Special issue article

Outcomes of social work and case management services during inpatient spinal cord injury rehabilitation: The SCIR rehab project

Flora M. Hammond^{1,2}, Julie Gassaway³, Nichola Abeyta⁴, Erma S. Freeman⁵, Donna Primack⁶, Scott E. D. Kreider⁴, Gale Whiteneck⁴

¹Carolinas Rehabilitation, Charlotte, North Carolina, USA, ²Indiana University, Indianapolis, Indiana, USA,

³Institute for Clinical Outcomes Research, Salt Lake City, Utah, USA, ⁴Craig Hospital, Englewood, Colorado, USA,

⁵Shepherd Center, Atlanta, Georgia, USA, ⁶Rehabilitation Institute of Chicago, Chicago, Illinois, USA

Objective: To investigate associations of social work/case management (SW/CM) services during inpatient rehabilitation following spinal cord injury (SCI) and patient characteristics with outcomes.

Design: Prospective observational cohort of individuals with SCI receiving inpatient rehabilitation.

Setting: Six inpatient rehabilitation centers.

Participants: 1032 individuals with traumatic SCI.

Interventions: Not applicable.

Main outcome measure(s): Type of residence at the time of rehabilitation discharge. Employment/school status, presence of a pressure ulcer, Patient History Questionnaire, Satisfaction with Life Scale, Craig Handicap Assessment and Reporting Technique (CHART) subscales, and rehospitalization at 1-year post-injury.

Results: The intensity of specific SW/CM services is associated with multiple outcomes examined. More sessions dedicated to discharge planning for a home discharge and financial planning were associated positively with more discharge to home, while more sessions focused on planning for discharge to a location other than home, e.g. nursing home or long-term acute care facilities, have negative associations with societal participation outcomes (CHART Social Integration, Occupation, and Mobility scores) as well as with residing at home at the time of the 1-year injury anniversary.

Conclusion(s): The intensity and type of SW/CM services are associated with outcomes at rehabilitation discharge and at 1-year post-injury. Discharge to home may require assistance from SW/CM in the area of discharge planning and financial planning, while discharge to non-home residence demands directed SW/CM services for such placement.

Note: This is the eighth of nine articles of this SCIR rehab series.

Keywords: Spinal cord injuries, Rehabilitation, Tetraplegia, Paraplegia, Patient discharge, Social work, Case management, Participation, Practice-based evidence, Outcomes

Introduction

Social work and case management (SW/CM) services during inpatient spinal cord injury (SCI) rehabilitation serve a variety of patient and family needs to prepare the patient and family for the safest and most suitable discharge disposition given each individual's circumstances. The evidence base for SW/CM interventions is limited. It has been suggested that case management can 'achieve a higher and/or faster level of recovery,

which ultimately results in lower costs'¹ and there is evidence pointing to the beneficial effect of SW/CM services in reducing some areas of difficulty faced by trauma patients. For example, among 120 individuals admitted to a trauma surgery service after trauma, Zatzick *et al.*² found a reduction in post-traumatic stress disorder and alcohol abuse with stepped collaborative care aimed at identifying and treating these disorders. However, a coordinated disease management program of emotional support, care coordination, education, and communication post-discharge for chronically ill patients with more than 72 hours of

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

continuous mechanical ventilation in an intensive care unit did not demonstrate a statistically significant effect on long-term outcomes of depression, overall health, and caregiver burden.³ Evidence of the impact of SW/CM in SCI is at a case study level.⁴

Data that describe the relationship of SCI rehabilitation discharge planning to outcome are needed and may be helpful in determining ways to anticipate need and direct patient-care services, improve patient outcomes, and inform resource allocation. Such data also would help elucidate next steps in research and program development in the area of SW/CM and SCI. The SCIREhab database provides the opportunity for such a study. The SCIREhab project enrolled individuals with SCI during acute inpatient rehabilitation and collected data regarding patient characteristics, treatments, and outcomes. For this project a classification scheme was developed to capture treatments delivered during inpatient rehabilitation, including a taxonomy specific to SW/CM services.⁵ These data were collected to facilitate analyses to help guide decision-making regarding the selection of the most appropriate interventions for patients with SCI to achieve the best outcomes. A preliminary report of the SCIREhab project shed light on the amount of time per patient spent by SW/CM during inpatient SCI rehabilitation and how that time is spent.⁶ Patients enrolled during the first year of a 2.5-year enrollment period received a mean total of 10 hours of SW/CM services over the course of rehabilitation and 72.8 minutes per week (mean). A majority of patients received SW/CM time spent on interdisciplinary conferencing on the patient's behalf (96%), discharge planning and services (89%), financial planning (67%), community/in-house services (66%), and supportive counseling (56%). Time spent varied by level of SCI injury group with the most time dedicated to those with high tetraplegia (ASIA Impairment Scale (AIS) A–C 1–4) and the least with low tetraplegia (AIS A–C 5–8).

The purpose of this study was to describe associations of SW/CM services following traumatic SCI with a variety of outcomes and report the amount of variance explained by treatments on top of that explained by patient characteristics alone.

