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The Relationship Between Sponsorship and Rehabilitation Outcome Following Spinal Cord Injury

M.J. DeVivo, Dr PH, S.L. Stover, MD, P.R. Fine, PhD, MSPH
Department of Rehabilitation Medicine, University of Alabama at Birmingham, Birmingham, Alabama 35294, USA.

Summary

The effect of sources of support on rehabilitation outcomes of 866 patients treated at the University of Alabama at Birmingham Spinal Cord Injury Care System since 1973 was assessed using multiple linear and logistic regression. System admission was delayed for Medicaid beneficiaries, while patients who were responsible for at least a portion of their incurred charges were admitted sooner than other patients. Increased lengths of stay were noted among vocational rehabilitation clients and patients with either Workers' Compensation or private insurance coverage. Patients with Workers' Compensation also had significantly higher average hospital charges. Medicaid patients were more likely to be rehospitalised after discharge from rehabilitation. Vocational rehabilitation clients averaged fewer days in nursing homes after injury while Medicaid and Medicare patients experienced longer stays in nursing homes. We conclude that source of support has a significant impact on numerous measures of outcome.

Key words: *Spinal cord injury; Sponsorship; Costs; Length of stay; Rehospitalisation.*

As a result of the ever escalating costs of medical care, the field of rehabilitation medicine has come under increasing pressure to document both the benefits and cost-effectiveness of rehabilitation programmes. This pressure has led to the publication of results from numerous recent investigations of rehabilitation outcomes, with particular emphasis on persons with spinal cord injuries (Carey *et al.*, 1988; DeVivo *et al.*, 1988; Stover *et al.*, 1986; Yarkony *et al.*, 1987). However, before proceeding further with these studies, it is important to develop a more complete understanding of the relationships between inherent patient characteristics and rehabilitation outcomes so that the potential confounding effects of these characteristics can be appropriately controlled.

Known determinants of rehabilitation outcomes for persons with spinal cord

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injuries include age (Charles *et al.*, 1978; DeVivo *et al.*, 1982, 1987, 1988; El Ghatit *et al.*, 1978; Felton *et al.*, 1965; Geisler *et al.*, 1966; Levenson *et al.*, 1965; Meyers *et al.*, 1985), sex (Charles *et al.*, 1978, DeVivo *et al.*, 1982, 1987), race (Charles *et al.*, 1978, DeVivo *et al.*, 1982, 1987), neurological level and extent of lesion (Charles *et al.*, 1974, 1978, El Ghatit *et al.*, 1978; Felton *et al.*, 1965; Fine *et al.*, 1987; Geisler *et al.*, 1966; Stover *et al.*, 1986; Yarkony *et al.*, 1987; Young *et al.*, 1982), number of associated injuries (Fine *et al.*, 1987), use of a mechanical ventilator (Fine *et al.*, 1987), intelligence quotient (DeVivo *et al.*, 1987), education level at injury (El Ghatit *et al*, 1978; Felton *et al.*, 1965; Geisler *et al.*, 1966) and employment status at injury (DeVivo *et al.*, 1982, 1987). However, the effect of sources of support (sponsors fiscally responsible for initial hospital expenses and post-discharge care) on rehabilitation outcomes remains largely unknown.

A few relevant studies have been conducted. Webb *et al.* (1978, 1979) reported initial length of stay and cost of care data for 85 patients covered by Workers' Compensation. However, the results were not compared with those of patients who had other sources of support. Further, these studies have been criticised on grounds of sample size and representativeness (Carle *et al.*, 1979; Hamilton, 1979).

DeVivo *et al.* (1987) found that patients having sources of support other than personal or familial resources were more likely to return to work within 7 years of injury than patients without such support. However, DeVivo and Fine (1982) also found that having ever been a vocational rehabilitation client did not significantly increase the likelihood of being gainfully employed 3 years after injury. Nonetheless, these findings should be interpreted cautiously because of the small population sizes in both studies.

The purpose of the present study was to assess the effect of sources of support (Medicare, Medicaid, Workers' Compensation, private insurance, state vocational rehabilitation agency and self-pay) on numerous 'process-oriented' and rehabilitation outcome measures, including: time from injury to spinal cord injury care system admission; length of initial hospitalisation; initial hospital charges; place of residence at discharge and 2 years post-injury; nursing home length of stay; number of days rehospitalised and use of hired attendant care services during the second post-injury year; and employment status 2 years post-injury.

Methods

Study population

The study population consisted of 866 persons with spinal cord injury who were injured between 1973 and 1985 and admitted to the University of Alabama at Birmingham Spinal Cord Injury Care System (UAB-SCICS) within 1 year of injury.

