Original Article

In-patient medical resource utilization for high-level cervical spinal cord injury without bone fracture in Taiwan

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Study design: Retrospective review of secondary data obtained from the Bureau of National Health Insurance (BNHI) on medical resource utilization in in-patient cervical spinal cord injury patients in Taiwan.

Objectives: Since the start of the National Health Insurance Program in Taiwan in 1995, costs have continued to increase each year. High-level cervical spinal cord injury, a catastrophic illness, consumes a large amount of medical resources. Appropriate control of in-patient costs for these patients is mandatory. Analyses of the factors influencing the health-care costs of these patients are needed, so cost-containment policies can be established by the BNHI to conserve health-care resources.

Setting: Health-care institutions throughout Taiwan.

Methods: We obtained secondary data on a randomized basis for diagnostic codes 952.00, 952.01, 952.02, or 952.03 of the International Classification of Diseases, Ninth Revision, Clinical Modification from the BNHI files of annual in-patient expenses during the period from 1998 to 2000. There were 184 hospital admission records studied.

Results: The lengths of stay and in-patient costs were significantly different among different hospital types. Length of stay also was statistically different according to patient, gender, and age. The lengths of stay and in-patient costs were influenced by the hospital accreditation level and patient gender. Medical orders were influenced by patient age.

Conclusions: Basic and selective diagnostics and therapeutics for high-level spinal cord injury without bone fracture should be established. Thus, patient needs for appropriate medical care will be met and overuse of medical resources will be prevented. Communication among doctors also should be strengthened.

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Keywords: high-level cervical spinal cord injury; medical resource utilization; national health insurance, non-US

Introduction

According to Spinal Cord Injury Association statistics for 2002 in Taiwan, there are approximately 2000 new spinal cord injury patients every year in Taiwan.¹ The average in-patient medical cost of each hospital admission due to spinal cord injury is NT\$236 271 (NT\$34/US\$1), which is significantly higher than that of many other major illnesses (range = NT\$1202–198 089).²

The aim of this study is to investigate the distribution of medical resource consumption in terms of the length of hospital stay, medical costs, and medical interventions (and statistical significance) by different hospital characteristics and patient gender and ages in patients with high-level cervical spinal cord injury without bone fracture. Additionally, since the cervical area is the most common site of spinal cord injury,³ these patients are usually paralyzed or otherwise disabled. Ongoing care of these injuries also consumes a considerable amount of medical resources.^{4,5} We identified the factors that

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influenced the utilization of medical resources in patients with high-level spinal cord injury without bone fracture.

Materials and methods

This retrospective study utilized secondary data obtained from the annual in-patient expenses information system of the Bureau of National Health Insurance (BNHI) from 1998 to 2000. Records of patients diagnosed with high-level cervical spinal cord injuries without bone fracture were randomly selected⁶ for study. Detailed in-patient cost and hospital records of 184 patients' first-time hospitalizations were studied.

Patients with codes 952.00, 952.01, 952.02 or 952.03 within ICD-9-CM were defined as having high-level cervical spinal cord injury without bone fracture. These codes are defined as follows:

ICD-9-CM 952: Spinal cord injury without evidence of spinal cord injury.

- (1) ICD-9-CM 952.00: C1 to C4 level with unspecified spinal cord injury;
- (2) ICD-9-CM 952.01: C1 to C4 level with complete lesion of spinal cord injury;
- (3) ICD-9-CM 952.02: C1 to C4 level with anterior cord syndrome;
- (4) ICD-9-CM 952.03: C1 to C4 level with central cord syndrome.

Since different and more complicated investigation and management were expected in spinal cord injury patients with associated fracture of the vertebral column, we did not enroll this group of patients in this study.

This study investigated two hospital variables including accreditation and ownership. Accreditation refers to the level of care the medical institution provides. Hospitals were divided into medical centers, metropolitan hospitals, and community hospitals. With regard to ownership, hospitals were classified as public hospitals, private hospitals, or nonprofit proprietary hospitals.

Patients were classified according to gender and age.

The length of initial hospital stay for acute admissions, direct in-patient costs, and medical interventions were defined as medical resources. In-patient costs included only direct medical expenses paid by the BNHI to hospitals. Medical interventions included the medical order items and utilization frequencies. These items were grouped into the general categories of medicine, treatment, and special materials, as reimbursed by the BNHI.