Methods

The SCIREhab study uses the practice-based evidence research methodology that has been described previously and is summarized in the first article of this series.^{7–13}

Study sample and facilities

The project enrolled patients who were 12 years of age or older, gave (or whose parent/guardian gave) informed

consent, and were admitted to the SCI unit at Carolinas Rehabilitation, Charlotte, North Carolina; Craig Hospital, Englewood, Colorado; The Mount Sinai Medical Center, New York, New York; MedStar National Rehabilitation Hospital, Washington, D.C.; Rehabilitation Institute of Chicago, Chicago, Illinois; or Shepherd Center, Atlanta, Georgia) for initial rehabilitation following traumatic SCI from the fall of 2007 through December 31, 2009.

Patient demographic and injury data

Patient demographic and injury variables, as listed in Table 1, were abstracted from patient medical records

Table 1 Patient demographic and injury characteristics

	SCIREhab study sample, <i>n</i> = 1032
Admission neurological injury group	
C1–4 ABC, %	28.5
C5–8 ABC, %	19.8
Para ABC, %	36.1
All Ds, %	15.6
Age at injury-years, mean (SD)	37.7 (16.7)
Gender, % Male	81
Race/ethnicity, %	
White	71
Black	22
Hispanic	3
Other	5
Primary language, % English	94
Payer, %	
Medicare	7
Medicaid	18
Private insurance/payer	64
Worker's compensation	11
Marital status at injury, % married	38
Education, %	
Less than high school diploma	20
High school diploma or GED	51
More than high school diploma	25
Other/unknown	4
Occupational status before injury, %	
Working	66
Student	15
Retired	8
Unemployed/other	11
Injury etiology, %	
Vehicle	49
Violence	11
Sports	11
Fall or hit by falling object	25
Other	4
Work-related injury? % no	86
Body mass index at admission, %, less than 30	82
Admission motor FIM (Rasch transformed), mean (SD)	17.8 (12.6)
Admission cognitive FIM (Rasch transformed), mean (SD)	73.6 (18.1)
Comprehensive Severity Index, mean (SD)	40.0 (31.6)
Days from injury to rehabilitation, mean (SD)	31.0 (27.8)

or obtained through interview. The International Standards of Neurological Classification of SCI (ISNCSCI) and its AIS¹⁴ were used to describe the neurologic level and completeness of injury. The Functional Independence Measure (FIM[®]) was used to characterize the patient's functional independence in motor and cognitive tasks at admission.^{15,16} Admission FIM scores reflect the level of independence upon which clinicians base care during rehabilitation. FIM data were Rasch-transformed as described in the first article of this series¹³ to improve psychometric properties and convert the ordinal scale to an interval measurement. The Comprehensive Severity Index (CSI[®]) was calculated for each patient to quantify medical severity throughout the rehabilitation stay.^{17–19} Body mass index (BMI) was categorized as obese (BMI ≥ 30) and not obese (BMI < 30).

Treatment data

Social workers and case managers provided detailed information about services provided on the patient's behalf. They used handheld personal digital assistants to enter the SW/CM data.^{5,6} Each time a service was provided, the social worker/case manager documented the session date and time, duration, and type of service(s) performed choosing among the seven intervention services in the taxonomy and interdisciplinary team or family conferences. Each intervention included multiple topics that differentiated the service provided better. For example, the 'discharge services' intervention included time spent providing information about and helping to arrange home health or personal care services, outpatient therapies, substance abuse support programs and medical supplies. 'Discharge planning' included preparation for discharge to home, addressing barriers and accessibility issues, and/or planning for discharge to a location other than home. Time is spent preparing for more than one discharge destination if the destination is uncertain at the time of admission or changes during the course of rehabilitation (see Table 2). If the service consumed 5 minutes or less then it was not documented. Table 3 depicts the mean amount of time per patient that was spent in each intervention and, for the two most frequently documented interventions (discharge planning and discharge services), the mean number of sessions per patient in which each subtopic was addressed.

Outcome data

Patient outcomes were obtained at rehabilitation discharge (disposition location) and at the 1-year injury anniversary (place of residence, presence of a pressure

Table 2 Social work/case management service taxonomy

Discharge planning	
• Home	• Assisted living
• Home accessibility	• Referring facility
• Barriers to discharge	• Transitional living facility
• Nursing home/long-term acute care	• Alternative living environment
Discharge services	
• Home health	• Substance abuse program
• Personal care services	• Medical follow-up
• Outpatient therapy	• Durable medical equipment (DME)
• Day rehabilitation program	• Supplies/meds
• Adult day care	
Community/in-house services	
• Waiver program	• Chaplain
• Lifelines	• Legal aid/legal services
• Crime victims assistance	• Transportation
• Vocational	• Housing
• Department of aging	• Service recovery/care coordination
• Correspondence	• Other services
Financial planning	
• Supplemental Security Insurance (SSI)	• Medicare/medicaid
• Social Security Disability Insurance (SSDI)	• Insurance
• Fundraising	• Alternative benefits/funding/self-pay
• Trust fund/facility funds	• Workers compensation
Supportive counseling	
• Physical/psychological abuse	• Knowledge of injury
• Alcohol/substance abuse	• Medical comorbidities
• Cultural considerations	• Sexuality
• Coping/adjustment	
Peer/advocacy (providing information and initiating referral)	
• National organizations	• Independent living centers
• Support groups	
Education:	
• SCI written materials	• Community re-entry
• Advance directives	• Guardianship
Team and patient/family conferences	
• Medical	• Behavior
• Goal setting	• Legal
• Discharge	• Other

