Original Article

Length of Stay and Direct Medical Costs for Psychogeriatric Inpatients in Taiwan

Chin-Ming Liu, M.D.[1, 2], Chu-Shiu Li, Ph.D.[3],
Chwen-Chi Liu, Ph.D.[4], Chu-Chin Tu, M.S.[2]

Objective: In this study, we aimed to analyze the length of stay (LOS) and direct medical costs (DMC) for psychogeriatric inpatients in Taiwan. **Methods:** We obtained the data from the Psychiatric Inpatient Medical Claim database of Taiwan's National Health Insurance. LOS and DMC of different mental illnesses were analyzed. **Results:** The average LOS of our study patients was 43.53 days, and the mean DMC was 2,576 US dollars. Dementia was the most common psychiatric diagnosis. Average LOS and DMC were significantly higher in male patients than female ($p < 0.001$ and $p = 0.022$, respectively). Over 90% of DMC were non-drug expenses (NDE). The LOS of patients with dementia and major depression was significantly higher for males than for females ($p < 0.001$). Patients' LOS and DMC showed differences among gender, diagnosis, and type of hospital. The LOS of dementia and delusional disorders and the DMC of major depressive disorders had heterogeneities across hospital types. The results of regression analysis indicated the LOS and the DMC of schizophrenic patients were significantly higher than those of dementia patients ($p < 0.001$); the LOS of community hospitals was significantly higher ($p < 0.001$) than that of general hospitals (medical centers and regional hospitals), with the opposite being true for DMC. Compared to public hospitals, the drug expense (DE) was significantly higher in private hospitals ($p < 0.04$), but LOS and NDE were lower. **Conclusion:** The determinants affecting differences of LOS and DMC of psychogeriatric inpatients were gender, psychiatric diagnosis, and type of hospital. The DE and NDE of DMC were about 10% and 90%, respectively, but only the NDE showed significant difference based on gender.

Key words: length of stay, direct medical cost, geriatrics
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Introduction

Length of stay (LOS) and direct medical costs (DMC) are frequently used to evaluate the healthcare efficiency and quality as well as hospital resource use [1-4]. At the stage of imbalance of Taiwan National Health Insurance (NHI) finance and reform of the NHI financial system, reducing LOS and DMC for hospital inpatient care is clearly a powerful strategic weapon [5]. Among all kinds of diseases, the LOS and DMC of mental illnesses are especially important because of their characteristics of chronicity and difficulty in treatment and restoration of social and occupational functioning. Combined with a predicted significant increase in the proportion of the elderly (aged 65 years and over) in the Taiwanese population (from 10.7% in 2010 to 41.6% in 2060), financing the medical care may lead to further financial difficulty in the NHI system in Taiwan [5, 6].

The LOS and DMC of psychogeriatric inpatients have become important issues in Taiwan due to three major reasons: First, similar to Japan and South Korea, life expectancy is increasing while the growth rate of the population is declining [7]. The increasing number of the elderly often increases in medical costs. Second, LOS and DMC are key subjects for research topics since the global budget system of NHI leads to a diversity of operating strategies in different hospitals for the same disease. This implies that the LOS and DMC of psychiatric inpatients may vary among the levels of medical institutions [8]. And third, different diseases vary in LOS and DMC.

The aim of this study was to examine several factors associated with the LOS and DMC for psychogeriatric inpatients in Taiwan during 2006. We hope that the findings of this study would pro-

vide an important reference for NHI planning and financing.

Methods

Data source and study sample

The NHI program of Taiwan, implemented in 1995, covers health cares for over 99% of the Taiwan's inhabitants [9]. All hospitals must provide information of medical services (including patient's gender, age, diagnosis, medicines and service fees, etc.) to claim reimbursement from the Bureau of NHI.

Extracting from the National Health Insurance Research Database (NHIRD) inpatient claims data, and the Psychiatric Inpatient Medical Claim (PIMC) datasets were constructed according to patients who were admitted to the psychiatric department. We used the PSY2 dataset, one subset of PIMC, in the study. In that dataset, we included patients who had their first psychiatric admissions between 2002 and 2007.

