Relationships between Length of Stay and Hospital Characteristics under the Case-Payment System in Taiwan: Using Data for Vaginal Delivery Patients

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Background: Case payment has been implemented since the beginning of Taiwan's National Health Insurance Program in 1995. This study selected patients undergoing a vaginal delivery to explore the relationships between maternal length of stay (LOS) and hospital characteristics under the case-payment system in Taiwan.

Methods: The National Health Insurance Research Database of 1999 from Taiwan's National Health Research Institutes was used in this study. In total, 5456 patients who underwent a vaginal delivery in 1999 meeting the selection criteria were drawn from the database. A multiple regression analysis was performed in which LOS was regressed against the variables of hospital level, hospital location, hospital ownership, and teaching status.

Results: The regression model indicated that hospital level, hospital ownership, and hospital location were significantly related to LOS after adjustment for patient age, principal procedure, and the presence of a secondary diagnosis. The LOS for patients undergoing a vaginal delivery in private hospitals was shorter than those in public and non-profit proprietary hospitals. Patients admitted to medical centers or regional hospitals were more likely to have a longer mean LOS in comparison with their counterparts admitted to district hospitals. The LOS for patients hospitalized in northern Taiwan tended to be significantly longer on average than those in central and southern Taiwan.

Conclusions: This study demonstrates that wide variations in LOS exist among hospitals in Taiwan under the case-payment system. It is recommended that the Bureau of the National Health Insurance develop a national system to monitor certain hospitals that have an unusually short LOS.

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Key words: **case payment, length of stay, vaginal delivery.**

Taiwan's National Health Insurance Program (NHIP) began on March 1, 1995 to remove financial barriers to health care and to enhance accessibility to comprehensive medical care for all citizens. Many goals set for the nascent stage had been achieved 7 years after its inception. For exam-

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ple, at the end of December 2001, the coverage rate had reached 96.16%, up from 92% at the end of the inaugural year (Bureau of the National Health Insurance, BNHI, 2002). However, due to the dramatic rise in medical expenses accompanying the expedited expansion of coverage rates and increased access to medical care, the NHIP was acknowledged to have gone into debt in 1999. In order to minimize deficits and to make better use of medical resources, the BNHI adopted more-efficient and economical strategies such as incessant expansion of the scope of diseases paid for by case payment to control medical expenditures.

Case payment, similar to diagnosis-related groups (DRGs) used in the US, has been implemented since the beginning of the NHIP. Under case payment, hospitals are allowed to keep the discrepancy or must absorb the differential between their costs and the reimbursement rate established for providing patient care by the BNHI. Therefore, the case payment system provides hospitals with financial incentives to discharge patients as quickly as medically feasible in order to obtain maximal profits. Studies have confirmed that implementation of DRGs led to significant decreases in the length of stay (LOS) for all DRGs in the US.[1] Similar to the US experience, the LOS for some case payment items also decreased after implementation of case payment in Taiwan.[2]

In addition to the reduction in LOS with the advent of DRGs, hospitals responded to the financial incentives created by third-party payers to different degrees as reflected in LOS data based on the US experience. Many studies have identified that wide variations in LOS exist among hospitals under a per-case-based payment system. For example, Leung et al. found that hospitals differed significantly in maternity LOS even after adjusting for the patient case mix.[3] Lutjens observed that wide variations in LOS existed among hospitals.[4] Specifically, studies have indicated that hospital characteristics such as hospital ownership, hospital location, teaching status, hospital size, and other factors can cause variations in LOS.[1,3,5-10]