ulcer at the time of the anniversary interview, rehospitalization during the period from rehabilitation discharge to the anniversary interview, employment/school status, depressive symptomatology (as defined by Patient History Questionnaire – PHQ-9),²⁰ life satisfaction (measured by the Diener Satisfaction With Life Scale),²¹ and societal participation as defined by Craig Handicap Assessment and Reporting Technique (CHART)).^{22–24} CHART dimensions include Physical Independence, Social Integration, Occupation, and Mobility. These outcomes and the processes of obtaining them are described in detail in the first article of this series;¹³ information was collected around the time of the one-year injury anniversary through a telephonic interview with trained personnel.

Table 3 SW/CM treatment data: LOS, activity duration and session quantity (n = 1032)

Treatment	Mean (SD) (per patient)	Frequency (number of sessions)
Length of rehabilitation stay-days	55.7 (36.6)	–
SW/CM activities – in hours per patient:		
Classes provided by SW/CM	0.5 (1.1)	–
Community/in-house services	0.8 (1.5)	–
Discharge planning	1.5 (2.7)	–
Discharge services	1.4 (2.2)	–
Education topics	0.1 (0.3)	–
Financial planning	1.3 (2.5)	–
Initial assessment	0.5 (0.6)	–
Peer/advocacy groups	0.1 (0.5)	–
Supportive counseling	0.6 (1.4)	–
Interdisciplinary conference or consultation	2.3 (1.8)	–
Sessions in each topic of DC planning – in hours per patient and frequency		
Home	1.7 (3.3)	648
Barriers to discharge	1.7 (3.3)	759
Nursing home/LTAC	0.6 (2.5)	189
Assisted living	<0.1 (0.4)	26
Referring facility	<0.1 (0.3)	31
Transitional living facility	0.1 (0.7)	73
Alternative living environment	0.2 (1.0)	161
Sessions in each topic of DC services – in hours per patient and frequency		
Home health	1.4 (3.2)	459
Personal care services	0.5 (1.4)	286
Outpatient therapy	0.9 (1.6)	512
Day rehab program	0.6 (1.5)	341
Adult day care	<0.1 (0.1)	11
Substance abuse program	<0.1 (0.2)	10
Medical follow up	1.2 (2.0)	628
Durable medical equipment	1.6 (2.8)	625
Supplies/medications	1.1 (1.9)	603

Data analysis

Ordinary least squares stepwise linear regression²⁵ was used for outcomes that are continuous, and logistic regression for dichotomized outcomes.²⁶ Three groups of independent variables were allowed to enter the stepwise regressions: (1) all patient demographic and injury characteristics are described in Table 1; (2) treatment variables that included rehabilitation LOS, time spent in individual SW/CM activities, and the number of sessions of each topic included in discharge planning and discharge services (Table 3); and (3) rehabilitation center. For linear regressions, the adjusted R^2 reduces the unadjusted R^2 to take into account the number of independent variables in the model, and thus, the adjusted R^2 is referred to in the description of results (both appear in the tables). The adjusted R^2 value indicates the amount of variation explained in the outcome by the significant independent variables, and thus, the strength of the model. R^2 values range from 0 (no association) to 1 (perfect association); values that are closer to 1 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 & Uhler's R^2 , is reported as a measure of the strength of the model.²⁷ This value is scaled the same as the R^2 (0 to 1) and reflects the relative strength of the logistic model. In addition, for logistic regression, discrimination 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 an outcome from patients who did. Values of c that are closer to 1 indicate better discrimination.

In each regression, the adjusted R^2 (linear regression) or the c statistic and the Max R^2 (logistic regression) are reported first with only patient characteristics included as independent variables. Next, the same statistics are reported for the combination of treatment variables and patient characteristics. Finally, to determine the added influence of rehabilitation center effects, dummy variables indicating the center where each patient was rehabilitated were added to the model (in addition to the treatment and patient variables) and the adjusted R^2 or c statistic/Max R^2 are reported. The change in the adjusted R^2 or c statistic/Max R^2 as the treatment variables and then the addition of center variables indicate the strength of additional explanation contributed by these components.

For all outcome models, parameter estimates (based on the regressions including patient/injury and treatment variables, but not center) are reported, indicating the direction and strength of the association between each independent variable and the outcome. In the linear regression models, semi-partial Omega R^2 s are reported, which indicate the proportion of the variance in the dependent variable that is associated uniquely with the independent variable. In the logistic regressions, odds ratios (ORs) are reported to indicate the magnitude of the association with the 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. In all regression models, the P value associated with each significant independent variable is also reported.