In the dataset, diagnoses of mental illness were coded using *the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)*. Codes 290-319 indicate mental disorders such as dementia disorders, alcohol-related disorders, transient organic brain syndromes, organic mental disorders, schizophrenic disorders, affective disorders and delusional disorders, etc.

Based on the PSY2 database, we extracted information about psychiatric inpatients such as numbers, hospitalization frequencies, demographics, LOS, diagnoses, DMC, and information of health facilities such as ownership type and institution type from the psychiatric service. We included 96,013 patients in PSY2. Among those patients, 15,109 (16%) elder patients (age 65 years and over) were admitted to psychiatric inpatient ward in the 2002-2007 period. The annual num-

bers of psychogeriatric inpatients from 2002 to 2006 were 2,282, 2,326, 2,590, 2,722, and 2641, respectively.

To examine the common factors influencing psychogeriatric inpatients' LOS and DMC, we selected the elderly patients who were admitted to psychiatric wards during a one-year period (January 1, 2006 - December 31, 2006). Excluded were patients who were foreigners or lacked basic information such as gender or age. We also excluded patients with DMC paid after 2006, and LOS which extended beyond December 31, 2006, or LOS or DMC reported to be zero. Ultimately, we included 2,641 inpatients with 3,455 hospitalizations in this study.

Measures and variables

LOS is defined as the period from the date of admission to the hospital to the date of discharge (measured in days per admission). For those who had more than one admission during 2006, we took an average, where LOS was calculated as the total length of stay over the total number of hospitalizations [1]. DMC is defined as a psychogeriatric inpatient's hospitalization costs, such as the drug expenses, the service fees, the acute bed fees, the chronic bed fees, etc., per admission. Therefore, we divided the DMC into drug expense (DE) and non-drug expense (NDE). The DMC, DE and NDE were denominated in United States Dollars (US$1/NT$31.42). Two categories of explanatory variables existed in this study. The first type was characteristics of psychogeriatric inpatients, such as gender, age and disease. The second type was referred to characteristics of health facilities. Five-year intervals were used to divide psychogeriatric inpatients into six age groups: 65-69, 70-74, 75-79, 80-84, 85-89, and 90 years and older [10].

We used the first of five diagnoses (principal diagnosis) in PSY2 claims data to classify patients into different diseases. We divided all inpatients according to their principal diagnoses in the ICD-9-CM's section 290-316 [11]. If patients had multiple admissions with same diagnosis, then they were categorized into "one major diagnosis." On the contrary, patients were assigned into "more than one major diagnosis," if they had multiple admissions with different diagnoses. Patients with only one major diagnosis that is not one of the top ten were labeled as "others." Therefore, our study had 12 diagnosis categories: 290, dementia disorders (included *ICD-9-CM* codes 331.0-331.2); 293, transient organic brain syndromes; 294, organic mental disorders; 295, schizophrenic disorders; 296, affective disorder (divided into major depressive disorder and bipolar affective disorder); 297, delusional disorders; 298, other non-organic mental disorders; 300, anxiety disorders; 300.4, neurotic depression; 311, depressive disorders, NOS; others (excluding the top 10 diagnoses); and more than one major diagnosis. The *ICD-9-CM* codes were added after the diagnostic terms in Tables.

Institutional characteristics were classified according to type and hospital ownership. Hospitals are accredited as medical centers, regional hospitals, community hospitals and psychiatric hospitals every four years by Taiwan Joint Commission of Hospital Accreditation (TJCHA). In this study, however, institutions were divided into three types: general, community, and psychiatric hospitals. Medical centers and regional hospitals were combined under the general hospitals category because of their similarities in scale of services and the same level of payment by BNHI. Psychiatric hospitals were defined as those with beds exclusively for psychiatric patients. This condition did not exist in general hospitals or community hospitals. Basing on ownership, institutions can be classified as private or public hospitals.

In our regression model, the reference groups were female, 65-69 years of age, dementia, admitted to general hospitals, and admitted to public hospitals.

