Original Article

Services provided following compensable work-related tetraplegia

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Design: Descriptive study.

Objective: To describe and compare the medical services provided following work-related tetraplegic spinal cord injury (SCI).

Setting: Workers' compensation claims database.

Methods: The administrative database of a workers' compensation provider was searched for work-related tetraplegia claims with dates of injury between 1 January 1989 and 31 December 1999. In total, 62 cases were identified and grouped by impairment category. Medical payment data were extracted and assigned to service categories.

Results: Although the level of services was directly related to the severity of impairment, patterns were similar across categories; for example, the largest proportions of payments were associated with durable medical equipment (DME) and attendant care in each impairment category. DME, readmissions and attendant care services varied considerably from year to year and within impairment category. Payments for physician care and medications/supplies showed the least variation within impairment categories. Workers' compensation payments were similar to National Spinal Cord Injury Database (NSCID) payments for the first year following injury; however, in subsequent years, workers' compensation figures were much higher.

Conclusions: Differences in annual medical payment and services by impairment category appear to be primarily due to variations in DME, attendant care and readmission. Payment differences in relation to National SCI figures may be related to better capture of payments by the workers' compensation administrative database. In addition, results suggest broader coverage by workers' compensation for medical services and items related to independent living. *Spinal Cord* (2004) 42, 248–260. doi:10.1038/sj.sc.3101598

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Introduction

Although the incidence of spinal cord injury (SCI) in the United States (US) is relatively low, its consequences can be staggering. As a result of this, SCI has been the focus of much enquiry. In the US, the surveillance of SCI dates back many years. Early projects included the establishment of the National SCI database (NSCID) in 1973. This database contains information on all patients receiving care from the Model SCI Care System Centers and captures approximately 13% of all new cases of SCI in the US.¹

In the early days of the NSCID, detailed service records were kept; however, due to the difficult and time-consuming nature of this task, collection of much of the information was discontinued in 1983.¹ Since then, the only information captured by the NSCID relevant to services provided following SCI is: acute hospital care and rehabilitation length of stay and associated charges while in the Model SCI care system, length of readmission, time spent in nursing homes, and sponsors of care.¹ While researchers in the 1990s conducted studies investigating the economic cost of SCI and published several papers on this topic,^{1–4} there have been no recent updates.

Of the studies that have been conducted, most are compromised by being limited to one jurisdiction and a reliance on the self-report of services received. In addition, the completeness of data collection and the representativeness of the samples could often be questioned. When workers' compensation insurance is

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the first payor, all medical and rehabilitation charges are forwarded to the insurer. Thus, investigation of workers' compensation databases has the advantage of allowing complete capture of injury-related medical expenditures. In addition, due to a differing population demographic⁵ and possible differences in benefit coverage, those who experience a compensable work-related SCI are likely to receive services that vary from those who do not experience comparable injury. Thus, the case of those with a work-related injury is worthy of special attention.

This paper is the second in a series focusing on tetraplegic SCI within the workers' compensation context. In the first paper,⁵ the demography of work-related SCI was detailed and overall annual medical payments were described. In this paper, the focus is on the services provided following injury. For this paper, our goals were to describe fully the range of services provided, variations within and by level of severity and, where possible, make comparisons with other studies that have described services received following tetraplegic SCI.

Methods

Procedure

The sample was identified through searching a workers' compensation provider's administrative database for work-related tetraplegia with dates of injury occurring between 1 January 1989 and 31 December 1999. The provider covered 8–10% of the US private workers' compensation market during this time. Level of injury, as determined at the time of first year follow-up visit, was classified according to the revised 2000 international standards for Neurological Classification of Spinal Cord Injury from the American Spinal Injury Association (ASIA). Cases were grouped by injury category: High Tetraplegia (C2–4 ASIA A–C), Low Tetraplegia (C5–8 ASIA A–C) and ASIA D (any injury to the cervical spine attracting an ASIA D classification). Additional details regarding case identification and approach to data collection have been reported previously.⁵

The workers' compensation provider's centralized data source was continuous and comprehensive for all actual insured expenditures. Information drawn from the data source included payment amount, service type, service date, provider name and type, and Physician's Current Procedural Terminology (CPT) codes. Line item payments were assigned to expenditure years and subcategories by year using available billing information. CPT codes were used when available to identify services. If CPT codes were lacking, billing codes of the insurer were used in combination with service provider description and designation codes. On occasion, it was necessary to review the electronic claim file medical and disability information (including case and claim manager notes) to identify the type of service provided.

All expenditures were adjusted using the Year 2000 medical care component of the Consumer Price Index.⁶ Payment data were stratified by the year following

injury when the service was provided, and is presented for up to 5 years after the initial date of injury (ie, Years 1, 2, 3, 4, 5 following injury, with each year equating to 365 days). Although expenditures are described over the 5 years following injury, data specific to medical services were only available from 1993 forward. Consequently, cases with an initial injury date from 1989 to 1992 included only payment data from 1993 forward. This resulted in the full 5 years of data not being available for all cases. As the first year of injury is atypical of later years,⁵ data relating to this year are presented separately. In total, valid first year information was available for 35 cases.

Based on earlier findings that indicated little difference between postinjury Years 2–5,⁵ and to facilitate comparisons with earlier studies, payments for Years 2–5 were averaged and the term 'subsequent years' has been adopted to refer to average annual post first-year payment. If information was not available for all four years, the mean was calculated using the number of years for which data were available.