Results reported here are for a 'primary analysis subset' (a randomly selected 75% of the full dataset containing 1378 patients where stratification was used to ensure equal representation by level and completeness of injury, treatment center, and availability of follow-up interview data); the regression models were tested using the validation subset, which contained the remaining 344 (25%) of patients. There were no significant differences between the primary analysis and validation

subsets on any dependent or independent variables used in the regression models. For linear outcomes the relative shrinkage of the original model R^2 that included all patient and treatment variables as the independent variables was compared with the R^2 for the same outcome using the 25% sample and only the significant variables from the original model.²⁸ A shrinkage (relative difference in R^2) of <0.1 was considered to be 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 sample. Models validated well if the HL P value was >0.1 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 to 0.1 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 models.

Results

Patient characteristics

Patient demographic and injury characteristics for the study sample (1032 patients) are presented in Table 1. There were no significant differences between this sample and the validation subsample on any dependent or independent variables used in the regression models. Patients were 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. The average age of subjects was 38 years, with a standard deviation (SD) of 17. Vehicular crashes were the most common cause of injury (49%), followed by falls (25%), sports (11%), and violence (11%). The mean motor FIM raw score at admission was 23.5 (SD 11.3) and the cognitive score was 28.7 (SD 6.1). The raw FIM data were Rasch-transformed; the 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 days (SD 28) had elapsed from the time of injury to rehabilitation admission.

Treatment time

The mean rehabilitation length of stay (LOS) was 56 days (range 2–267, standard deviation (SD) 37, median 45). All 1032 patients received some SW/CM intervention during rehabilitation; the mean amount of SW/CM treatment time was 9.1 hours (range, 0.03–89.4 hours, SD 10.4, median 5.6) of SW/CM.

Associations of SW/CM time and activities with outcomes

The 1-year post-injury interview was completed with 91% of the 1032 enrolled patients; 12.5% of these were conducted with a proxy rather than the patient. Interview questions were asked in a sequential manner. Some participants may not have had an answer for each question, some may have fatigued prior to the end of the interview, and, if the interview was conducted with a proxy, some questions were not asked (e.g. satisfaction with life and PHQ-9); therefore, we see variation in sample sizes for specific outcomes.

Discharge location

Most patients (89%) were discharged to home and 11% went to a location other than home (Table 4). Patient characteristics explained some of the variation (c statistic = 0.77, Max R^2 = 0.20). Older age, greater medical severity (CSI), and race other than White (Black, Hispanic, other minority) were associated with smaller likelihood of discharge to home and higher admission motor FIM score with greater likelihood. The addition of SW/CM treatments increased the c statistic to 0.91 and Max R^2 to 0.50. More total hours spent in SW/CM community/in-house services (see Table 2 for topics included) and financial planning and more SW/CM sessions involving planning for a home discharge and arranging for supplies and medications were associated with greater likelihood of discharge to home. More time spent providing information and making referrals for peer/advocacy groups and more SW/CM sessions involving planning for discharge to a nursing home or alternative living environment were negative. Adding rehabilitation center to the model increased the c statistic by only 0.01.

Residential location at 1-year injury anniversary

Patient characteristics were associated weakly with residential location at the 1-year injury anniversary (c statistic = 0.55); the only significant variable was speaking English. SW/CM treatment variables added a moderate increase; c statistic = 0.77. More SW/CM sessions dedicated to planning a nursing home discharge was associated with less home residence and more sessions focused on arranging for supplies and medications was associated with more. Adding rehabilitation center to the model increased the c statistic by only 0.01 (see Table 4).

Work/school

Patient characteristics were associated with patients being employed or in school at the time of the 1-year injury anniversary. Students (prior to injury) were

Table 4 Regression models for residential location at discharge and one-year anniversary and work/school status at one-year anniversary

	Discharged to home			Reside at home at 1 year			Work/school at 1 year		
Observations used	1031:Yes = 917, No = 114			878:Yes = 828, No = 50			856:Yes = 236, No = 620		
Step 1: Pt characteristics: c/Max R ²	0.77/0.20			0.55/0.02			0.81/0.32		
Step 2: Pt characteristics + treatments: c/Max R ²	0.91/0.50			0.77/0.17			0.82/0.34		
Step 3: Pt characteristics + treatments + center identity: c/Max R ²	0.92/0.53			0.78/0.19			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									
C1-4 ABC							−1.817	0.162	<0.001
C5-8 ABC							−0.057	0.347	<0.001
Para ABC							−0.289	0.749	0.128
All Ds (reference)							0.000	—	—
Admission FIM motor-Rasch transformed	0.041	1.041	<−0.001						
Comprehensive Severity index	−0.011	0.989	0.019						
Traumatic etiology									0.025
Medical/surgical/other							−0.309	0.734	0.550
Violence							−0.051	0.950	0.875
Sports							0.949	2.583	0.002
Fall							−0.010	0.990	0.967
Vehicular (reference)							0.000	—	—
Age at injury	−0.029	0.971	<0.001				−0.019	0.981	0.030
Race			0.002						
All other minorities	−1.182	0.307	0.026						
Black	−0.910	0.403	0.002						
Hispanic	−1.368	0.255	0.038						
White (reference)	0.000	—	—						
Occupational status at injury									<0.001
Unemployed/other							−0.826	0.438	0.029
Student							1.528	4.607	<0.001
Retired							−0.715	0.489	0.208
Working (Reference)							0.000	—	—
Highest education achieved									<0.001
College							1.049	2.853	<0.001
High school							0.237	1.267	0.387
<12 Years/other/unknown (Reference)							0.000	—	—
Primary language is English				1.476	4.375	0.001			
Primary payer									0.001
Medicare							−1.021	0.360	0.100
Medicaid							−0.776	0.460	0.005
Worker's compensation							−0.921	0.398	0.009
Private insurance/pay (reference)							0.000	—	—
SW/CM hours of specific treatment:									
Community/in-house services	0.463	1.588	0.018						
Financial planning	0.336	1.399	0.023						
Peer/advocacy groups	−1.896	0.150	<0.001						
# Session of SW/CM treatment topics:									
Discharge planning – home	0.426	1.531	<0.001						
Discharge planning – nursing home/LTAC	−0.511	0.600	<0.001	−0.266	0.766	<0.001	−0.674	0.510	0.008
Discharge planning – alternative living environment	−1.078	0.340	<0.001						
Discharge services – supplies/meds	1.254	3.505	<0.001	0.304	1.356	0.015			