Data collection

Data on sources of support for the patient's initial hospital expenses and discharge outcome measures cited previously were collected prospectively by

patient interview with confirmation from appropriate providers of care. In addition, descriptive data including age at injury, sex, race, neurological level of lesion, neurological extent of lesion measured by Frankel grade (Frankel *et al.*, 1969), education level and use of a mechanical ventilator were also collected prospectively.

Data on sources of support and outcome measures for the second post-injury year were collected prospectively for a subset of 457 patients. The remaining patients either died post-discharge, had not yet been injured for 2 years or were lost to follow-up.

Statistical analysis

Separate multiple linear regression analyses (Chatterjee *et al.*, 1977) were conducted with the dependent variables being: number of days from injury to admission to the UAB-SCICS; length of initial hospitalisation; initial hospital charges adjusted to 1986 dollars using the Medical Care Component of the Consumer Price Index; number of days rehospitalised during the second post-injury year and number of days spent in a nursing home during the second post-injury year. Only patients who were discharged alive were included in the analyses of initial length of hospitalisation and hospital charges. To control for possible confounding effects, age at injury, sex, race, neurological level of lesion, Frankel grade and use of a mechanical ventilator were included in all regression models as independent covariates. The magnitude and direction of the effect of each source of support was determined by examining the appropriate regression model coefficients. Since most patients had more than one source of support, appropriate multiplicative interaction terms were included in the regression models. These terms were subsequently deleted when no statistically significant interactions were identified.

In each case, the plot of residual versus predicted values was examined to assess the degree to which the underlying assumptions of multiple linear regression may have been violated (i.e. to detect the presence of outliers and heteroscedasticity of residuals). First-order correlation coefficients for all pairs of variables were examined to detect the possible presence of collinear relationships among the explanatory variables (Chatterjee *et al.*, 1977).

Because the outcome variables were not normally distributed, both the raw data and the square root transformations were used in the analyses. The square root was selected because it was the transformation that provided the most nearly normal distributions. However, the results using the raw data and the transformed data did not differ meaningfully. Therefore, because the analyses using the raw data are easier to interpret, only those results are presented.

For outcomes that were categorical in nature, separate multiple linear logistic regression analyses (Kleinbaum *et al.*, 1982) were conducted with the dependent variables being: discharge to a nursing home; nursing home residence 2 years post-injury; use of hired attendant care services during the second post-injury year and employment status 2 years post-injury. Once again, the appropriate descriptive data were included in the regression models as independent covariates to control their possible confounding effects. Appropriate interactive effects were included and subsequently deleted when found to be insignificant.

Table I Effects of sources of support for initial hospital expenses on days to system admission, length of initial hospitalisation and hospital charges: results of multiple linear regression analyses

Source of support	Days to system admission*		Length of initial hospitalisation		1986 Adjusted hospital charges**	
	Days	p	Days	p	$	p
Private insurance	−0·43	·7845	9·17	·0011	1011	·6177
Vocational rehabilitation agency	1·37	·3970	16·10	·0001	−672	·7442
Medicaid	4·63	·0875	6·16	·1988	2883	·4057
Medicare	−2·76	·4100	−5·88	·3254	−3865	·3742
Self-pay	−6·96	·0006	−16·87	·0001	2513	·3452
Workers' Compensation	−3·31	·3345	11.41	·0620	8505	·0525
Other	5·53	·0984	2·50	·6670	−3847	·3611

* adjusted for age, sex, race, neurologic level of lesion, Frankel grade and use of mechanical ventilator.

** adjusted for age, sex, race, neurological level of lesion, Frankel grade, use of a mechanical ventilator and days to system admission.

Each source of support's adjusted odds ratio and its approximate 95% confidence limits were determined from the appropriate logistic regression model coefficients (Miettinen, 1976). The odds ratio is an estimate of the likelihood of a given outcome among patients who have the source of support relative to those who do not have the same source of support. An odds ratio of 1·0 implies no increased likelihood, whereas an odds ratio of 2·0 implies that patients with the source of support are twice as likely to experience the particular outcome as are patients without that source of support. A 95% confidence interval around an odds ratio that does not include 1·0 implies a statistically significant difference in the likelihood of an outcome associated with that source of support at a two-tailed probability (alpha) of 0·05.

Results

Initial hospitalisation

The proportion of patients with each source of support for initial hospitalisation expenses was as follows: self-pay (patient was either indigent or responsible for at least a portion of incurred charges, such as a deductible or copayment), 77%; private insurance, 52%; vocational rehabilitation agency, 44%; Medicaid, 9%; Workers' Compensation, 8%; Medicare, 7%; other sources, 5%. The percentages do not sum to 100 because most patients had more than one source of support. For example, most patients with private insurance were also responsible for a deductible or copayment (self-pay). Only 55 of the self-payers (8%) were indigent.