Exploratory analyses were conducted to determine overall and group means, and identify highly divergent (outlying) scores. Between-group differences were tested using ANOVA. When variances were found to be unequal (assessed using Levene's statistic), Welch's statistic was interpreted. *Post hoc* testing was conducted using Tukey's honestly significant difference or Tamhane's was used to T2 depending on equability of variance. All analyses were undertaken using SPSS. Where needed, χ^2 analyses were also employed.

Expenditures for all workers' compensation injury-related medical services included payments for service categories as described below:

- *Initial acute hospitalization and acute rehabilitation:* total payments for acute hospitalization were compiled for the period from date of injury until date of discharge. Total payments for acute rehabilitation were compiled from date of admission to date of discharge from the rehabilitation unit. These categories included expenditures for all services except durable medical equipment (DME), which is reported separately.

Services provided following discharge from acute rehabilitation were divided into the following subcategories.

- *Nursing home* – included facility charges with all other individually billed services assigned to relevant subcategories.
- *Attendant care* – in-home health care from a nurse, personal care attendant or paid family member.
- *Physician care* – outpatient physician visits and diagnostic testing.
- *Outpatient therapy* – outpatient physical, occupational, psychological and speech therapy.
- *DME* – included items such as wheelchairs, beds, orthotics, exercise equipment, vehicle and home purchase or modifications.

- *Medications and medical supplies* – included all medications and supplies (eg catheters, gauze, gloves) used outside of a hospital/in-patient rehabilitation setting.
- *Readmission* – hospital or rehabilitation readmission for SCI-related conditions. Routine urology, orthopedics, physiatry and neurology evaluations were not included in this category. The payments included all payments for services provided except DME and were compiled from date of readmission to date of discharge.
- *Case management* – case manager or management consultant charges.
- *Transportation* – car service, ambulance transport and travel reimbursement that occurred at any time other than the initial acute/rehabilitation admissions or readmissions.
- *Vocational rehabilitation* – included funding for job retraining, computer skills and vocational-learning equipment.
- *Unassignable* – items that could not be accurately assigned to any other category due to insufficient information. Overall, less than 0.05% of payments were unassignable.

Participants

Data presented in this paper relate to 62 individuals residing in 28 states. The average age at injury was 38.7 years and the vast majority of cases were male (92%). Application of impairment classification resulted in eight cases being defined as having High Tetraplegia, 39 as having Low Tetraplegia and 15 having an ASIA D impairment. The majority of injuries were the result of falls (36%), followed by vehicular accidents (34%), struck by/against (21%), violence and sports (3.2%

each). For further demographic information, please consult our earlier publication.⁵

Results

Acute hospitalization and rehabilitation accounted for the greatest proportions of first-year payments; 26% and 34%, respectively (see Table 1). For High Tetraplegia cases, a greater proportion of the total was for acute hospitalization than for acute rehabilitation, but this was reversed for those with Low Tetraplegia and ASIA D impairments. The various other services provided, along with associated payments, for the first 5 years of injury are displayed in Figure 1. A breakdown by impairment category is given in Figures 2–4. Only relatively small within-category differences were observed over Years 2–5. Details of average subsequent year payments by type of service and impairment category are displayed in Table 2.

Overall, first-year medical payments were close to four times those of subsequent years. This trend remained when findings were broken down by impairment category: for those with High Tetraplegia, the average annual payments for subsequent years was 22% of first year payments; for those with Low Tetraplegia, subsequent years accounted for 32% of first year payments; and for those with an ASIA D categorization, payments in subsequent years were only 19% of first-year payments.

In subsequent years, attendant care accounted for the greatest proportion (42%) of monies paid. Interestingly, for those with Low Tetraplegia, readmission payments accounted for a larger proportion of subsequent year payments than was the case for the other impairment groups. DME and readmissions also accounted for a

Table 1 Mean^a expenditure (Year 2000 dollars) for each service category for the first year following injury

Service category	Injury category			
	High (n = 5) M (SD)	Low (n = 21) M (SD)	ASIA D (n = 9) M (SD)	All (n = 35) M (SD)
Acute hospitalization ^b	\$209,232 (\$61,131)	\$103,569 (\$67,884)	\$29,943 (\$15,824)	\$99,731 (\$79,189)
Acute rehabilitation ^b	\$187,318 (\$44,312)	\$142,607 (\$81,981)	\$78,222 (\$37,792)	\$132,438 (\$76,193)
Nursing home	\$0 (\$0)	\$21,621 (\$49,899)	\$0 (\$0)	\$12,972 (\$39,751)
Attendant care ^b	\$35,707 (\$18,943)	\$40,106 (\$40,688)	\$10,166 (\$13,856)	\$31,779 (\$35,073)
Physician care ^b	\$2149 (\$446)	\$4034 (\$4155)	\$2799 (\$1613)	\$3445 (\$3436)
Outpatient therapy	\$9158 (\$5370)	\$14,337 (\$27,338)	\$17,686 (\$14,627)	\$14,459 (\$22,366)
Durable medical equipment ^b	\$81,241 (\$47,652)	\$70,463 (\$61,813)	\$12,555 (\$13,782)	\$57,112 (\$57,277)
Medications & medical supplies ^b	\$6804 (\$2220)	\$7922 (\$4907)	\$2157 (\$2152)	\$6280 (\$4695)
Readmission(s)	\$36,016 (\$27,190)	\$7061 (\$11,701)	\$13,289 (\$17,774)	\$12,799 (\$18,480)
Case management	\$9226 (\$6675)	\$11,960 (\$10,306)	\$5802 (\$8480)	\$9986 (\$9579)
Transportation	\$7859 (\$11,992)	\$6155 (\$5603)	\$4214 (\$4023)	\$5899 (\$6368)
Vocational rehabilitation	\$1422 (\$2585)	\$595 (\$1175)	\$1042 (\$1802)	\$828 (\$1576)
Unassignable	\$688 (\$1088)	\$604 (\$1654)	\$164 (\$361)	\$503 (\$1360)
Total ^b	\$586,821 (\$65,473)	\$430,961 (\$140,205)	\$178,041 (\$61,629)	\$388,190 (\$177,717)