*All patient and treatment variables listed in Tables 1 and 2 and the number of sessions of each discharge planning and discharge services topic were allowed to enter the models. Only statistically significant predictors are reported here; a missing variable name means that 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.

about 4.5 times as likely to be working or in school and patients with a college education were almost three times as likely (<12 years/other/unknown was the reference group). Other significant patient variables include injury group, etiology of injury, age, and payer. The *c* statistic for patient variables alone was 0.81; it increased only slightly with the addition of SW/CM treatments (to 0.82); the only significant variable was more SW/CM sessions focused on discharge planning to a nursing home (negative) (see Table 4). The addition of rehabilitation center increased the *c* statistic by only 0.01.

Societal participation

Table 5 contains regression models with patient characteristics and SW/CM treatments as the independent variables for the four dimensions of the CHART: Physical Independence ($R^2 = 0.43$), Social Integration ($R^2 = 0.16$), Occupation ($R^2 = 0.26$), and Mobility ($R^2 = 0.29$). Various patient variables were significant in one or more of these four dimensions. Older age was associated with lower scores in all models. Higher admission motor FIM was associated with higher Physical Independence, Occupation, and Mobility scores. Neurological injury group was also significant: high tetraplegia ABC with lower scores on three dimensions, low tetraplegia with lower Physical Independence and Mobility scores and paraplegia with lower Occupation and Mobility scores as compared to AIS D injuries. Persons who were married at the time of injury have higher Social Integration, Occupation, and Mobility scores. Black race was associated with lower Mobility scores. Level of education achieved prior to injury was significant in each model: having a college education was associated with higher scores (<12 years combined with other was the reference group). Payer also was significant: Medicaid was associated with lower Social Integration and Mobility scores (private insurance was the reference group). Several SW/CM treatment activities also were significant. More total time spent in classes provided by social workers/case managers was associated with higher Physical Independence and Social Integration scores. More time spent providing supportive counseling and doing assessments was associated with lower Occupation scores. More SW/CM sessions dedicated to planning discharge to an alternative living environment was associated with higher scores in all dimensions except for Physical Independence, which has a negative association. More sessions dedicated to planning discharge to a nursing home were associated with lower Social Integration, Occupation, and

Mobility scores. More sessions dedicated to arranging personal care services were associated with lower Social Integration scores. The addition of center variables added only 0.01 or 0.02 to the adjusted R^2 for each model.

Mood state and life satisfaction

Together, patient characteristics, SW/CM treatments, and rehabilitation center were associated weakly with depressive symptomology, as measured by the PHQ-9 (adjusted $R^2 = 0.08$); more SW/CM sessions focused on addressing barriers to discharge were associated with more depressive symptomatology (Table 6). SW/CM interventions had no significant associations with life satisfaction.

Rehospitalization

SW/CM treatments, along with patient characteristics also were not strongly associated with rehospitalization after rehabilitation discharge (*c* statistic = 0.70, Max $R^2 = 0.16$) (see Table 7). Higher medical severity during rehabilitation and longer time from injury to rehabilitation admission were associated with greater likelihood of rehospitalization. Payer was also significant – payers of Medicare, Medicaid, and workers compensation were associated with higher likelihood (as compared to private insurance), along with more SW/CM sessions dedicated to addressing barriers to discharge. Higher admission motor FIM, longer rehabilitation LOS, male gender, student status prior to injury, and more time spent in classes led by social workers/case managers were associated with a smaller likelihood of rehospitalization. The addition of rehabilitation center as an independent variable improved the explanatory power by only 0.01.

Pressure sore at the anniversary

Persons with paraplegia were four times more likely to report a pressure sore at the time of the 1-year anniversary (OR = 4.2) than persons with AIS D injuries. Other patient characteristics associated with greater likelihood of reporting a pressure sore at the anniversary included greater medical severity during rehabilitation, longer duration from injury to rehabilitation admission, being unemployed or retired at the time of injury, and having Medicare as the payer type. Variables associated with a smaller likelihood of reporting pressure sores included: higher admission motor FIM scores, being retired at the time of injury, and longer rehabilitation LOS (see Table 7). Adding rehabilitation center to the model increased the explanatory power by only 0.02.