Based on experience with DRGs, wide variations exist in LOS among hospitals under a per-case-based payment system in the US. However, little research has been conducted to investigate the relationships between LOS and such hospital characteristics as hospital type, hospital ownership, hospital location, and hospital teaching status under implementation of case payment in Taiwan. To explore the relationships between hospital characteristics and LOS may not only help hospital administrators understand the possible effects of case payment on hospitals, but may also help policy makers identify those hospitals in which patients are more likely to have shorter stays. There is an imperative need for investigations of hospital characteristics that may be associated with hospital LOS under the case-payment system. Therefore, this study used patients undergoing a vaginal delivery to explore the relationships between LOS and hospital characteristics under the case-payment system in Taiwan. The reasons for selecting vaginal delivery as a target case payment item were that: (1) vaginal delivery is the most frequent cause of hospital admissions in Taiwan; (2) vaginal delivery was one of the first three diseases paid for on a case-payment basis; and (3) patients undergoing a vaginal delivery are described as being a fairly homogeneous group because of gender, age, and low complication or comorbidity rates compared with patients treated under other case-payment items.

METHODS

Database and subjects

This study used the National Health Insurance Research Database (NHIRD) of 1999, which was published by Taiwan's National Health Research Institutes. As to the sampling of the NHIRD, Taiwan's National Health Research Institutes used a systematic sampling method to randomly select a representative subgroup from the entire database due to the large number of inpatient and outpatient medical benefit claims in a year. The sampling bases of outpatient medical benefit claims and inpatient medical benefit claims were 0.2% and 5% of the entire database, respectively. The sampled subgroup was similar with regards to age, gender, and costs to those of the entire population.

In total, 8602 patients who underwent a vaginal delivery in 1999 meeting the selection criteria were identified on the basis of the case-payment code for vaginal delivery (0373A). After excluding patients who had a LOS of longer than 6 days (N=10), who were less than 15 years of age (N=10), who were over 40 years of age (N=20), and who were discharged from obstetrics and gynecology clinics

(N=3106), the remaining eligible sample size amounted to 5456 in the analysis. Since this study focused on the relationship between hospitals and patients undergoing a vaginal delivery, those patients who were discharged from obstetrics and genecology clinics were excluded from the study.

Variables

The dependent variable was maternity LOS in the hospital. This continuous variable was operationalized as the time, in days, from patient admission to the hospital until discharge. Hospital characteristics described by hospital level, hospital ownership, hospital location, and teaching status of hospitals were selected as independent variables. Hospital level was classified into medical center, regional hospital, and district hospital. Hospital ownership was recorded as 1 of 3 types: public (including veterans hospitals), non-profit proprietary, and private. Based on the site of division of the BNHI where hospitals claimed medical benefits, hospital location was divided into northern, central, southern, and eastern. The hospital teaching status was treated as a dichotomous category on the basis of whether or not a hospital was accredited as a teaching hospital by the Department of Health in 1999. The principal procedure codes for patients undergoing a vaginal delivery are 73.6 (episiotomy), 72.71 (a vacuum extraction with episiotomy), 73.59 (other manually assisted delivery), and others. Age and whether or not a secondary discharge diagnosis was present were also included as control variables to adjust the LOS in the analysis. Patient age was used as a continuous variable. The variable of the presence of a secondary discharge diagnosis was used with intent to control whether a patient had complications or comorbidity because there is no severity index of illness currently available in Taiwan. The variable of the presence of a secondary discharge diagnosis was divided into the 2 categories of "yes" and "no".

Statistical methods

Statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS 10.0 for Windows, 1997, SPSS, Chicago, IL). Descriptive statistical analyses including the frequency, percentage, mean, and standard deviation were performed on all identified variables. A multiple regression analysis was also performed in which LOS was regressed against the independent variables of hospital level, hospital ownership, hospital location, and whether or not a hospital was a teaching hospital. In the case of categorically independent variables, dummy variables were created to account for the effect that the variable might have on the response. Hospital level, hospital ownership, hospital location, hospital teaching status, principal procedure code, and whether or not a secondary discharge diagnosis was present were treated as sets of dummy variables, while district hospital, private hospital, northern hospital, non-teaching hospital, others (principal procedure code), and the presence of a secondary discharge diagnosis were selected as reference groups, respectively. The interaction variables of teaching status and hospital level, teaching status and hospital ownership, teaching status and hospital location, hospital level and hospital ownership, hospital level and hospital location, and hospital ownership and hospital location were also assessed in this multiple regression model. A 2-sided p value of ≤ 0.05 was required for statistical significance.