^aGroup averages with zero dollars being entered if individuals were not in receipt of particular services

^bSignificant between-group differences at $P < 0.05$

^cFigure differs from that presented in Table 4 of our first paper⁵ due to the inclusion of outlying value

Figure 1 Expenditure for services following discharge from acute rehabilitation for persons with compensable work-related Tetraplegia

Figure 2 Expenditure for services following discharge from acute rehabilitation for persons with compensable work-related High Tetraplegia (C2-4 ASIA A-C)

substantial proportion of monies paid; 16 and 15%, respectively. A more detailed presentation of each of the specific service categories follows.

Acute hospitalization and rehabilitation

Overall, the average acute hospitalization length of stay (LOS) was 22.63 (SD 17.38) days with a decrease in the LOS seen with a decrease in the severity of injury: High Tetraplegia = 35.40 (SD 13.09), Low Tetraplegia = 24.71 (SD 18.99) and ASIA D = 10.67 (SD 4.72). Analysis of

variance revealed significant differences between impairment groups in LOS: $F(2, 32) = 4.35, P < 0.05$. *Post hoc* analysis indicated that the length of acute hospitalization was significantly shorter for those with an ASIA D impairment in comparison with High Tetraplegia ($P < 0.05$).

The mean LOS for acute rehabilitation was longest for those with Low Tetraplegia and the shortest for ASIA D cases: High Tetraplegia = 97.20 (SD 21.51), Low Tetraplegia = 106.52 (SD 45.54) and ASIA D = 57.44 (SD 25.05). Statistically significant differences

Figure 3 Expenditure for services following discharge from acute rehabilitation for persons with compensable work-related Low Tetraplegia (C5-8 ASIA A-C)

Figure 4 Expenditure for services following discharge from acute rehabilitation for persons with compensable work-related ASIA D grade Tetraplegia

were observed when comparisons were made of LOS for acute rehabilitation: $F(2, 32) = 5.06$, $P < 0.05$. *Post hoc* testing indicated that those with an ASIA D classification had a significantly shorter LOS in comparison with Low Tetraplegia cases. The slightly higher mean for the Low Tetraplegia group can be attributed to one individual who was admitted for rehabilitation for 248 days. When this case was removed, the mean LOS for the Low Tetraplegia group decreased to 98.45 (SD 32.81) days. While the mean for the High and Low Tetraplegia groups was very similar, more variability was observed in the Low group.

The median LOS for all groups for acute hospitalization and rehabilitation was very similar to the mean LOS except in the case of people with Low Tetraplegia, in which case mean LOS for acute hospitalization was longer (median = 18 days versus mean = 24 days).

When between impairment group comparisons were made, significant differences were observed in expenditures for acute hospitalization and acute rehabilitation: Welch (2) = 27.97, $P < 0.001$ and 11.45, $P < 0.01$, respectively. In the case of acute hospitalization, all groups were significantly different ($P < 0.05$). However, for acute hospitalization, only the difference between the

Table 2 Mean^a expenditure (Year 2000 adjusted) for each service category for Years 2–5 following injury

Service category	Injury category			
	High (n = 7) M (SD)	Low (n = 35) M (SD)	ASIA D (n = 15) M (SD)	All (n = 57) M (SD)
Nursing home	\$2464 (\$6520)	\$12,182 (\$42,209)	\$0 (\$0)	\$7783 (\$33,438)
Attendant care ^b	\$69,496 (\$48,067)	\$54,615 (\$54,771)	\$14,965 (\$23,985)	\$46,008 (\$50,853)
Physician care	\$2991 (\$1501)	\$5038 (\$5877)	\$2200 (\$2687)	\$4040 (\$4968)
Outpatient therapy	\$4873 (\$7643)	\$6533 (\$22,166)	\$4686 (\$5086)	\$5843 (\$17,658)
Durable medical equipment	\$32,451 (\$26,673)	\$18,309 (\$31,056)	\$7020 (\$17,088)	\$17,075 (\$28,150)
Medications & medical supplies ^b	\$9928 (\$6628)	\$11,535 (\$7454)	\$2407 (\$2785)	\$8935 (\$7493)
Readmission(s) ^b	\$2809 (\$5715)	\$25,610 (\$45,367)	\$2246 (\$4247)	\$16,661 (\$37,246)
Case management	\$1562 (\$1769)	\$1568 (\$2506)	\$452 (\$848)	\$1273 (\$2139)
Transportation	\$3085 (\$5327)	\$2833 (\$8724)	\$342 (\$576)	\$2209 (\$7113)
Vocational rehabilitation	\$1405 (\$3647)	\$726 (\$2108)	\$235 (\$561)	\$680 (\$2079)
Unassignable	\$100 (\$194)	\$367 (\$963)	\$11 (\$21)	\$240 (\$771)
Total ^b	\$130,992 (\$43,614)	\$137,722 (\$88,454)	\$34,564 (\$37,278)	\$110,231 (\$85,924)

^aGroup averages with zero dollars being entered if individuals were not in receipt of particular services

^bSignificant between-group differences at $P < 0.05$

^cFigure differs from that presented in our first paper⁵ due to the inclusion of outlying values

High group and those with an ASIA D impairment were significant ($P < 0.05$).