Table 5 Regression models for societal participation (CHART)

	CHART: Physical Independence			CHART: Social Integration			CHART: Occupation			CHART: Mobility		
	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
Observations used	856			831			845			844		
Step 1: Pt characteristics: adj. R ²	0.41			0.12			0.24			0.27		
Step 2: Pt characteristics + treatments: adj. R ²	0.43			0.16			0.26			0.29		
Step 3: Pt characteristics + treatments + center identity: adj. R ²	0.44			0.18			0.28			0.30		
Independent variables*												
Neurological group	—	<0.001	0.022					0.012	0.007	—	0.002	0.010
C1-4 ABC	−22.049	<0.001	—				−14.515	0.002		−10.832	<0.001	—
C5-8 ABC	−8.562	0.028	—				−6.739	0.128		−6.075	0.030	—
Para ABC	−2.554	0.430	—				−7.251	0.051		−5.885	0.011	—
All Ds (Reference)	0.000	—	—				0.000	—		0.000	—	—
Admission FIM motor	0.916	<0.001	0.034				0.857	<0.001	0.029	0.330	<0.001	0.011
−Rasch transformed												
Admission FIM cognitive				0.106	0.005	0.007						
−Rasch transformed												
Comprehensive Severity Index	−0.149	<0.001	0.008				0.119	0.010	0.005			
Days from trauma to rehabilitation admission	−0.257	<0.001	0.033				−0.120	0.005	0.006	−0.126	<0.001	0.020
Traumatic etiology	—	0.004	0.008					0.022	0.007			
Medical/surgical/other	−11.676	0.032	—				−9.542	0.124				
Violence	−6.787	0.053	—				−9.378	0.020				
Sports	−10.982	0.002	—				2.385	0.549				
Fall	−2.863	0.271	—				−6.574	0.028				
Vehicular (reference)	0.000	—	—				0.000	—				
Age at injury	−0.303	<0.001	0.010	−0.245	<0.001	0.015	−0.420	<0.001	0.012	−0.417	0.000	0.029
Gender is male							−9.460	0.001	0.008			
Marital status is married				7.127	<0.001	0.019	6.758	0.014	0.004	3.702	0.037	0.003
Race										—	0.002	0.010
All other minorities										−3.496	0.320	—
Black										−6.981	<0.001	—
Hispanic										−3.522	0.471	—
White (reference)										0.000	—	—
Occupation status at injury				—	<0.001	0.022		0.021	0.006	—	0.006	0.008
Unemployed/other				−7.330	0.002	—	−2.142	0.582		−4.323	0.084	—
Student				1.320	0.568	—	9.610	0.015		6.439	0.012	—
Retired				9.913	0.002	—	−10.079	0.050		1.194	0.733	—
Working (Reference)				0.000	—	—	0.000	—		0.000	—	—
Highest education achieved	—	<0.001	0.012	—	0.004	0.009	—	<0.001	0.020	—	<0.001	0.017
College	13.937	<0.001	—	6.409	0.003		16.146	<0.001		10.286	<0.001	—
High school	8.688	0.002	—	1.644	0.378		4.312	0.182		3.329	0.106	—

<12 Years/other/ unknown (Reference)	0.000		—	0.000			0.000			0.000		
Primary language is English							15.616	0.003	0.007	13.328	<0.001	0.011
Primary payer				—	0.009	0.009				—	0.032	0.005
Medicare				−5.869	0.072	—				0.888	0.807	—
Medicaid				−5.569	0.003	—				−6.032	0.004	—
Worker's compensation				−2.877	0.217	—				−0.329	0.898	—
Private insurance/pay (Reference)				0.000	—	—				0.000	—	—
SW/CM hours of specific treatment:												
Classes provided by SW/CM	3.124	0.001	0.006	1.440	0.014	0.005						
Discharge planning	−1.115	0.025	0.003									
Initial assessment							−5.136	0.016	0.004			
Supportive counseling							−2.341	0.011	0.005			
# Session of SW/CM treatment topics:												
Discharge planning - nursing home/LTAC				−2.038	<0.001	0.036	−1.266	0.012	0.005	−1.582	<0.001	0.015
Discharge planning - alternative living environment	−2.382	0.020	0.003	1.402	0.034	0.004	3.033	0.006	0.006	1.808	0.010	0.005
Discharge services - personal care services				−1.310	0.009	0.006						
Discharge services - medical follow up	3.044	<0.001	0.009									
Discharge services supplies/meds	−1.602	0.039	0.002									

*All patient and treatment variables listed in Tables 1 and 2 and the number of sessions of each discharge planning and discharge services topic were allowed to enter the models. Only statistically significant predictors are reported here; a missing variable name means that 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.
Pt, patient.