Hospital accreditation, ownership, and patient demographics were considered independent variables. Length of hospital stay in days, direct in-patient costs in NT\$ (NT\$34/US\$1), and medical interventions were considered dependent variables. Frequency distributions, percentages, means $\pm$ standard deviations (SDs), coefficients of variation, skew trends, and peak values were calculated for each variable after logarithmic transformation using the Statistical Package for the Social

Sciences (SPSS 1.0 for Windows, SPSS, Inc., Chicago, IL, USA) software. Student's *t*-test, analysis of variance (ANOVA), and multivariate linear regression were used to analyze hypotheses for different research purposes. Probability values of less than 0.05 were considered significant.

Results

There were no statistically significant differences in patient demographics among the different hospitals with respect to accreditation and ownership.

We found that the average ($\pm$ SD) length of initial hospital stay for acute cervical spinal cord injury without bone fracture admissions among the 184 patients was 11 ± 13 days. Average direct in-patient costs were NT\$57 224 $\pm$ 91 932 per patient per stay. Treatment-associated costs accounted for 56% of the total hospitalization costs. There was an average of 64 ± 66 medical order items per patient per hospitalization, and the average utilization frequency of medical order items was 549 ± 1040 times per patient per hospitalization period. Publicly owned medical center hospitals used the most medical resources for taking care of spinal cord injury patients (Table 1).

Medical center patients had significantly longer hospital stays ($P < 0.001$) and higher in-patient costs ($P < 0.001$), more medical order items ($P < 0.05$), and higher utilization frequencies ($P < 0.001$) than did patients in hospitals with other accreditations. Publicly owned hospitals had similar findings to other owned hospitals (as stated above); elderly patients in comparison to younger adult patients had similar findings as well. Male patients had longer in-patient stays and higher costs than female patients ($P < 0.05$) (Tables 2 and 3).

The total direct in-patient costs, medical order items, and utilization frequency were further adjusted by length of stay. The length of stay-adjusted direct in-patient costs were significantly different in hospitals of different accreditation and ownership. The adjusted costs in the medical centers were significantly higher than those in metropolitan and community hospitals. The adjusted costs in public hospitals were significantly higher than those of private hospitals. The comparisons in age and gender failed to show significance (Table 4).

High-priced items with NHI reimbursement points of 1000 or more, constituting 44% of the total costs, were most frequently used in medical centers (Figure 1), contributing 56% of the total number of items and 64% of the total utilization frequencies (Figure 2). The percentage of patients admitted to the intensive care unit (ICU) in medical centers was four times that of metropolitan hospitals and seven times that of community hospitals. The utilization frequency of a respirator (administered in 23 patients) in medical centers was nine times that of metropolitan and community hospitals.

Using multiple regression analysis, we found that the length of initial hospital stay, direct in-patient costs, medical order items, and utilization frequencies had

Table 1 Medical resource by hospital accreditation and ownership (per patient ($N = 184$) per hospitalization)

Accreditation	Ownership	N	Length of stay		Direct in-patient costs		Medical order items		Utilization frequency	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD
Medical centers	Public	22	26	21	180 380	166 363	123	101	1553	2418
	Private	8	18	21	79 604	106 555	94	115	730	852
	Nonprofit proprietary	21	10	9	79 254	98 157	69	96	517	610
Metropolitan hospitals	Total	51	18	18	122 932	140 077	96	102	997	1717
	Public	10	10	6	27 383	15 988	46	16	314	135
	Private	24	7	6	33 497	46 424	47	50	309	273
	Nonprofit proprietary	42	10	12	45 221	62 370	61	48	521	762
	Total	76	9	10	39 171	53 549	55	46	427	594
Community hospitals	Public	4	5	5	17 159	14 230	50	27	219	203
	Private	47	7	6	24 039	27 739	47	25	326	441
	Nonprofit proprietary	6	7	3	14 030	5 453	41	14	243	117
	Total	57	7	6	22 503	25 637	47	24	310	406
Total	Public	36	19	19	119 745	150 467	94	88	1061	1977
	Private	79	8	9	32 539	48 777	52	50	362	466
	Nonprofit proprietary	69	9	11	52 866	74 603	62	65	495	683
	Total	184	11	13	57 224	91 932	64	66	549	1040

Table 2 Length of initial hospital stay and direct in-patient costs by hospital accreditation, ownership, and patient demographics (per patient ($N = 184$) per hospitalization)