The mean payment per day for acute care hospitalization for all cases was \$4945 (SD \$2753). Payments per day decreased with the severity of injury: High Tetraplegia = \$6176 (SD \$1884), Low Tetraplegia = \$5135 (SD \$2767) and ASIA D = \$3820 (SD \$2971). When comparisons were made of expenditures for acute hospitalization by impairment category (see Table 1), statistically significant differences were observed between all impairment groups: $F(2, 32) = 15.26$, $P < 0.001$, *post hoc* testing significant at $P < 0.01$. The mean payment per day for rehabilitation for all tetraplegia cases was \$1445 (SD \$513). As was true in the case of acute hospitalization, the mean daily payments for acute rehabilitation decreased with injury severity: High Tetraplegia = \$1978 (SD \$550), Low Tetraplegia = \$1363 (SD \$513) and ASIA D = \$1341 (SD \$321). While expenditure per day was not significantly different for the impairment groups, overall, significantly more was spent on acute rehabilitation for those with High Tetraplegia in comparison with those with an ASIA D impairment: $F(2, 32) = 4.55$, $P < 0.05$.

Nursing home care

Of the 35 cases with first-year payment information available, five (all Low Tetraplegia cases) were discharged from acute rehabilitation into a nursing home and another was discharged to an independent living facility. While reliable payment information was not available prior to 1993, a review of the case narratives of people without first-year payment information revealed that one additional person with Low Tetraplegia was discharged to a nursing home and another with High Tetraplegia was discharged to an assisted living facility. Thus, of the 60 cases where place of discharge could be

ascertained, eight (13%) were discharged to a nursing home or an independent living setting. Of those with Low Tetraplegia, 24% were discharged to a nursing home.

An analysis of age by place discharged indicated that the age of the injured person at injury was not related to whether or not the individual was discharged to a nursing home facility. Nor was there an effect that could be attributed to ASIA grade. Analysis of variance revealed no significant between-group differences in expenditure on nursing home care in either the first year following injury nor in subsequent years (see Tables 1 and 2).

Only one person discharged to a nursing home later took up residence in a community setting; however, this individual was readmitted for nursing home care in the third year following injury. No person discharged to a residential setting following acute rehabilitation received nursing home care in subsequent years.

For those receiving nursing home care (as opposed to group means, which are presented in Tables 1 and 2), the average first-year payment for this care was \$97,224 (SD \$59,911) and the average annual subsequent year payment was \$67,695 (SD \$76,944). The average overall annual subsequent years payments for those discharged to a nursing home or assisted living center was \$140,386 (SD \$102,424). In comparison, the average annual subsequent year payments for those discharged to the community was \$103,718 (SD \$76,016). While this mean difference was substantial, it was not statistically significant: $F(1, 53) = 1.16$. When analysis was restricted to only the Low Tetraplegia group, the mean subsequent years expenditure for those discharged to a nursing home or assisted living center was \$126,632 (SD \$75,940) and \$158,755 (SD \$102,871) for those discharged to a community setting. Again while the mean difference was substantial, it was not statistically significant: $F(1, 33) = 0.70$.

Inspection of Figure 1 suggests that payment for nursing home care decreased as time following injury increased. However, Year 1 and 2 averages are inflated by one person with payments of greater than \$200,000 annually, and the means for Years 4 and 5 are drawn down by two cases receiving payments of less than \$20,000. With these cases excluded the means were: Year 1, \$69,407 (SD \$24,850); Year 2, \$72,766 (SD \$375); Year 3, \$42,819 (SD \$17,495); Year 4, \$46,744 (SD \$0); Year 5, \$45,314 (SD \$6040).

Attendant care

In total, 85% of cases received support for attendant care services with this care being provided by professional attendant care providers and/or family members. The percentage of people receiving attendant care services was 88% for the High group, 92% for the Low group and 67% for those with an ASIA D classification. Significantly fewer of those in the ASIA D group received attendant care services when comparisons were made with those with other ASIA classifications: $\chi^2(1) = 5.46$, $P < 0.05$.

Five people who received support for attendant care services ceased using these services in later years. Of these, four had ASIA D impairments and presumably became independent in their self-care, the other (C6 ASIA B) changed to receiving his care solely from his nursing home facility. Overall, there was no significant difference between groups on expenditures on attendant care in the first year following injury. However, in subsequent years, the ASIA D group received significantly less funding for attendant care services ($P < 0.05$) in comparison to both the High and Low Tetraplegia groups.

For those who received attendant care, the mean first-year payment for attendant care was \$34,768 (SD \$35,245) and the mean for subsequent years was \$49,506 (SD \$50,765). For those with High Tetraplegia, the mean annual subsequent year payment for attendant care services was \$81,079 (\$40,566), for those with Low Tetraplegia it was \$59,735 (SD \$54,538) and for those in the ASIA D group it was \$28,060 (SD \$27,031).

Between-group analysis of first-year AC expenditure indicated that those in the ASIA D category received significantly less funding for attendant care than those with High Tetraplegia; Welch (2) = 6.22, $P < 0.05$. In subsequent years, the ASIA D group received significantly less attendant care funding than the Low Tetraplegia group: Welch (2) = 8.49, $P < 0.01$.

While Figure 1 suggests that the monies paid for attendant care services appear to increase in later years, this was largely due to five cases for which only Years 4 and 5 data were available. When these cases were excluded, the mean annual payments for those receiving attendant care services were: Year 1 = \$40,486, Year 2 = \$41,082, Year 3 = \$40,624, Year 4 = \$42,320. With the outlying cases excluded, the mean for subsequent years was \$41,128 (SD \$36,972).