We did not seek study approval from the institutional review board from our institution because the data were de-linked information purchased from NHIRD.

Statistical analyses

We used one-way ANOVA and *t*-test analyses to examine the relationship among LOS, DMC, DE, NDE, patient characteristics, and hospital characteristics. During the data processing, we found that LOS was positively skewed and DMC was so large that it biased our regression results. All outcome variables, such as LOS, DMC, DE and NDE, were given a natural logarithmic transformation for statistic process that solved potential biases. Finally, we used zero-truncated Tobit regression analysis, to assess the correlation between explanatory and outcome variables because zero or negative LOS and DMC of patients were not included in our samples.

All data of the study were computed using Statistical Analytic System (SAS, Cary, North Carolina, USA) software version 9.13 for Windows. The differences between the groups were considered significant if *p*-values were smaller than 0.05.

Results

Table 1 lists characteristics of 2,641 psychogeriatric inpatients in 2006. Table 2 shows the relationship among the characteristics of psychogeriatric inpatients with length of stay, direct medical cost, drug expense and non-drug expense. Table 3 is the relationship between gender, age and diagnosis in length of stay and direct medical cost (N

= 2,641). Table 4 illustrates the relationship between types of hospitals and psychiatric diagnoses in length of stay and direct medical cost (N = 1,872). And Table 5 represents determinants of psychogeriatric inpatients for length of stay, direct medical cost, drug expense, and non-drug expense (N = 2,641).

Discussion

As shown in Table 1, we found that the gender ratio of the patients was predominantly male with M: F = 1.65: 1. This result was the highest one when compared to findings from studies in Japan (M: F = 1.11: 1), and the ratio was reversed in the data from Shanghai (M: F = 1: 1.87), Korea (M: F = 1: 1.16), and the United States (M: F = 1: 1.43) [1-2, 12-13]. In 1949, Taiwan had the population of roughly 8 million. But at the end of the Chinese civil war, 600,000 male soldiers retreated from China to Taiwan, which led to obvious changes in Taiwan's gender distribution pattern [14, www.aamh.edu.au]. Now those soldiers have become part of the elderly population. In addition, preference for sons in Taiwan is another important factor in the further worsening of the imbalance of the gender ratio [15].

Elderly patients' average LOS (43.53 days) in Taiwan (Table 2) was shorter than that of elderly patients in Korea (128 days) and Japan (minimum LOS is 146 days) [1-2], but longer than that of the US (11.7 days) [16]. Compared with other countries, DMC in Taiwan (US$2,576) was lower than that of the United States (US$5,904). In addition, DMC of dementic patients in Shanghai (US$708) are lower than that of Taiwan (US$2,572) [12]. The ratio of DE to NDE was reversed; DE (US$172) in our data was lower than that of Shanghai (US$653). Based on this study finding, we suggest that the supply of manpower in the

Table 1.　Characteristics of psychogeriatric inpatients in 2006 (N = 2,641)