Dependent variables/Independent variables	Length of stay			Direct in-patient costs		
	Mean	SD	P Scheffe's	Mean	SD	P Scheffe's
Hospital characteristics						
<i>Accreditation</i>						
Medical centers ($n = 51$)	18	18	*** (1) > (2)	122 932	140 077	*** (1) > (2)
Metropolitan hospitals ($n = 76$)	9	10	(1) > (3)	39 171	53 549	(1) > (3)
Community hospitals ($n = 57$)	7	6		22 503	25 637	
<i>Ownership</i>						
Public hospitals ($n = 36$)	19	19	*** (1) > (2)	119 745	150 467	*** (1) > (2)
Private hospitals ($n = 79$)	8	9	(1) > (3)	32 539	48 777	(1) > (3)
Nonprofit proprietary hospitals ($n = 69$)	9	11		52 866	74 603	
Patient demographics						
<i>Gender</i>						
Female ($n = 58$)	8	10	* (2) > (1)	44 189	82 519	* (2) > (1)
Male ($n = 126$)	12	14		63 224	95 670	
<i>Age (years)</i>						
≤ 19 ($n = 19$)	13	21	* (7) > (2)	63 480	116 145	* (7) > (2)
20–29 ($n = 39$)	8	10		36 814	89 615	
30–39 ($n = 35$)	10	12		48 467	70 491	
40–49 ($n = 31$)	10	11		56 748	69 244	
50–59 ($n = 17$)	12	10		79 165	123 074	
60–69 ($n = 28$)	12	10		61 954	76 526	
≥ 70 ($n = 15$)	16	18		90 085	131 117	

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$

Table 3 Medical order items (*n*) and utilization frequency (number of times used) by hospital accreditation, ownership, and patient demographics (per patient (*N* = 184) per hospitalization)

Dependent variable/Independent variable	Medical order items			Utilization frequency		
	Mean	SD	P Scheffe's	Mean	SD	P Scheffe's
Accreditation of hospital						
Accreditation level			*			***
Medical centers (<i>n</i> = 51)	96	102	(1) > (2)	997	1717	(1) > (2)
Metropolitan hospitals (<i>n</i> = 76)	55	46	(1) > (3)	427	594	(1) > (3)
Community hospitals (<i>n</i> = 57)	47	24		310	406	
Ownership						
Ownership			*			**
Public hospitals (<i>n</i> = 36)	94	88	(1) > (2)	1061	1977	(1) > (2)
Private hospitals (<i>n</i> = 79)	52	50	(1) > (3)	362	466	(1) > (3)
Nonprofit proprietary hospitals (<i>n</i> = 69)	62	65		495	683	
Patient demographics						
Gender						
Female (<i>n</i> = 58)	61	55		424	508	
Male (<i>n</i> = 126)	65	71		606	1206	
Age (years)						
Age (years)			**			**
≤ 19 (<i>n</i> = 19)	54	74	(7) > (2)	393	627	(6) > (1)
20–29 (<i>n</i> = 39)	48	49		296	371	(6) > (2)
30–39 (<i>n</i> = 35)	51	49		471	694	
40–49 (<i>n</i> = 31)	71	64		500	529	
50–59 (<i>n</i> = 17)	86	80		550	555	
60–69 (<i>n</i> = 28)	69	55		1013	2224	
≥ 70 (<i>n</i> = 15)	97	110		817	924	

P* < 0.05; *P* < 0.01; ****P* < 0.001

statistically significant correlations with all independent variables (*P* < 0.001 for all). After controlling for other variables, we found that patient gender and hospital accreditation influenced the length of hospital stay and in-patient costs. This effect was the greatest for hospital accreditation. Patient age influenced medical order items and utilization frequencies (Table 4).

Discussion

Of the many patients who are hospitalized each year for high-level cervical spinal cord injury without bone fracture, the average age at presentation is 41.5 years, with peak incidence in the 20- to 29-year-old age group. The injury occurs more often in males than in females. These findings are consistent with the findings of other studies.^{7–9}

Based on the different hospital characteristics, patients are more commonly seen in the metropolitan and private hospitals (Table 1). This could be due to the medical environment of Taiwan where there are greater numbers of private hospitals than other hospitals and wider distribution of metropolitan hospitals than medical centers (which are better equipped than community hospitals).

The current study showed that medical centers had greater direct in-patient costs than other hospital types.

This finding was consistent with that of previous studies.^{2,10–20} The length of stay and direct in-patient costs in public medical centers are significantly higher than those in other hospitals. Analysis of patient medical orders showed that medical center patients usually had more than one diagnosis, underwent more procedures and surgical operations, had more frequent usage of mechanical ventilators, and were admitted more frequently to ICUs.