Physician care

On average, expenditure for physician care in the first year following injury accounted for less than 1% of payments (see Table 1). In subsequent years, this percentage increased to 4%; however, the dollar amounts remained relatively stable. Although there appears to be a trend for higher expenditure for physician care for those in the Low Tetraplegia group, only in the first year was the difference significant: Welch (2) 3.66, $P = 0.05$. The higher means can be attributed to two Low Tetraplegia cases who received funding for services well beyond their group's interquartile mean: one receiving more than \$120,000 in their first year following injury and the other, with a mean of more than \$30,000 in subsequent years.

Outpatient therapy

The proportion of monies spent for outpatient therapy was small in both the first year following injury and in subsequent years (4 and 5%, respectively). Although no significant between-group differences were observed in expenditures for outpatient therapy in either the first year following injury or subsequent years, as inspection of Table 1 reveals, those in the ASIA D category received more outpatient therapy in the first year following injury. This trend was not, however, sustained in later years (see Table 2). Interestingly, an inverse relationship was observed between time since injury and expenditure for outpatient therapy (see Figure 1).

Durable medical equipment

On average, DME accounted for 15% of first-year payments and 16% of subsequent years. As depicted in Figures 1–4, payments were highest in the first year following injury and trailed off in later years. While this is true for all injury categories, those with High Tetraplegia still received substantial funding for DME in later years (see Figure 2). In all, 90% of cases received a payment for DME, with the minimum annual amount being \$25 and the maximum being \$247,415. There were eight cases where individuals were paid more than \$100,000 in 1 year for DME and three cases where annual payments exceeded \$200,000. A comparison of group means indicated that those with an ASIA D impairment received significantly less funding for DME in the first year following injury in comparison with those in the Low Tetraplegia group: $F(2, 32) = 4.51$, $P < 0.05$.

The mean annual expenditure for DME over the study period was \$51,266 (SD \$50,236) for cases with High Tetraplegia, \$30,393 (SD \$16,812) for cases with Low Tetraplegia and \$8537 (SD \$16,812) for cases in the ASIA D category. There was much greater variability in the payments received by those more severely injured, with the interquartile range being \$53,567, \$31,260 and \$9960 for High Tetraplegia, Low Tetraplegia and ASIA D, respectively. When between-impairment group comparisons were made, no significant differences were

observed. Inspection of the data revealed two outlying Low Tetraplegia cases who received payments well beyond their group's interquartile range. When these cases were removed, the mean annual expenditure for the Low Tetraplegia group dropped to \$21,999 (SD \$26,479) and significant differences were observed: $F(2, 56) = 5.80, P < 0.01$. *Post hoc* testing indicated that those in the High Tetraplegia group received more funding for DME than the other groups.

When the analysis of first-year expenditure for DME was rerun excluding the outlying Low Tetraplegia cases, the mean for the Low Tetraplegia group decreased to \$56,744 (SD \$46,440) and it was found that those in the ASIA D group received significantly less funding for DME than both the other groups: $F(2, 20) = 5.54, P < 0.05$. For subsequent years, the mean for the Low Tetraplegia group dropped to \$14,512 (SD \$21,770), with testing indicating that the ASIA D group received less funding in comparison to the High Tetraplegia group: $F(2, 53) = 3.41, P < 0.05$.

Medications and supplies

Payments for medications and supplies remained relatively stable over the study period and accounted for 2% of expenditure in the first year and 8% in subsequent years (see Tables 1 and 2). Analysis of variance indicated that the ASIA D group received less funding for medications and supplies than both the other groups in the first year of injury: Welch (2) = 12.45, $P < 0.01$. In subsequent years, payments received by the ASIA D group were significantly lower in comparison with those received by the Low Tetraplegia groups: Welch (2) = 4.39, $P < 0.05$.

Readmissions

Readmissions accounted for 3% of average first-year payments and 15% for subsequent years. In the first year, those in the High Tetraplegia group received more funding for readmission in comparison to the other groups; however, this difference was not significant. A significant between-group difference was observed in subsequent years (Welch (2) = 4.40, $P < 0.05$), with *post hoc* testing indicating a higher amount spent on the Low Tetraplegia cases. Although the average annual expenditure in subsequent years was higher for the Low Tetraplegia group (see Table 2), once again the mean was inflated by outlying cases. When these figures were excluded, the mean annual expenditure for readmission for those with Low Tetraplegia was \$15,672 (SD \$25,410). While this mean was higher than that observed for the other impairment groups, it was not significantly so.

Only 38% of claimants had no readmission during the data collection period. In the first year following injury, 51% of cases were readmitted. This percentage dropped in later years, with little difference observed in the rate of readmission in Years 2–5: Year 2, 21%; Year 3, 19%; Year 4, 12%; and Year 5, 19%. Overall, the annual rate

of readmission was 24%. Multiple readmissions were common, with 14% of cases being readmitted more than once a year; indeed, cases with six and seven readmissions in a single year were identified. The mean payment of each readmission episode was \$16,708 (SD \$15,887). There was no significant difference between groups with regard to the payments of each readmission episode: mean of \$14,575 (SD \$13,423) for High, \$17,227 (SD \$17,210) for Low and \$16,592 (SD \$14,130) for the ASIA D group, $F(2, 35) = 0.07$.

Transportation

In the first year following injury, transportation accounted for 1.5% of payments and no significant difference was observed between impairment categories: $F(2, 32) = 0.55$. In subsequent years, approximately 2% of the average payment total was for transportation. While the mean amount paid for transportation was much lower than those with an ASIA D injury, no statistically significant difference was observed when means were tested using analysis of variance: $F(2, 54) = 0.70$.