Characteristics	Inpatient		Rank for diagnosis
	N	%	
Gender			
Female	997	37.8	
Male	1,644	62.3	
Age			
65-69	618	23.4	
70-74	495	18.7	
75-79	661	25.0	
80-84	524	19.8	
85-89	252	9.5	
≥ 90	91	3.5	
Psychiatric diagnosis			
Only one major diagnosis	2,412	91.3	
Dementia (290 and 331.0-331.2)	879	33.3	1
Alcohol-related (291)	27	1.0	
Drug psychosis (292)	11	0.4	
Transient organic brain syndrome (293)	51	1.9	8
Organic mental (294)	208	7.9	4
Schizophrenic (295)	295	11.2	3
Affective (296)			
Major depressive (296.2-296.3)	388	14.7	2
Bipolar affective (296.0-296.8 except 296.2-296.3)	171	6.5	6
Delusional (297)	149	5.6	5
Other Non-organic mental (298)	41	1.6	9
Psychoses with origin specific to childhood (299)	1	0.0	
Anxiety (300 excluded 300.4)	32	1.2	
Neurotic depression (300.4)	60	2.3	7
Personality (301)	2	0.1	
Nondependent abuse of drugs (305)	1	0.0	
Adjustment reaction (309)	13	0.5	
Specific nonpsychotic mental due to organic brain damage (310)	4	0.2	
Depressive (311)	36	1.4	10
Psychic factors associated with diseases classified elsewhere (316)	1	0.0	
Others (excluded 290-316)	42	1.6	
Sum of top ten major diagnoses	2,278	86.2	
More than one major diagnosis	229	8.7	
Institutional characteristics			
Type (that the inpatients were admitted to)			
Only one type	2,545	96.4	
General hospital	1,684	63.8	
Community hospital	378	14.3	
Psychiatric hospital	483	18.3	
Multiple types	96	3.6	
Ownership (of those that the inpatients were admitted to)			
Only one ownership	2,589	98.0	
Public hospital	1,838	69.6	
Private hospital	751	28.4	
Both ownerships	52	2.0	
Numbers of admission (mean = 1.97)			
Only one admission	1,011	38.3	
Multiple admissions	1,630	61.7	

Table 2.　The Relationship among the characteristics of psychogeriatric inpatients with length of stay, direct medical cost, drug expense, and non-drug expense

Characteristics	LOS Mean	LOS SD	LOS p-value	DMC Mean	DMC SD	DMC p-value	DE Mean	DE SD	DE p-value	NDE Mean	NDE SD	NDE p-value
All	43.5	53.0		2,576	2,213		176	265		2,401	2,045	
Gender			< 0.001			0.022			0.695			0.012
Female	37.3	47.7		2,425	2,104		176	281		2,492	2,098	
Male	47.3	55.6		2,668	2,273		175	236		2,250	1,945	
Age			0.0354			0.928			0.172			0.948
65-69	41.0	49.9		2,548	2,147		183	277		2,365	1,963	
70-74	40.0	48.6		2,530	2,038		175	224		2,355	1,896	
75-79	42.2	50.2		2,574	2,306		161	232		2,412	2,153	
80-84	47.2	57.8		2,668	2,321		193	305		2,474	2,127	
85-89	50.4	61.5		2,531	2,242		151	179		2,380	2,111	
≥ 90	49.6	59.2		2,630	2,218		201	476		2,429	1,935	
Psychiatric diagnosis												
Only one major diagnosis			< 0.001			< 0.001			< 0.001			< 0.001
Dementia (290 and 331.0-331.2)	48.6	60.2		2,561	2,216		173	278		2,388	2,048	
Transient organic brain syndrome (293)	19.1	15.5		1,822	1,542		114	190		1,708	1,399	
Organic mental (294)	34.4	39.8		2,228	1,589		153	220		2,075	1,458	
Schizophrenic (295)	58.9	62.3		3,154	2,636		229	314		2,925	2,432	
Major depressive (296.2-296.3)	37.6	43.4		2,530	2,140		176	194		2,354	1,997	
Bipolar affective (296.0-296.8 except 296.2-296.3)	28.2	26.9		2,115	1,600		172	314		1,943	1,436	
Delusional (297)	48.3	54.5		2,836	2,097		142	149		2,694	1,988	
Other non-organic mental (298)	17.1	28.5		1,356	1,471		76	126		1,280	1,366	

(cont.)