Table 6 Regression models for mood state (PHQ-9) and satisfaction with life (SWLS)

PHQ9				SWLS		
Observations used		810				745
Step 1: 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		0.08				0.11
Independent variables*	Parameter estimate	P value	Semi-partial Omega ²	Parameter estimate	P value	Semi-partial Omega ²
Neurological group				—	0.002	0.014
C1-4 ABC				−2.718	0.012	—
C5-8 ABC				−0.374	0.716	—
Para ABC				−2.030	0.015	—
All Ds (reference)				0.000	—	—
Admission FIM motor-Rasch transformed				0.073	0.024	0.005
Days from trauma to rehabilitation admission	0.021	<0.001	0.014			
Age at injury	0.033	0.019	0.005	−0.095	<0.001	0.018
Gender is male	−0.895	0.041	0.004			
Occupational status at injury		0.001	0.015	—	0.018	0.009
Unemployed/other	1.561	0.008		−2.566	0.005	—
Student	−0.926	0.110		0.782	0.406	—
Retired	−1.221	0.112		0.507	0.699	—
Working (reference)	0.000			0.000	—	—
Highest education achieved		0.027	0.006			
College	−1.468	0.008				
High school	−0.977	0.041				
<12 Years/other/unknown (reference)	0.000					
BMI ≥ 30	−1.709	<0.001	0.015			
Primary payer					0.010	0.010
Medicare				1.686	0.222	—
Medicaid				−2.129	0.004	—
Worker's compensation				−1.297	0.145	—
Private insurance/pay (reference)				0.000	—	—
#Sessions in discharge planning – barriers to discharge	0.248	<0.001	0.016			

*All patient and treatment variables listed in Tables 1 and 2 and the number of sessions of each discharge planning and discharge services topic were allowed to enter the models. Only statistically significant predictors are reported here; a missing variable name means that 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.

Pt, patient.

Model validation

Linear regression models that validated well (relative shrinkage <0.1) include CHART Physical Independence and Social Integration. The models for CHART Occupation validated moderately well (relative shrinkage 0.1–0.2). Three models validated poorly (relative shrinkage >0.2): CHART Mobility, PHQ-9, and SWLS. For dichotomous outcomes, the models for working or being in school at the anniversary, rehospitalization, and pressure ulcer at the time of the anniversary validated well (HL P value >0.1 for both), the model for residential location at the anniversary showed some lack of fit (HL P value was 0.05 to 0.1 for one or both models) and the model for discharge location showed lack of fit (HL P value <0.05 for one or both models).

Discussion

A major goal of all SW/CM programs is to work with the patient and family toward a safe discharge back to the home environment. Efforts are put forth to optimize living environments, ensure adequate availability and training of caregivers, obtain equipment, and secure necessary financing for needed services. For some patients, especially those with stable family situations, developing and implementing the plan for a home discharge generally goes smoothly. For other patients, the plan may become more tenuous as the rehabilitation course progresses and the patient may end up not being discharged to home.

Of all activities included in the SW/CM taxonomy, the two that were delivered to almost all patients and

Table 7 Regression model for rehospitalization between rehabilitation discharge and one-year post injury and pressure sore(s) at 1-year post injury

	Rehospitalized			Pressure score(s) at 1 year		
Observations used	950:Yes = 343, No = 607			936:Yes = 128, No = 808		
Step 1: Pt characteristics: c/Max R^2	0.66/0.10			0.71/0.12		
Step 2: Pt characteristics + treatments: c/Max R^2	0.70/0.16			0.71/0.13		
Step 3: Pt characteristics + treatments + center identity: c/Max R^2	0.71/0.17			0.73/0.16		
Independent variables*	Parameter estimate	Odds ratio	P value	Parameter estimate	Odds ratio	P value
Neurological group						
C1-4 ABC				0.537	1.711	0.312
C5-8 ABC				0.970	2.638	0.058
Para ABC				1.427	4.168	0.003
All Ds (Reference)				0.000	—	—
Admission FIM motor – Rasch transformed	−0.024	0.976	<0.001	−0.044	0.957	0.002
Comprehensive severity Index	0.016	1.016	<0.001	0.013	1.013	0.002
Days from trauma to rehabilitation admission	0.008	1.009	0.002	0.009	1.009	0.005
Gender is male	−0.451	0.637	0.015			
Occupational status at injury	—	—	0.008	—	—	0.008
Unemployed/other	0.149	1.161	0.526	0.498	1.645	0.083
Student	−0.749	0.473	0.001	−0.378	0.685	0.234
Retired	−0.177	0.838	0.601	−1.297	0.273	0.024
Working (reference)	0.000	—	—	0.000	—	—
Primary payer	—	—	0.010	—	—	0.024
Medicare	0.668	1.950	0.048	1.207	3.344	0.008
Medicaid	0.527	1.694	0.006	0.240	1.272	0.339
Worker's compensation	0.420	1.523	0.099	−0.473	0.623	0.245
Private insurance/pay (reference)	0.000	—	—	0.000	—	—
Rehabilitation length of stay	−0.016	0.985	<0.001	−0.009	0.991	0.021
Classes hours	−0.251	0.778	0.002			
#Sessions in discharge planning – barriers to discharge	0.076	1.078	0.009			

*All patient and treatment variables listed in Tables 1 and 2 and the number of sessions of each discharge planning and discharge services topic were allowed to enter the models. Only statistically significant predictors are reported here; a missing variable name means that 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.