In total, 87% of the sample received funding for transportation services. Payments were highest in the first year of injury and steadily decreased as time progressed (see Figure 1). The average annual expenditure for transportation for those in receipt of such services was \$3194 (SD \$5265). Once again, values ranged widely with the minimum annual average being \$14 and the maximum, \$26,578.

Case management

Case management services accounted for 3% of first-year expenditure, with this figure dropping to 1% in subsequent years. Again, while there was a trend for those with an ASIA D classification to receive less funding for case management services, this difference was not statistically significant in either the first year following injury or in subsequent years: first year, $F(2, 32) = 1.34$ and subsequent years, $F(2, 54) = 1.53$.

In all, 59% of cases received funding for case management services. Such payments were highest in the first year following injury, then decreasing to almost nothing in later years (see Figure 1). For those in receipt of case management services, the mean first year payment was \$13,442 (SD \$8745), with mean annual payments dropping to \$2341 (SD \$2440) in subsequent years. The amount of funding received was also independent of impairment type: the mean annual first-year payment was \$11,532 (SD \$4893) for the High group, \$14,774 (SD \$9411) for the Low group and \$10,443 (SD \$9122) for the ASIA D group; for subsequent years the mean was \$1823 (SD \$1785) for the High group, \$3048 (SD \$2789) for the Low group and \$967 (SD \$1047) for the ASIA D group.

Vocational rehabilitation

Of all the expense categories, the least was spent on vocational rehabilitation; less than 1% in both the first year following injury and subsequent years. Overall, 36% of cases were funded for vocational rehabilitation services at some time during the data collection period. For those who received services, the average amount spent annually was \$1776 (SD \$2201). The minimum annual payment was \$22 and the maximum was \$8941.

Although, on average, those with High Tetraplegia received more funding for vocational rehabilitation services (the annual mean was \$2389 for the High Tetraplegia group, \$1898 for the Low groups and \$1123 for the ASIA D group), there was no significant relationship between the level of impairment and the amount paid for vocational rehabilitation services: $F(2, 19) = 0.41$. There was also no statistically significant relationship between the level of impairment and the receipt of any vocational rehabilitation services: $\chi^2(2) = 1.11$. Nor was there a statistically significant relationship between age and the receipt of vocational rehabilitation services: the mean age at injury of people receiving services was 36.68 versus 39.82 years for those not in receipt of services, $F(1, 59) = 0.73$.

Discussion

After initial hospitalization and rehabilitation, the service categories that accounted for the greatest proportion and dollar amounts were DME and attendant care. Although the services received varied depending on impairment category, within impairment category the mean annual payments remained relatively stable after the first year following injury. An exception was DME, which decreased steadily over time. Regardless of injury type, a very small proportion of expenditures were accounted for by case management, transportation and vocational rehabilitation services.

Figures for the High and Low Tetraplegia groups were often similar and generally much greater than for the ASIA D group. Greater variation was often observed within the Low Tetraplegia group. In particular, it was within this group that the majority of outlying values were found. This greater variation within the category may relate to more variation in severity within the group. While the trend for people with ASIA D impairments to have fewer services in later years has not been observed in prior studies,^{1,4,7} current findings suggest a gradual increase in independence and a resulting decreased need for ongoing care.

While the current study had the strength of complete data capture, it was limited by its small sample size. In several cases, even though the mean differences were large, they were not found to be significant. Unfortunately, this is a problem common to much SCI research; DeVivo *et al*¹ also noted that their small number of cases made estimates of charges somewhat unstable. Further investigation of the trends identified may be warranted if they have implications for resource allocation.

Although all figures were converted to year 2000 dollars so that meaningful comparisons with previous reports could be made, the duration of stay and payments for services are likely to be influenced by technological advancements and the health care systems of the day. Thus, differences observed may be related to contextual variables associated with the time of data collection as well as differences in coverage offered by differing insurance providers.

Acute hospitalization and rehabilitation

Prior studies that reported on LOS and payment for acute hospitalization and rehabilitation were either based on NSCID^{1,4,8–11} or state-specific populations.^{7,12} As several of the studies^{8–11} reported LOS and payments for all levels of SCI combined, it is difficult to make comparisons with the current findings. However, one study by DeVivo *et al*¹ presented LOS and payments for High and Low Tetraplegia and all Frankel D (much the same as ASIA D) cases from the NSCID sample with injury dates from 1989 to 1990. The LOS for both hospitalization and rehabilitation was generally longer in their study (hospitalization/rehabilitation: High Tetraplegia 46/110, Low Tetraplegia 31/116, and Frankel D 20/56 days) as compared to the current findings with first-year information on cases for 1993–1999 (hospitalization/rehabilitation: High Tetraplegia 35/97, Low Tetraplegia 25/107 and Frankel D 11/57 days).

