inpatient spinal cord rehabilitation. J Spinal Cord Med 2011; 34(2):205–15.
6 Fredericks S, Guruge S, Sidani S, Wan T. Postoperative patient education: a systematic review. Clin Nurs Res 2010;19(2):144–64.
7 Fredericks S, Beanlands H, Spalding K, Da Silva M. Effects of the characteristics of teaching on the outcomes of heart failure patient education interventions: a systematic review. Eur J Cardiovasc Nurs 2010;9(1):30–7.
8 Yehle K, Plake K. Self-efficacy and educational interventions in heart failure: a review of the literature. J Cardiovasc Nurs 2010; 25(3):175–88.
9 Vallerand A, Musto S, Polomano R. Nursing's role in cancer pain management. Curr Pain Headache Rep 2011;15(4):250–62.
10 Johansson K, Liisamaija N, Heli V, Katajisto J, Salantera S. Preoperative education for orthopaedic patients:systematic review. Integrative literature reviews and meta-analyses. J Adv Nurs 2005;50(2):212–23.
11 Colodny A. Teaching for life: integrating aging into the rehabilitation education program. SCI Nurs 2002;19(2):67–70.
12 Lindsey L, Kurilla L, DeVivo M. Providing SCI education during changing times. SCI Nurs 2002;19(1):11–4.
13 Hoffman J, Salzman C, Garbaccio C, Burns S, Crane D, Bombardier C. Use of on-demand video to provide patient education on spinal cord injury. J Spinal Cord Med 2011;34(4): 404–9.
14 Chase T. Learning styles and teaching strategies: Enhancing the patient education experience. SCI Nurs 2011;18(3):138–41.
15 Kruger S. A review of patient education in nursing. J Nurs Staff Dev 1990;6(2):71–4.
16 Gassaway J, Whiteneck G, Dijkers M. Clinical taxonomy development and application in spinal cord injury research: the SCIRehab Project. J Spinal Cord Med 2009;32(3):260–9.
17 Johnson K, Bailey J, Rundquist J, Dimond P, McDonald C, Reyes I, *et al.* SCIRehab: the supplemental nursing taxonomy. J Spinal Cord Med 2009;32(3):328–34.
18 Marino RJ, Barros T, Biering-Sorensen F, Burns SP, Donovan WH, Graves DE, *et al.* ASIA Neurological Standards Committee 2002. International standards for neurological classification of spinal cord injury. J Spinal Cord Med 2003;26(Suppl 1): S50–6.
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. p. 75–92.
20 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 Serv Res 1992;27(5): 587–617.
21 Horn S. Clinical practice improvement: Improving quality and decreasing cost in managed care. Med Interface 1995;8(7): 60–4.
22 Horn S. Clinical practice improvement: A new methodology for outcomes research. Nutrition 1996;12(5):384–5.
23 Lenze E, Munin M, Quear T, Dew M, Rogers J, Begley A, *et al.* The Pittsburgh Rehabilitation Participation Scale: Reliability and validity of a clinician-rated measure of participation in acute rehabilitation. Arch Phys Med Rehabil 2004;85(3):380–4.
24 Whiteneck G, Gassaway J, Dijkers M, Heinemann A, Kreider SED. Relationship of patient characteristics and rehabilitation services to outcome following spinal cord injury. J Spinal Cord Med. 2012;35(6):484–502.
25 Kirshblum SC, Burns SP, Biering-Sorensen F, Donovan W, Graves DE, Jha A, *et al.* International standards for neurological

classification of spinal cord injury (revised 2011). J Spinal Cord Med 2011;34(6):535–46.
26 National Spinal Cord Injury Statistical Center. Annual report for the Spinal Cord Injury Model Systems 2008. (Table 51). Birmingham, AL: University of Alabama; 2009.
27 Whiteneck G, Brooks C, Charlifue S, Gerhart K, Mellick D, Overholser D, *et al.*, (eds.) Guide for use of CHART: Craig Handicap Assessment and Reporting Technique. Englewood, CO: Craig Hospital; 1992.
28 Hall J, Dijkers M, Whiteneck G, Brooks C, Krause J. The craig handicap assessment and reporting technique (CHART): Metric properties and scoring. Top Spinal Cord Inj Rehabil 1998;4(1):16–30.
29 Mellick D, Walker N, Brooks C, Whiteneck G. Incorporating the cognitive independence domain into CHART. J Rehabil Outcome Measure 1999;3(3):12–21.
30 Diener E, Emmons R, Larsen J, Griffin S. The satisfaction with life scale. J Pers Assess 1985;49(1):71–5.
31 Spitzer R, Kroenke K, Williams J. Validation and utility of a self-report version of PRIME-MD: the PHQ primary care study. Primary care evaluation of mental disorders. Patient health questionnaire. JAMA 1999;282(18):1737–44.
32 Derogatis L, (ed.) BSI-18: Administration, scoring and procedures manual. Minneapolis, MN: National Computer Systems; 2000.
33 Derogatis LR, Melisaratos N. The brief symptom inventory: an introductory report. Psychol Med 1983 Aug 1983;13(3):595–605.
34 Kutner M, Neter J, Nachtsheim C, Li W. Applied linear statistical models. 5th ed. New York, NY: Irwin Professional Pub; 2004.
35 Hosmer D, Lemeshow S. Applied logistic regression. 2nd ed. New York, NY: John Wiley & Sons; 2000.
36 Nagelkerke N. A note on a general definition of the coefficient of determination. Biometrika 1991;78(3):691–2.
37 Nizam A, Kleinbaum D, Muller K, Kupper L. Applied regression analysis and other multivariable methods. 3rd ed. Pacific Grove, CA: Duxbury Pr; 1998.
38 Friberg F, Granum V, Bergh A. Nurses' patient-education work: Conditional factors-an integrative review. J Nurs Manag 2012; 20(2):170–86.
39 Consortium of Spinal Cord Medicine. Bladder management for adults with spinal cord injury: a clinical practice guideline. J Spinal Cord Med 2006;29(5):527–73.
40 Gould C, Umscheid C, Agarwal R, Kuntz G, Pegues D. Guideline for prevention of catheter-associated urinary tract infections, 2009. 2009; Available from: http://www.cdc.gov/hicpac/cauti/001_cauti.html (accessed 2012 April 16).
41 Ullrich P, Jensen M, Loeser J, Cardenas D. Pain intensity, pain interference and characteristics of spinal cord injury. Spinal Cord 2008;46(6):451–5.
42 Manns PJ, LA M. Perceptions of issues associated with the maintenance and improvement of long-term health in people with SCI. Spinal Cord 2007;45(6):411–9.