Characteristics	LOS			DMC			DE			NDE		
	Mean	SD	p-value	Mean	SD	p-value	Mean	SD	p-value	Mean	SD	p-value
Neurotic depression (300.4)	20.4	18.7		1,396	1,059		86	168		1,310	1,000	
Depressive (311)	19.4	17.3		1,591	1,200		70	59		1,522	1,166	
Others (excluded top ten psychiatric diagnoses)	25.5	26.4		2,286	2,307		173	401		2,113	1,985	
More than one major diagnosis	61.7	62.9		3,480	2,639		235	256		3,245	2,472	
Institutional characteristics												
Type (that the inpatients were admitted to)												
Only one type			< 0.001			0.322			< 0.001			0.085
General hospital	38.0	46.5		2,529	2,125		186	273		2,343	1,946	
Community hospital	64.9	74.3		2,558	2,334		187	304		2,371	2,136	
Psychiatric hospital	45.5	53.5		2,703	2,501		125	199		2,578	2,370	
Multiple types	46.1	32.3		2,831	1,613		199	228		2,632	1,495	
Ownership (of those that the inpatients were admitted to)												
Only one ownership			0.011			< 0.001			0.535			< 0.001
Public hospital	45.3	53.3		2,731	2,309		178	269		2,553	2,139	
Private hospital	39.5	52.8		2,210	1,944		171	259		2,039	1,773	
Both ownerships	38.0	24.2		2,231	1,077		135	91		2,097	1,029	

Abbreviations: LOS = length of stay, DMC = direct medical cost, DE = drug expense, NDE = non-drug expense, and SD = standard deviation

Note: p-values were obtained from t-tests or one-way analyses of variance as appropriate; DMC are in U.S. dollars (US$1/NT$31.42).

Table 3. The relationship between gender, age and diagnosis in length of stay and direct medical cost (N = 2,641)

Characteristics	Numbers of inpatient		LOS					DMC				
	Male	Female	Male		Female		p-value	Male		Female		p-value
			Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Age												
65-69	301	317	43.3	52.1	38.8	47.8	0.262	2,530	2,065	2,566	2,226	0.838
70-74	246	249	42.4	52.5	37.6	44.3	0.269	2,458	2,000	2,601	2,076	0.436
75-79	445	216	44.9	52.1	36.5	45.8	0.044	2,712	2,461	2,288	1,921	0.026
80-84	399	125	50.2	59.r5	37.7	51.1	0.036	2,784	2,376	2,297	2,101	0.040
85-89	185	67	57.4	65.1	31.2	45.3	0.003	2,731	2,312	1,978	1,948	0.018
≥90	68	23	53.8	50.0	37.1	80.6	0.246	2,883	2,053	1,881	2,549	0.060
Psychiatric diagnosis												
Only one major diagnosis	1,485	927	45.5	54.6	35.8	43.8	< .0001	2,578	2,208	2,349	1,982	0.011
Dementia (290 and 331.0-331.2)	607	272	51.5	61.1	42.1	57.8	0.032	2,519	2,634	1,918	1,625	0.039
Transient organic brain syndrome (293)	35	16	21.2	16.1	14.5	13.7	0.154	3,501	2,671	3,431	2,584	0.329
Organic mental (294)	149	59	36.9	40.3	28.0	38.2	0.147	1,966	1,548	1,507	1,531	0.327
Schizophrenic (295)	151	144	64.6	67.2	52.9	56.2	0.108	2,296	1,608	2,056	1,540	0.908
Major depressive (296.2-296.3)	197	191	44.3	50.7	30.7	33.0	0.002	3,172	2,581	3,136	2,702	0.297
Bipolar affective (296.0-296.8 except 296.2-296.3)	84	87	28.8	24.8	27.5	28.9	0.757	2,642	2,303	2,415	1,957	0.662
Delusional (297)	104	45	51.6	60.2	40.5	37.7	0.253	2,169	1,681	2,062	1,525	0.379
Other non-organic mental (298)	24	17	11.9	10.7	24.3	42.1	0.174	2,936	2,265	2,606	1,645	0.234
Neurotic depression (300.4)	36	24	21.3	18.0	18.9	20.1	0.633	1,123	987	1,684	1,953	0.963
Depressive (311)	16	20	23.5	19.4	16.1	15.2	0.205	1,390	1,147	1,403	937	0.174
Others (excluded top ten psychiatric diagnoses)	82	52	29.4	31.3	19.3	14.2	0.030	1,898	1,542	1,346	796	0.143
More than one major diagnosis	159	70	63.7	62.2	57.1	64.9	0.467	2,664	2,256	2,331	2,109	0.854

Abbreviations: LOS = length of stay, DMC = direct medical cost, and SD = standard deviation

Note: p-values were obtained from t-tests or one-way analyses of variance as appropriate; DMC are in U.S. dollars (US$1/NT$31.42).