These duration differences may be explained by a study by Fiedler *et al*,⁹ who found that significant decreases in LOS occurred over time from 1972 to 1997 for both acute hospitalization and rehabilitation. Eastwood *et al*¹⁰ also found a decrease in rehabilitation LOS from 1990 to 1997 and suggested that these decreases were due, in part, to the effects of Diagnostic Related Groups and managed care on physician reimbursement. While the small sample size in the current study prevents a similar trends analysis, the same influences are thought to be in effect for the population resulting in shorter stays. In a more recent publication, based on 1994–1995 NSCID admissions, the reported hospitalization LOS for Frankel A–C tetraplegia cases was consistent with the current ASIA A–C figures (27 days); however, fewer days for rehabilitation were observed (77 versus 105 days in the current study).⁴

Variation was also noted when payments per day for acute hospitalization and rehabilitation comparisons were made. The current payments per day for acute hospitalization for High and Low Tetraplegia cases were higher than reported by DeVivo *et al*¹: High Tetraplegia \$6176 versus \$4819 and Low Tetraplegia \$5135 versus \$3307, respectively. This may be attributable to a longer LOS, advances in medical technology and increased intensity of services. Fiedler *et al*⁹ also reported that per diem charges increased while the LOS decreased. While payments per day were higher for acute hospitalization, payments for acute rehabilitation were slightly lower in comparison with DeVivo *et al*'s findings: High \$1978 versus \$2218 and Low \$1363 versus \$1701, respectively.

When compared to Berkowitz *et al*'s⁴ more recent figures (1994–1995), the payment per day in the current study was more than a third lower for both stays (acute hospitalization: \$4945 versus \$6674 and rehabilitation \$1445 versus \$2061, respectively). Considering the fact that Fiedler *et al*⁹ reported the per diem charges increased while the LOS decreased, it may be expected that the current payments should be higher in comparison with Berkowitz *et al*'s findings, who reported a similar LOS for acute hospitalization and shorter LOS for acute rehabilitation admissions. One possible explanation is that the workers' compensation insurance carrier may have negotiated service contracts with the institutions.

Nursing home

In the current study, a higher percentage of cases (13%) were discharged from acute rehabilitation centers to a nursing home facility than was reported by DeVivo *et al*¹ whose figure was 3.1%; however, it should be noted that this included all levels of SCI. The mean total annual payments for those cases in nursing homes in the current study were also higher than reported in the DeVivo study (mean for the first year was \$97,224 versus \$67,695 and subsequent years \$67,695 versus \$52,085). Again, these differences may be related to the fact that DeVivo *et al*'s sample included all levels of SCI. In the current study, no person who was discharged home later took up residence in a nursing home within the study period. This finding is consistent with previous reports.^{1,10} Contrary to the findings of others,¹¹ no relationship was found between place of discharge and age or impairment type. This is likely to be due to the lack of power afforded by the current study's small sample size.

Attendant care

After acute hospitalization and rehabilitation, attendant care was usually either the first or the second largest expenditure for all years. Greater variation was observed in the attendant care services received by the Low Tetraplegia group. This may be explained by greater variation of severity within this group. While there appeared to be an inverse relationship between expenditures for attendant care and nursing home facilities, closer inspection of the data revealed it to be an artefact with the trend disappearing when outlying cases were removed.

In the current study, 85% of the tetraplegia cases received payment for both attendant care and household services. This figure is consistent with the figures of Berkowitz *et al*⁴ who reported that 80% of tetraplegics required assistance with Activities of Daily Living; however, only 61% received reimbursement, with the remaining services being provided by unpaid family members.

Studies have reported on the costs of attendant care services using actual costs when available, or in combination with estimated costs^{1,7}, or estimates based

on hours of services reported multiplied by the average hourly wage for attendant care providers.⁴ However, differences in impairment classification methodology (eg complete versus incomplete tetraplegia as used by Berkowitz *et al*⁴) make comparison with the current findings difficult.

The current first-year findings were similar to those reported by DeVivo *et al*¹ for High Tetraplegia cases (\$35,707 and \$34,740, respectively); however, they are more than two times DeVivo's Low Tetraplegia (\$40,106 and \$20,247, respectively) and ASIA D figures (\$10,166 and \$5736). The current results were also similar for High Tetraplegia cases in subsequent years (\$69,496 and \$66,059), but were again higher for Low Tetraplegia and ASIA D cases (Low: \$54,615 versus \$23,141; ASIA D \$14,965 versus \$5150).

Johnson *et al*⁷ reported almost double (\$75,994) the current payments for 'in-home care' (which included attendant care, paid and unpaid comparable costs, registered nursing and household assistance) for those with High Tetraplegia in the first year following injury. Lower figures were, however, reported for Low Tetraplegia (\$30,155) and ASIA D cases (\$5736).⁷ Johnson *et al* also reported higher attendant care costs for High and Low Tetraplegia cases in Year 2 (\$126,644 and \$73,681, respectively). In contrast, Year 2 in-home care cost for ASIA D cases was lower (\$5150) than that found in the current study.

The differences across these studies may be due to a number of factors. The current study had actual payment information, whereas the other studies required some cost estimations for unpaid services. While in the current study, a number of claimants received attendant care from paid family members, the extent to which unpaid care was provided is not known. It is possible that an inclusion of unpaid time would bring the current figures up to, or over, those reported by previous authors. The finding that more attendant care was provided to ASIA D cases suggests that more paid attendant care may be provided to workers' compensation eligible cases.

Physician care and outpatient therapy

The current figures for physician services, which included payments for diagnostic services, were similar to those reported by Johnson *et al*⁷ for SCI patients treated in Colorado. Current figures for outpatient therapy services were higher than those reported by Johnson *et al*; however, as the authors did not provide a listing of the service types included in their 'outpatient services' category, a direct comparison is difficult.

Durable medical equipment

Although payments for DME decreased over time, they represented one of the highest recurring categories for High and Low Tetraplegia cases. Payment for DME accounted for 14% of first-year payments for High, 16% for Low and 7% for ASIA D cases. As a

percentage of the total payments in subsequent years, DME decreased slightly for Low Tetraplegia cases, but increased for High Tetraplegia and ASIA D cases (13 and 20% respectively).