The effects of sources of support for initial hospitalisation expenses on days to system admission, length of initial hospitalisation and adjusted hospital charges appear in Table I. The average number of days from injury to system admission for the entire study population was 19·3. Overall, source of support explained 3.5% while the complete model (including age, sex, race, neurologic level of lesion, Frankel grade, use of a mechanical ventilator prior to system admission and source of support) explained 12·4% of the variance in number of

days from injury to system admission. Based on the multiple linear regression analysis, self-payers (including indigents) were admitted an average 6·96 days sooner after injury than patients who were not responsible for any portion of their hospital expenses ($p = 0·0006$). Admission to the system for Medicaid beneficiaries was delayed an average 4·63 days compared to non-Medicaid patients ($p = 0·0875$). Patients with sources of support other than those listed in Table I were admitted to the system an average 5·53 days later than patients with no other sources of support ($p = 0·0984$).

The average initial length of stay for the entire study population was 90·4 days (standard deviation = 44·7 days). Source of support explained 6·9% and the complete model explained 38·0% of the variance in length of stay. Based on multiple linear regression analysis, several sources of support were associated with increased lengths of stay. Vocational rehabilitation clients had an average length of stay 16·1 days greater than non-clients ($p = 0·0001$). Patients with Workers' Compensation had an average length of stay 11·41 days greater than patients without Workers' Compensation ($p = 0·062$), while private insurance coverage increased length of stay by an average 9·17 days ($p = 0·0011$). However, patients responsible for at least a portion of their hospital expenses had an average length of stay 16·87 days less than patients not responsible for any portion of their hospital expenses ($p = 0·0001$).

The average adjusted hospital charges for the entire study population were $50 444 (standard deviation = $34 334). These charges include room and board, X-ray, laboratory, pharmacy, rehabilitation medicine (occupational therapy, physical therapy, respiratory therapy, neurological programme), central supply, intensive care unit, operating room, recovery room, anesthaesia, nuclear medicine and other miscellaneous charges associated with acute care and rehabilitation.

Although the complete model explained 47·1% of the variance in adjusted hospital charges, only 0·5% of the variance was explained by source of support. Moreover, the only source of support with a statistically significant effect on adjusted hospital charges was Workers' Compensation. Patients with Workers' Compensation had average hospital charges $8 505 greater than patients without Workers' Compensation coverage ($p = 0·0525$). Interestingly, state vocational rehabilitation agency clients had lower average hospital charges than nonclients despite having significantly longer lengths of stay. This is because the University of Alabama at Birmingham is also considered a state agency, and as such charges a discounted rate for state vocational rehabilitation agency clients.

The effects of sources of support for initial hospital expenses on discharge to a nursing home appear in Table II. Thirty one patients (3·6%) were discharged to a nursing home. Based on the multiple linear logistic regression analysis, two sources of support (Medicaid and Medicare) increased the likelihood of discharge to a nursing home, although the increases were not statistically significant ($p > 0·05$). Medicare patients were 2·5 times more likely to be discharged to a nursing home than non-Medicare patients (even after controlling for age) and Medicaid patients were 50% more likely to be discharged to a nursing home than non-Medicaid patients. Conversely, patients with private insurance coverage and vocational rehabilitation clients were both only 30% as likely to be discharged to nursing homes as patients without these sources of support

Table II Effects of sources of support on discharge to a nursing home and nursing home length of stay during the second post-injury year

Source of support	Discharge to nursing home Odds ratio*	95% Confidence limits	Nursing home length of stay Days*	p
Private insurance	0·3	0·1 – 0·8	−2·76	·6575
Vocational rehabilitation agency	0·3	0·1 – 0·9	−18·45	·0012
Medicaid	1·5	0·5 – 4·5	20·25	·0021
Medicare	2·5	0·7 – 9·2	36·41	·0023
Self-pay	0·5	0·2 – 1·7	3·81	·6398
Workers' Compensation	0·2	<0·1 – 1·8	−12·84	·2960
Other	0·3	<0·1 – 3.0	−16.70	·1122

*adjusted for age, sex, race, neurological level of lesion, Frankel grade and use of a mechanical ventilator.

($p < 0·05$). This is consistent with the facts that the state vocational rehabilitation agency only sponsors persons who are judged to have vocational rehabilitation potential and therefore are unlikely to be discharged to nursing homes, and most private insurance policies held by these patients do not cover nursing home charges. No other sources of support had a statistically significant effect on discharge to a nursing home ($p > 0·05$).