Medical centers in Taiwan differ from other accredited hospitals with regard to business administration, equipment provisions, various types of medical specialty care, and medical education.

Medical centers in Taiwan usually have more than 1000 beds as compared with metropolitan hospitals that usually provide greater than 250 beds. The training of medical personnel and the quality of the medical facility are better in medical centers than in hospitals with other accreditations. Medical centers are also teaching hospitals. Patients receive care in a greater number of medical specialties at medical centers in Taiwan than at other medical institutions. Thus, the most severely ill patients are likely sent to medical centers. The public medical centers have financial and political support from the government; the physicians use every possible management technique to treat their patients. (There are no specific trauma centers as such in Taiwan.) Thus, lengths

Table 4 Length of stay-adjusted direct in-patient costs, medical order items, and utilization frequency by hospital characteristics and patient demographics

Dependent variables/ Independent variables	Length of stay-adjusted direct in-patient costs			Length of stay-adjusted medical order items			Length of stay-adjusted utilization frequency		
	Mean ^a	SE	P Scheffe's	Mean ^a	SE	P Scheffe's	Mean ^a	SE	P Scheffe's
Hospital characteristics									
<i>Accreditation</i>			<i>*P < 0.05</i>			<i>P > 0.05</i>			<i>P > 0.05</i>
Medical centers (n = 51)	86 201 ^a	8528	(1) > (2)	74 ^a	8		697 ^a	131	
Metropolitan hospitals (n = 76)	49 236 ^a	6674	(1) > (3)	61 ^a	6		509 ^a	102	
Community hospitals (n = 57)	41 948 ^a	7790		58 ^a	7		469 ^a	119	
<i>Ownership</i>			<i>*P < 0.05</i>			<i>P > 0.05</i>			<i>P > 0.05</i>
Public hospitals (n = 36)	76 202 ^a	10339	(1) > (2)	68 ^a	9		720 ^a	154	
Private hospitals (n = 79)	45 872 ^a	6736		60 ^a	6		466 ^a	101	
Nonprofit proprietary hospitals (n = 69)	60 319 ^a	7157		66 ^a	6		554 ^a	107	
Patient demographics									
<i>Gender</i>			<i>P > 0.05</i>			<i>P > 0.05</i>			<i>P > 0.05</i>
Female (n = 58)	58 113 ^a	7947		69 ^a	7		534 ^a	117	
Male (n = 126)	56 815 ^a	5374		62 ^a	5		556 ^a	79	
<i>Age (years)</i>			<i>P > 0.05</i>			<i>P > 0.05</i>			<i>P > 0.05</i>
≤ 19 (n = 19)	52 965 ^a	13 930		48 ^a	12		312 ^a	202	
20–29 (n = 39)	55 186 ^a	9784		58 ^a	8		438 ^a	142	
30–39 (n = 35)	51 498 ^a	10 253		53 ^a	9		495 ^a	149	
40–49 (n = 31)	60 589 ^a	10 895		73 ^a	9		530 ^a	158	
50–59 (n = 17)	74 489 ^a	14 712		84 ^a	13		514 ^a	213	
60–69 (n = 28)	54 260 ^a	11 472		65 ^a	10		954 ^a	166	
≥ 70 (n = 15)	60 283 ^a	15 780		80 ^a	14		587 ^a	229	

^aEvaluated at covariates appeared in the model: The length of stay = 10.90

*The mean difference is significant at the 0.05 level

Figure 1 Costlier medical items with National Health Insurance reimbursement points of 1000 or more, constituting 44% of the total costs were most frequently used in medical centers

of stay are longer, there are more medical order items and utilization frequencies, and greater medical expenses.

Not all the public hospitals have greater medical utilizations than other hospital types. In the current study, 61% of public hospitals were medical centers, which is probably the reason why the medical expenses

in public hospitals were greater than those of the private or nonprofit proprietary hospitals.