Table 4. The relationship between types of hospitals and psychiatric diagnoses in length of stay and direct medical cost (N = 1,872*)

Panel A: LOS

Diagnosis/Hospital type	All hospitals		General hospital (N = 1,273)		Community hospital (N = 334)		Psychiatric hospital (N = 403)		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	p-value
Dementia (290) (N = 858)	48.7	60.7	45.5	48.9	38.2	48.6	31.0	35.5	< 0.001
Organic mental (294) (N = 203)	33.8	39.6	65.9	77.2	63.2	62.2	53.1	56.9	0.225
Schizophrenic (296) (N = 282)	58.8	63.2	45.7	58.4	38.6	51.9	36.1	39.9	0.319
Major depressive (296.2-296.3) (N = 382)	37.4	43.6	75.8	81.9	42.5	45.3	40.7	42.7	0.377
Delusional (297) (N = 147)	48.1	54.7	71.0	77.6	44.7	53.4	42.6	54.7	0.009

Panel B: DMC

Diagnosis/Hospital type	All hospitals		General hospital (N = 1,273)		Community hospital (N = 334)		Psychiatric hospital (N = 403)		
Dementia (290) (N = 858)	2,551	2,228	2,589	2,395	2,634	2,426	2,512	2,104	0.801
Organic mental (294) (N = 203)	2,197	1,566	2,398	1,632	2,135	1,822	2,184	1,499	0.816
Schizophrenic (296) (N = 282)	3,158	2,676	2,853	2,574	3,341	2,840	3,176	2,622	0.559
Major depressive (296.2-296.3) (N = 382)	2,519	2,144	1,569	1,702	2,608	2,528	2,650	2,129	0.006
Delusional (297) (N = 147)	2,804	2,054	2,974	2,271	2,558	1,852	2,874	2,089	0.644

Abbreviations: LOS = length of stay, DMC = direct medical cost, and SD = standard deviation

Note: p-values were obtained from one-way analyses of variance. DMC are in U.S. dollars (US$1/NT$31.42).

* Included in our cross analyses, each psychogeriatric inpatient had only one of the top five psychiatric diagnoses and was admitted to only one type of institution.

field of psychogeriatric care in Taiwan was more sufficient than that in Shanghai.

The higher LOS and DMC in male compared to female inpatients might be caused by a patriarchal culture, shame and negative attitudes toward mental illnesses [17], the more aggressive behavioral symptoms of males [18], and less adherence to treatment among males [19, 20]. In Korea, LOS is consistent with our study findings of being higher among males than among females [1].

As shown in Table 2, our study result showed a significant difference in LOS among age groups (p = 0.035). This finding is similar to that in Korea [1]. But differences among age groups in this study were not found significant in DMC (Table 2).

Further indicated in Table 2, the clinical and symptomatic courses of dementia disorders,

schizophrenic disorders, and delusional disorders in psychogeriatric inpatients were longer than those in other disorders such as transient organic brain syndromes, other non-organic mental, anxiety, and depressive disorders (NOS). Longer treatment programs were needed, and more staff and facility resources were used for dementia, schizophrenic, and delusional disorders, thus leading to longer LOS and higher DMC, especially for the part of NDE (Table 2).

Based on the findings of our study, we found that longer LOS was associated with higher DMC (Table 2). In this study (Table 5), community hospitals were found to have significantly higher LOS than that in general hospitals (p < 0.001). Again, this study finding is also true in Korea [1]. But the results were not found to be significantly different for DMC in this study because a comparison of

Table 5.   Determinants of psychogeriatric inpatients for log(length of stay), log(direct medical cost), log(drug expense), and log(non-drug expense) (N = 2,641)