Two years post-injury

The proportion of patients with each source of support for second post-injury year expenses was as follows: self-pay, 85%; vocational rehabilitation agency, 55%; private insurance, 40%; Medicaid, 35%; Workers' Compensation, 8%; Medicare, 7%; other sources, 7%. Thus, there was a substantial increase in the proportion of patients with Medicaid coverage between discharge from rehabilitation and 2 years post-injury. The proportions of self-payers and vocational rehabilitation clients also increased slightly while the proportion of patients with private insurance coverage decreased somewhat. Once again, the percentages do not sum to 100 because many patients had more than one source of support.

The effects of sources of support for second post-injury year expenses on nursing home length of stay during the second post-injury year also appear in Table II. The average nursing home length of stay for all patients was 11·9 days, while the average length of stay for the 22 patients who actually spent time in a nursing home was 247·5 days. Overall, source of support explained 9·2% and the complete model explained 17·5% of the variance in nursing home length of stay.

Because the state vocational rehabilitation agency only sponsors persons who have vocational rehabilitation potential it is not surprising that patients it supported averaged 18·45 fewer days in nursing homes during the second post-injury year than patients it did not sponsor ($p = ·0012$). Conversely, Medicaid patients averaged 20·25 more days in nursing homes than non-Medicaid patients ($p = ·0021$) and Medicare patients averaged 36·41 more days in nursing homes than non-Medicare patients, even after controlling for age ($p = ·0023$). No

Table III Likelihood of rehospitalisation and number of days rehospitalised during the second post-injury year for each source of support

Source of support	Rehospitalisation Odds ratio*	95% Confidence limits	Days rehospitalised Days*	p
Private insurance	1·9	1·1 – 3·2	4·20	·2203
Vocational rehabilitation agency	0·9	0·6 – 1·5	−0·44	·8874
Medicaid	2·5	1·5 – 4·2	9·34	·0095
Medicare	1·5	0·5 – 4·2	−1·46	·8215
Self-pay	0·7	0·4 – 1·4	−3·92	·3776
Workers' Compensation	2·5	0·9 – 6·5	3·47	·6043
Other	1·6	0·7 – 3.5	−2.23	·6971

*adjusted for age, sex, race, neurological level of lesion, Frankel grade and use of a mechanical ventilator.

other sources of support had a statistically significant effect on nursing home length of stay during the second post-injury year.

The likelihood of rehospitalisation and number of days rehospitalised during the second post-injury year appear in Table III. One hundred and ninety seven patients (43·5%) were rehospitalised during the second post-injury year. The average length of rehospitalisation for all patients was 13·2 days, while the average length of rehospitalisation for patients who were actually rehospitalised was 30·4 days. Medicaid patients were 2·5 times more likely to be rehospitalised and averaged 9·34 more days in the hospital than their non-Medicaid counterparts ($p = ·0095$).

Private insurance coverage also had a statistically significant effect on the likelihood of rehospitalisation. Patients with private insurance were 90% more likely to be rehospitalised than patients without private insurance. Since most rehospitalisations are for acute medical complications occurring secondary to the spinal cord injury, these would normally be covered by private insurance. However, the average increase in number of days rehospitalised (4·2 days) for patients with private insurance was not statistically significant.

Patients with Workers' Compensation were 2·5 times more likely to be rehospitalised than patients without Workers' Compensation. However, this finding was not quite statistically significant because of the small number of patients with Workers' Compensation included in this study. No other source of support had a statistically significant effect on number of days rehospitalised or likelihood of rehospitalisation. Overall, source of support explained 1·7% and the complete model explained 8·8% of the variance in number of days rehospitalised during the second post-injury year.

Fifty one patients (11%) utilised hired attendant care services during the second post-injury year. Although source of support did not have a statistically significant effect on the utilisation of hired attendant care services, some interesting trends were observed. Not surprisingly, self-payers were only 40% as likely to use hired attendant care services as patients who were neither indigent nor responsible for any portion of incurred charges (95% confidence interval = 0·2 – 1·1). In fact, the only source of support that slightly increased the likelihood of using hired attendant care services was private insurance (odds ratio = 1·1, 95% confidence interval = 0·5 – 2·6).

Forty seven patients (10%) were employed in the competitive labour market two years post-injury. Controlling for age, sex, race, neurological level of lesion, Frankel grade and education level, Medicaid patients were significantly less likely to be employed than non-Medicaid patients (odds ratio = 0·2, 95% confidence interval = 0·1 − 0·8), while findings for patients with Workers' Compensation were of borderline statistical significance (odds ratio = 0·2, 95% confidence interval = 0·1 − 1·0). No other sources of support had a statistically significant impact on employment status 2 years post-injury.