In addition, since severe multicollinearity leads to unreliable coefficient estimates and large standard errors in a multiple regression model, the effects of multicollinearity of the parameter estimates were also evaluated using a variance inflation factor (VIF). Glantz and Slinker stated that values of VIF exceeding 10 are a sign of serious multicollinearity.[11] Therefore, if the VIF of an independent variable was greater than 10 in this study, this variable was dropped from the multiple regression model.

RESULTS

Descriptive analysis

Frequency distributions and sample percentages were calculated for each variable. In the sample, patients ranged in age from 15 to 40 years (Table 1), with a mean age of 26.88 years and a standard deviation (SD) of 4.57 years. The maternity LOS of patients in the study, ranged form 1 to 5 days, with a mean LOS of 2.60 days and a SD of 0.78 days.

With regards to hospital level, the percentage of sample patients discharged from medical centers was 21.6%, from regional hospitals was 35.2%, and from district hospitals was 42.8%. As to hospital ownership, the majority of patients (44.5%) were admitted to non-profit proprietary hospitals, 16.9% to public

hospitals, and the remaining 38.6% to private hospitals. With respect to hospital location, 44.3% were admitted to hospitals located in northern Taiwan, followed by those admitted to hospitals located in southern Taiwan (29.4%). Only 1.8% of the sampled patients were admitted to hospitals located in eastern Taiwan. Among all sampled patients, 67% were treated in teaching hospitals, with the other 33% in non-teaching hospitals (Table 1).

Unadjusted LOS for patients by hospital level, hospital ownership, hospital location, and hospital teaching status is shown in Table 2. ANOVA showed that LOS for patients hospitalized to undergo a vaginal delivery was significantly related to hospital level ($p=0.000$), hospital ownership ($p=0.000$), hospital location ($p=0.000$), teaching status ($p=0.000$), age ($p=0.000$), whether or not a secondary diagnosis was present ($p=0.000$), and principal procedure ($p=0.000$).

Multiple regression analysis

Multiple regression analysis revealed that 18.2% of the observed variation in LOS was explained with the help of independent variables (Table 3). The results show that variables of age ($p=0.000$), the presence of a secondary diagnosis ($p=0.000$), and being a medical center ($p=0.000$), regional hospital ($p=0.000$), public hospital ($p=0.000$), non-profit proprietary hospital ($p=0.000$), central hospital ($p=0.000$), and southern hospital ($p=0.000$) were significantly related to LOS.

That is, 2 dummy variables of hospital level were significantly positively associated with LOS after controlling for age and the presence of a sec-

Table 1. Characteristics of Sampled Patients and Hospitals

	Variables	N	%	Mean	S.D.	Min	Max
Dependent							
LOS		5456		2.60	0.78	1.00	5.00
Independent							
Hospital level							
	medical center	1181	21.6				
	regional hospital	1940	35.2				
	district hospital	2335	42.8				
Hospital ownership							
	public	920	16.9				
	non-profit proprietary	2426	44.5				
	private	2110	38.6				
Hospital location							
	northern	2415	44.3				
	central	1339	24.5				
	southern	1602	29.4				
	eastern	100	1.8				
Teaching status							
	yes	3653	67.0				
	no	1803	33.0				
Control							
Age		5456		26.88	4.57	15.00	40.00
Presence of a secondary diagnosis	yes	3122	57.2				
	no	2334	42.8				
ICD-9-CM code							
	73.6	4078	74.7				
	72.71	620	11.4				
	73.59	642	11.8				
	other	116	2.1				