According to some studies,^{3,11,14–17,21} hospitals stays are longer for male patients than for female patients. Additionally, these studies show gender also affects medical expenses, which are significantly higher for males than for females. Multiple regression analyses

Figure 2 The number of items and utilization frequency of high-cost medical orders for high-level cervical spinal cord injury patients were greatest in medical centers and lowest in regional hospitals

Table 5 Multiple regression analysis of medical resource utilization in high-level cervical spinal cord injury ($N = 184$)

Dependent variables/Independent variables	Length of stay	Direct in-patient costs	Medical order items	Utilization frequency
Interception	6.83*	18909.57	24.18	-40.29
Age	0.05	387.59	0.65**	10.35**
<i>Gender</i>				
Male (control)				
Female	-4.96**	-26598.46*	-8.95	-245.94
<i>Hospital</i>				
Metropolitan hospitals (control)				
<i>Accreditation</i>				
Medical centers	8.18***	76183.16***	32.82**	501.63**
Community hospitals	-1.77*	-6467.62*	-7.06	-34.10
<i>Ownership</i>				
Private hospitals (control)				
Public hospitals	2.63	28486.49	15.10	285.20
Nonprofit proprietary hospitals	-3.74	-19869.47	-15.90	-177.03
F-value	7.292***	8.287***	5.716***	4.267***
R ²	0.318	0.346	0.268	0.214
Adjusted R ²	0.274	0.305	0.221	0.164

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$

showed that the gender of patients influenced the lengths of stay and medical costs. The average length of stay for male patients was 4.96 days more than for female patients and direct in-patient costs were NT\$26 598 more for male patients. This could be related to the social culture of Taiwan, since Taiwanese men are typically the main economic providers for families. Thus, when men are admitted to a hospital, the family expects the physician to more thoroughly investigate and manage the patient.

The older the patients were, the longer the hospital stays were. This finding is consistent with the results of other studies.^{4,5,13,22-26} Multiple regression analysis also

showed that the age of patients influenced the choice of medical order items and utilization frequencies. Medical order items increased by 0.65 and utilization frequencies by 10.35 for each yearly increase in age per patient per hospitalization. These increases might be due to the older patients having more associated medical problems or complications, and doctors requiring greater medical resources to manage these patients at a greater medical expense (see Table 5).

The BNHI reimbursements were about the same for medical order items irrespective of whether they were ordered in community hospitals or major medical centers.²⁷ High-priced medical items (BNHI

reimbursement points ≥ 1000) were obviously higher in medical centers than in hospitals with other accreditations. The same trend was also found for the rates of respirator usage and numbers of ICU admissions. BNHI reimbursement for high-level cervical spinal cord injury without bone fracture is made on a 'fee for service' basis, and there are no rules determining medical treatment use. Therefore, medical service providers may prescribe treatment based on factors such as the severity of spinal cord injury, hospital policy, hospital facility and personal experiences, or physician preference with consideration of economical benefits, costs, or quality of care. The distribution of medical order items for the treatment of cervical spinal cord injury without bone fracture was widely scattered and without a consistent standard, indicating the need for defining clinical pathways and standards of care for these injuries.

It is interesting to note that the results of our study were also consistent with the NHI statistical survey published by the Department of Health in 2002, in which the average medical resource utilization was the highest in medical centers, public hospitals, in the area of Taipei, and in male patients and older patients in terms of claims for hospitalization costs.²⁸

As it is difficult to obtain the operating costs of each hospital, the direct in-patient costs used in this study were obtained from the National Health Insurance Research Database of the National Health Research Institutes using systematically randomized sampling. There may be a 5 to 10% error in disease diagnosis due to economic attractions of the reimbursement system. Therefore, maximum and minimum cost values may be biased. Nonetheless, such error should be minimized because means were used in calculations. Additionally, these secondary data were subject to existing errors, which were unidentifiable or unable to be corrected, such as coding errors. We carefully screened and verified our data so that these errors were minimal.

This study was analyzed based on claims for direct in-patient costs for acute hospital admissions made to the BNHI, and did not include self-payment or partial or full fees paid by the patients. Therefore, medical resource utilization in this study was limited only to BNHI estimates and cannot be applied to non-NHI cases. There are very few non-NHI cases in the current medical environment; thus, this should have little effect on the study results.

This study only considered the costs during periods of acute hospitalization. It did not capture medical care costs for chronic care wards, outpatient clinics, or home care for these particular patients. Thus, total medical resource utilization for these patients cannot be inferred from this study. Similarly, this study should not be used to generalize about resource utilization for all spinal cord injury patients.

Conclusions

Our results showed that medical resource utilization in patients with cervical spinal cord injury without bone

fracture varied significantly by hospital accreditation and ownership and patient characteristics. Furthermore, that there was no standard of treatment for such patients. In the future, appropriate medical resource utilization patterns, basic and optional treatment items, and standard clinical pathways should be determined, so medical resources might be used more effectively. Establishing these policies and procedures will safeguard patients' rights to quality care without placing undue burden on the BNHI.

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