Discussion

The results of this study cannot necessarily be generalised to other geographic locations or to other care systems. For example, the majority of patients who have private insurance and who are treated at the UAB-SCICS are covered by Blue Cross and Blue Shield of Alabama. The coverage provided by Blue Cross and Blue Shield is somewhat different from that provided by other insurance companies. Also, vocational rehabilitation programmes are not uniform throughout the USA. In fact, the vocational rehabilitation services Homebound Program is unique to Alabama, providing supplemental support for up to 30 days of inpatient rehabilitation, professional medical services, equipment, medications, supplies, home modifications and up to 25 hours per week of attendant care in the home. Finally, the eligibility criteria and benefits provided by Medicaid programmes also vary from state to state.

As mentioned previously, this study includes patients injured between 1973 and 1985. Several important changes in the USA health care system occurred during this time period that might have influenced the results of this study. Unfortunately, it was not possible to allow for the effects of these extraneous factors.

One such factor was the introduction of Diagnosis Related Groups (DRGs) for reimbursement of acute care hospital expenses incurred by Medicare beneficiaries. However, the impact of DRGs on the results of this study should be minimal because implementation of DRGs did not occur until October 1983, only 7% of study patients were Medicare beneficiaries, and rehabilitation continues to be exempt from DRG reimbursement.

Inspection of the correlation matrices for all variables did not reveal any substantial collinearity in the data set other than the anticipated relationship between age and Medicare sponsorship (r = ·54). This might cause a slight bias in the regression coefficients for Medicare appearing in Tables I to III. All residual plots appeared to be homoscedastic. However, it was necessary to delete one outlier from the analysis of number of days from injury to system admission.

Although the odds ratios and linear regression coefficients shown in Tables I to III were adjusted for the possible confounding effects of all other variables contained in the models, variables not included in this study might still confound the results. For example, if Medicare beneficiaries are more likely to have an array of pre-existing major medical conditions such as chronic heart disease, diabetes, etc., and if the presence of pre-existing major medical conditions also has an effect on the outcomes being measured in this study (such as

length of stay), then because these pre-existing conditions were not included in the regression models, the estimates of Medicare's impact on that outcome might be confounded.

Unfortunately, it was not possible to determine the proportion of expenses covered by each sponsor for those patients who had multiple sponsors. It is primarily for this reason that the data were analysed using multiple linear and logistic regression techniques. In this way the coefficients depicted for each source of support can be interpreted as the effect of that sponsor on the particular outcome being assessed given that other sources of support (as well as patient characteristics such as age, sex, race, etc.) are comparable.

One hundred and sixty four patients (19%) had a single source of support while 381 patients (44%) had 2 sources of support. However, 299 of these 381 patients (78%) had self-pay as their second sponsor only as a result of a deductible or copayment requirement. Therefore, most patients (63%) had a single sponsor with or without a deductible or copayment. Three hundred patients (35%) had 3 sources of support, and 20 patients (2%) had 4 sources of support, 1 of which was almost always a deductible or copayment. A single patient had 5 sources of support.

Controlling for age, sex, race, neurological level of lesion, Frankel grade and use of a mechanical ventilator, individual sources of support were shown to exert statistically significant effects on numerous measures of outcome for patients treated at this spinal cord injury care system. No single source of support had a statistically significant effect on all measures of outcome. Instead, each individual source of support affected a subset of the outcomes in a manner that was consistent with the differences in the nature of coverage provided by each sponsor of care. However, even though many statistically significant relationships were found, in general the proportion of variance explained by individual sources of support was not large. The overall impact of source of support was greatest for length of nursing home stay during the second post-injury year (9·2% of variance explained) and for length of initial hospitalisation (6.9% of variance explained).

Although several statistically significant associations between sponsors of care and outcomes were observed, it was not possible to assess the causal nature of these associations. While we believe that sponsorship plays a small causal role in determining outcomes, it is likely that in certain situations outcomes may actually cause changes in sponsorship. For example, a patient who is admitted to a nursing home may apply for Medicaid coverage because his insurance does not cover nursing home expenses. Therefore, these data have been interpreted cautiously.

Conclusion

In general, this study demonstrates that sources of support should be considered when assessing rehabilitation outcomes of persons with spinal cord injury. However, the specific sources of support that should be considered will depend on which outcomes are being measured and the nature of the coverage provided by each sponsor of care.

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