Pt, patient.

in which most time was spent, were discharge planning and discharge services.⁶ Time spent in these activities was associated significantly with multiple outcomes. Because the topics contained within these two activities were numerous and diverse (Table 2), we identified the mean duration and number of sessions in which each sub-topic was addressed. In the discharge planning activity, the most common services were planning for a home discharge and addressing barriers; less common services included planning for discharge to locations other than home. Topics included in the discharge services activity were more similar, but still identified different areas of need. Thus, we allowed the number of sessions in which each topic of the discharge planning and discharge services activities to serve as additional independent variables in regression models.

Discharge to home after SCI is highly complex with needs including accessible housing, home modifications,

equipment, supplies, medications, and therapy services. Successful home discharge requires the social worker/case manager to educate the patient and family about accessible transportation, housing options, waiver programs to fund services such as homecare or home modifications, and local and government financial resources; the social worker/case manager also assists with completing appropriate applications. The association of SW/CM time spent on financial planning and community services with home discharge is indicative of how important such planning is to discharging patients to home as opposed to alternative settings. When the need for discharge to a location other than home, typically a nursing home, is determined, discharge efforts are expanded to include planning for this alternative type of discharge, and indeed, we see associations of more time spent on planning for discharge to a nursing home or alternative living environment to be

associated with less likelihood of discharge to home. The association of the number of sessions dedicated to discharge planning and services with discharge to home and other outcomes is probably due to the fact that most of these services are addressed with all patients while time is spent on planning for a discharge to a location other than home only after home discharge has been explored and determined to be unsafe or otherwise not feasible.

More sessions focused on planning for discharge to a location other than home, along with other SW/CM interventions had many associations with societal participation. The association of more sessions spent on planning for personal care services and discharging to alternative environments with lower social integration scores may signal a need for greater intervention to improve societal participation, or we could infer that when patients do not live at home or require much personal care services in the home, their ability to spend time with family, business associates, or friends is diminished. Other negative associations were also seen, for example, more time spent addressing barriers to discharge was associated with greater likelihood of rehospitalization. It may be that these interventions provide benefits to the patients and families who need them. Typically, patients who need more assistance with addressing barriers and improving accessibility would be those patients with limited mobility, which could be associated with greater likelihood of rehospitalization. Thus, negative associations should be interpreted with caution, and not necessarily as 'bad' but rather may be an indicator of patient need.

It is astonishing to see positive associations between more time spent in classes led by SW/CM with several outcomes (higher CHART physical and social integration and less rehospitalization). Perhaps the learning that occurs in these classes can be used by the patient and family to manage low-risk medical situations for which care may otherwise be sought in a hospital setting. Further research is needed to determine benefits of SW/CM classes and other forms of education as well as the most effective ways to deliver such information.

In addition to examining the associations of SW/CM interventions with outcomes, it is also interesting to discuss the influence of primary payer. Medicaid as a payer was associated with lower CHART Social Integration and Mobility scores, a smaller likelihood of working or being in school at the 1-year anniversary, reporting lower life satisfaction, and greater likelihood of rehospitalization after discharge. Medicare was associated with more rehospitalization and reporting of pressure sore at the time of the anniversary. Thus,

Medicaid and Medicare as a primary payer source appear to be a marker for worse outcomes. Persons who qualify for Medicaid benefits have limited income and assets, and thus, may have limited access to resources and may live in an environment less conducive to satisfying their needs. Persons with Medicare tend to be of an older age and/or have more complex medical conditions (co-morbidities). Payer type is indicative of socioeconomic status and age, which may influence educational and employment opportunities, as well as access to high-level technological devices (environmental controls, computer technology), personal transportation (accessible van), leisure pursuits involving costly high-tech equipment or additional costs, and travel. While a majority of third-party payers provide benefits for skilled services in the home (intermittent nursing visits and therapy services), both Medicaid and Medicare recently have begun imposing limits on the amount of services provided. There also may be access to care issues for patients covered by Medicaid or Medicare as some health care providers may not accept the lower Medicare or Medicaid reimbursement for services.

Limitations

The SCIREhab sites are highly specialized centers for SCI rehabilitation, and thus, findings may not be generalizable to all rehabilitation facilities that provide care for patients with SCI. Data are only as complete as the data entered by each social worker/case manager; some intervention time may not have been included. Additionally, potentially meaningful service may have been lost by not capturing interventions that occurred during interventions lasting 5 minutes or less, as it is common for SW/CM to conduct interventions in small periods of time. This study assessed associations of treatment variables with outcomes and is not designed to answer questions of cause and effect, but provides information that can inform future clinicians and researchers in their future work.

Insurance information was available for the time of admission to rehabilitation but not at the time of the 1-year injury anniversary. Thus, while insurance payer is significantly associated with several outcomes 1 year post-injury, the insurance may have been different at that time.

Conclusions

The type and intensity of various SW/CM services are associated with outcomes at the time of rehabilitation discharge and 1-year post-injury, which may have implications for treatment planning and future clinical trial

development. Discharge to home is associated with more time spent by social workers and case managers providing financial planning services as well as discharge planning that addresses accessibility issues and access to medications and supplies.

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