For both the first year following injury and in subsequent years, much higher payments for DME were observed in the current study than has been reported previously.^{1,7} High Tetraplegia cases received a higher mean first-year payment for DME (\$81,241) than was reported by De Vivo *et al*¹ and Johnson *et al*⁷ whose reported mean DME costs were \$30,356 and \$45,970, respectively. Current Low Tetraplegia cases received higher average payments for DME (\$70,463) in comparison to the means reported by De Vivo *et al* and Johnson *et al*, which were \$24,450 and \$19,547, respectively. The currently observed mean annual payment for all tetraplegia cases (\$57,112) was much higher than the mean of \$37,946 as reported by Berkowitz *et al*.⁴ These differences may be explained by a higher percentage of the cases in the current study receiving DME under the workers' compensation system. In addition, previous studies often had to rely on estimates for DME, which may have resulted in an underestimation of the costs incurred.

Medications and supplies

Payments for medications and supplies were similar for High and Low Tetraplegia cases; however, they were significantly lower for the ASIA D group. This may be attributed to ASIA D cases having fewer requirements for daily supplies such as dressings and catheters. Previously reported costs for medications and supplies have identified a similar trend, although figures for each group have been about half that observed in the current study.^{1,7} Again, the higher figures are likely to be attributable to the more complete capture afforded by the use of the insurance administrative database. In this case, as most medications and supplies are provided as a matter of necessity, it is unlikely that differences within this service category are due to differences in coverage.

Readmissions

The overall proportion of people readmitting in the first five years following injury is likely to be even higher than the reported figure (62%) as there were incomplete data for many cases (ie, cases that were injured prior to 1993 when payment information first became reliable). The proportion of people readmitted for care in any given year following injury (24%) was similar to the figure reported by Berkowitz *et al* (20%).⁴ The greater funding for readmission received by the High Tetraplegia group in the first year following injury is likely to be for the additional procedures and rehabilitation often required by this group. Although no significant relationship was observed, there was a trend for those with Low Tetraplegia to receive greater funding for readmission in later years. This trend is worthy of further investigation

as it is not the case that people within this group should be more likely to be readmitted for routine care. If readmissions are related to preventable conditions, the case may be made for more resources to be invested into preventative care (ie, more consistent with that provided to those with higher-level injuries).

Consistent with previous reports,^{1,4,7} wide variations in funding for readmissions were observed. Thus, it would appear that while readmissions are frequent and expensive, they are not highly predictable. Inspection of the reasons why people were readmitted may reveal that many readmissions are avoidable. If this is the case, substantial savings, including pain and suffering, could be made through the better use of preventative health care.

Transportation

In the current study, 85% of cases received payment for transportation services with payments decreasing over the 5-year follow-up period. Seemingly, as patients become more independent, their need for paid public or private transportation services decreases. No published costs for these transportation services are available for comparison with the current study. Access to transportation, either through the provision of modified vehicles or payment for transportation services, is an important factor in increasing independence.

Case management

Case managers in the workers' compensation setting are often assigned to catastrophic cases such as SCI to assist patients and their families in the utilization of services initially during hospitalization and later after discharge. Their role is to get the patient the optimal care and services necessary to ensure the best outcome. While case management services accounted for a substantial proportion (3%) of funding in the first year following injury, very little was spent on such services in later years. While this finding may be interpreted to mean that individuals became independent of the need for such services, given that people continued to use services and experienced difficulties associated with their SCI resulting in readmission to hospital, an argument for additional ongoing case management services could be made. No comparison data for case management services were available in the literature.

Vocational rehabilitation

Of all the service categories, vocational rehabilitation received the least amount of funding. While the percentage of people receiving vocational rehabilitation may be higher because complete information was not available for all years and individuals may have received such services from state agencies, it would seem that the population has the potential to benefit from such services. DeVivo *et al*¹ also reported that few persons with SCI received vocational rehabilitation services.

The more recent reported rates of employment in the US among those with SCI range from 23 to 36%^{13–16} and are generally lower than is observed in other countries, including Sweden (46%),¹⁷ Australia (47%)¹⁸ and Canada (42%).¹⁹ However, this need not be the case. While in the past, unemployment following SCI may have been expected, it is now considered that in a modern society, SCI should not preclude gainful employment.²⁰

Within those with SCI, it has been shown that enhanced adjustment is correlated with a positive movement from unemployment to employment.²¹ Further, it has been found that employment status is positively related to life satisfaction.²² Research has also shown that persons with SCI with activities and interests are likely to maintain better mental and physical health, not be a burden to others and enjoy a better quality of life.²³ These findings highlight the importance of assisting those with SCI to find employment and the potential for improving outcomes through assisting individuals to return to a productive life.

Conclusion

Workers' compensation payments were similar to NSCID figures for the first year following injury; however, in subsequent years, the figures in the current study were two and a half to three times higher, depending on impairment category. These differences are attributable to several categories of payment with the likely explanation being that the current figures are higher due to more complete data capture and/or greater coverage of services by the workers' compensation insurer. In many cases, means were affected by outlying values, for this reason the use of current figures for resource allocation at an individual level is not recommended.

Although the current study has indicated that there are differences in the services received by people with a compensable work-related injury, the extent to which this impacts on outcome is unknown. Further research is warranted so as to facilitate effective and efficient resource allocation. While a large amount of money is spent on acute care, relatively little is spent on facilitating wider rehabilitation gains. Considering that life expectancy following SCI is increasing and that those affected can now expect a closer to normal life span,²⁴ a case may be made for focusing more resources towards promoting wider rehabilitation gains such as a successful return to work.

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