Characteristics	log (LOS)		log (DMC)		log (DE)		log (NDE)	
	Estimate (SE)		Estimate (SE)		Estimate (SE)		Estimate (SE)	
Gender: Female (reference)								
Male	0.16 ***	(0.04)	0.08 *	(0.04)	-0.08	(0.05)	0.09 *	(0.04)
Age: 65–69 years (reference)								
70-74	-0.05	(0.06)	0.05	(0.06)	0.04	(0.07)	0.05	(0.06)
75-79	-0.05	(0.06)	-0.01	(0.06)	-0.04	(0.07)	-0.01	(0.06)
80-84	0.00	(0.07)	0.04	(0.06)	0.05	(0.08)	0.04	(0.06)
85-89	-0.02	(0.08)	-0.05	(0.07)	-0.09	(0.10)	-0.04	(0.07)
≥ 90	-0.02	(0.12)	0.02	(0.11)	-0.04	(0.14)	0.02	(0.11)
Psychiatric diagnosis: Dementia (reference)								
Transient organic brain syndrome (293)	-0.71 ***	(0.15)	-0.33 *	(0.14)	-0.50 **	(0.18)	-0.31 *	(0.14)
Organic mental (294)	-0.14	(0.08)	-0.02	(0.07)	-0.08 **	(0.10)	-0.01	(0.07)
Schizophrenic (295)	0.32 ***	(0.07)	0.33 ***	(0.07)	0.40 ***	(0.09)	0.33 ***	(0.07)
Major depressive (296.2-296.3)	-0.06	(0.07)	-0.02	(0.06)	0.05	(0.08)	-0.02	(0.06)
Bipolar affective (296.0-296.8 except 296.2-.3)	-0.19 *	(0.09)	-0.05	(0.08)	0.09	(0.11)	-0.06	(0.08)
Delusional (297)	0.08	(0.09)	0.20 *	(0.08)	-0.06	(0.11)	0.22 **	(0.08)
Other non-organic mental (298)	-0.78 ***	(0.18)	-0.68 ***	(0.15)	-1.10 ***	(0.20)	-0.66 ***	(0.15)
Neurotic depression (300.4)	-0.58 ***	(0.14)	-0.51 ***	(0.12)	-0.77 ***	(0.16)	-0.50 ***	(0.13)
Depressive (311)	-0.60 ***	(0.18)	-0.39 *	(0.16)	-0.70 **	(0.21)	-0.36 *	(0.16)
Others (exclude top ten psychiatric diagnoses)	-0.39 ***	(0.10)	-0.19 *	(0.09)	-0.44 ***	(0.12)	-0.18 *	(0.09)
More than one major diagnosis	0.35 ***	(0.08)	0.43 ***	(0.07)	0.51 ***	(0.09)	0.43 ***	(0.07)
Institutional characteristics								
Type: General hospital (reference)								
Community hospital	0.26 ***	(0.06)	-0.18 **	(0.06)	-0.15 *	(0.07)	-0.19 ***	(0.06)
Psychiatric hospital	0.07	(0.06)	-0.07	(0.05)	-0.63 ***	(0.07)	-0.04	(0.05)
Multiple types	0.19	(0.13)	0.15	(0.12)	0.14	(0.15)	0.15	(0.12)
Multiple types								
Ownership: Public hospital (reference)								
Private hospital	-0.12 *	(0.05)	-0.19 ***	(0.04)	0.12 *	(0.06)	-0.21 ***	(0.04)
Both ownerships	-0.25	(0.23)	-0.31	(0.21)	-0.33	(0.28)	-0.31	(0.21)

Abbreviations: log(LOS) = log-transformed length of stay; log(DMC) = log-transformed direct medical costs; SE = standard error.
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

general and psychiatric hospitals yielded no significant differences in LOS or DMC (Table 5). Three major reasons accounted for the differences of LOS among three levels of hospitals: First, the different LOS control policies have been used by top hospital administrators. Second, the different intensities of medical and paramedical professional manpower (minimal human resource standards set by TJCHA) have been set differently among general, psychiatric, and community hospitals, which resulted in producing dissimilar LOS in different kinds of hospitals. This finding reflects the issue of healthcare manpower supply. And third, hospitals' strategic considerations were directed at financial goal attainment [21].

Under DMC, the DE value of psychiatric hospitals was found to be significantly different than that of general and community hospitals ($p < 0.001$, Table 2). Although the DE and DMC of general hospitals were less than those of community hospitals (186 vs. 187; 2,529 vs. 2,558), the differences were not significant. But after controlling for gender, age, diagnosis, and ownership effects, the estimated results for institutional characteristics showed that DMC, DE, and NDE of general hospitals were significantly greater than those of community hospitals ($p < 0.01$, Table 5). Only DE of psychiatric hospitals was significantly less than that of general hospitals ($p < 0.001$, Table 5). Based on those findings, we suggest that the smallest DE for psychiatric hospitals is reflecting their healthcare model being more dependent on intense manpower and medical equipment.

Comparing the operating efficiency of public and private hospitals as revealed from results of regressions, LOS and DMC of private hospitals were significantly lower than those of public ones. When breaking down DMC into DE and NDE, DE of private hospitals was indeed higher than that of public hospitals, but NDE, including per-sonal use, of private hospitals was lower. In Korea, LOS in private hospitals is lower than LOS in public hospitals, indicating greater operating efficiency in private hospitals.

Limitations of the study

The readers are cautioned against over-interpreting the study data because this study has four major limitations. First, we focused on patients who were admitted and were discharged only in 2006. We excluded the patients who were not discharged in 2006 from our study. Therefore, LOS and DMC in this study could be underestimated. In addition, based on the data of PSY2, we did not include the patients who were admitted to the psychiatric ward before 2002 and who were also admitted to the psychiatric ward in 2006. Second, the NHIRD data of Taiwan's NHI program do not have specific clinical individual information to definitively analyze the causal relationship of etiologies of admissions and treatment outcomes. Third, as most psychiatrists in Taiwan adopted *DSM-IV* diagnostic criteria rather than the *ICD-9* system to evaluate their patients, some gaps exist in diagnostic accuracy. And finally, because of the complexity of cost measurement, we only divided DMC into DE and NDE for comparison, and we did not do detailed differential evaluation (e.g., the composite of NDE such as manpower fee, clinical laboratory cost, and brain imaging cost, etc.).

Implications of the study

Three major implications exist from this study. First, the elderly people in the population is increasing, the total numbers of psychogeriatric patients are growing rapidly. The issues of LOS and DMC for psychogeriatric patients have become increasingly important. Previous Taiwanese studies focusing on LOS and DMC have been lim-

ited to mental illnesses. In a 2003 study of schizo-phrenia by Yeh et al., the values for LOS (40 days) and DMC (US$2,040) are lower than those obtained in our study results [22]. Chan et al. in 2009 studied the DMC of Alzheimer's disease between 2000 and 2002 and found that the total DMC is increased annually [3]. But in this study, we focused on all psychiatric disorders of geriatric inpatients, rather than only 1 or 2 types of mental illnesses. We thoroughly examined LOS and DMC for psychogeriatric inpatients to discover the determining factors that cause them.

Second, the classifications of mental disorders are also important determinants of LOS and DMC. The heterogeneities and complexities among geriatric mental disorders lead to different levels of healthcare use. The diagnoses of dementia, organic mental, schizophrenic, and major depressive disorders make up to 65% of the study population. Furthermore, LOS and DMC of dementia, schizophrenic, and delusional disorders are longer and higher than for other mental disorders. Therefore, mental healthcare teams should develop more cost-effective treatments to cope with the demands of these patients.

Finally, for managerial implication, the type of institution also plays an important role in determining inpatient LOS and DMC. The characteristics of institutions vary among general hospitals, community hospitals and psychiatric hospitals [15]. Therefore, different levels of institutions need to use dissimilar strategies for economic pursuit through the control of LOS and DMC.

Conclusion

In spite of four limitations in this study, we would like to conclude that gender, psychiatric diagnoses, and types of hospital determined differences of LOS and DMC of psychogeriatric inpatient hospitalization. The DE and NDE of DMC

were found to account about 10% and 90%, respectively. But only NDE was demonstrated to have significant difference based on gender.

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