Table 2. Relationships between LOS and Hospital Characteristics

		LOS					
	Variables	N	Mean	S.D.	Min.	Max.	F/t/r
Hospital level							
	medical center	1181	2.90	0.68	1.00	5.00	245.38***
	regional hospital	1940	2.72	0.70	1.00	5.00	
	district hospital	2335	2.36	0.82	1.00	5.00	
Hospital ownership							
	public	920	2.95	0.69	1.00	5.00	375.09***
	non-profit proprietary	2426	2.76	0.67	1.00	5.00	
	private	2110	2.27	0.81	1.00	5.00	
Hospital location							
	northern	2415	2.84	0.69	1.00	5.00	196.32***
	central	1339	2.25	0.84	1.00	5.00	
	southern	1602	2.54	0.74	1.00	5.00	
	eastern	100	2.80	0.65	1.00	5.00	
Teaching status							
	yes	3653	2.74	0.73	1.00	5.00	18.25***
	no	1803	2.44	0.81	1.00	5.00	
Presence of a secondary diagnoses	yes	3122	2.68	0.75	1.00	5.00	8.26***
	no	2334	2.50	0.81	1.00	5.00	
ICD-9-CM code							
	73.6	4078	2.58	0.76	1.00	5.00	11.41***
	72.71	620	2.77	0.77	1.00	5.00	
	73.59	642	2.59	0.87	1.00	5.00	
	other	116	2.72	0.81	1.00	5.00	
	Total	5456	2.60	0.78			

***$p < 0.001$; F: one-way ANOVA; t: independent sample t-test; r: Pearson correlation.

ondary diagnosis. This shows that patients undergoing a vaginal delivery admitted to medical centers or regional hospitals were more likely to have a longer mean LOS in comparison with their counterparts admitted to district hospitals. Two dummy variables of hospital ownership were also significantly positively associated with LOS. This reveals that those patients undergoing a vaginal delivery admitted to public hospitals or non-profit proprietary hospitals were apt to have a longer LOS on average than were patients undergoing a vaginal delivery admitted to private hospitals. Two dummy variables of hospital location were also observed to have significant negative relationships with LOS. This indicates that lengths of stay for patients hospitalized to undergo a vaginal delivery in northern Taiwan tended to be significantly longer on average than those in central or southern Taiwan. In summary, private district hospitals located in central Taiwan had a shorter mean LOS than did other kinds of hospitals.

In addition, this study found that the VIFs of interaction variables between teaching status and hospital level, teaching status and hospital ownership, teaching status and hospital location, hospital level and hospital ownership, and hospital level and hospital location were greater than 10. This suggests that the partial effects of these interaction variables on other independent variables cannot be ignored in the interpretation of the regression coefficients in this multiple regression model. Therefore, these interaction variables were dropped from the model.

DISCUSSION

The purpose of this study was to explore the relationships between maternal LOS and hospital characteristics for patients undergoing a vaginal delivery under the case-payment system in Taiwan.

Table 3. LOS Regression Results

Variables	LOS				
	B	std. error	*t*-value	VIF	partial R^2
Independent					
Hospital level					
medical center (yes/no)	0.276	0.036	7.57 ***	2.47	0.039
regional hospital (yes/no)	0.105	0.031	3.42 ***	2.36	0.002
Hospital ownership					
public (yes/no)	0.413	0.035	11.77 ***	1.89	0.017
non-profit proprietary (yes/no)	0.243	0.030	8.00 ***	2.50	0.019
Hospital location					
central (yes/no)	-0.416	0.028	-15.09 ***	1.54	0.066
southern (yes/no)	-0.184	0.025	- 7.50 ***	1.37	0.022
eastern (yes/no)	0.029	0.073	0.39	1.06	
Teaching status					
yes (yes/no)	-0.010	0.031	-0.31	2.33	
Control					
Age	0.015	0.002	7.03 ***	1.04	0.008
Presence of a secondary diagnosis (yes/no)	-0.090	0.023	-3.85 ***	1.46	0.001
ICD-9-CM code					
736 (yes/no)	-0.339	0.068	-5.01 ***	9.46	
7271 (yes/no)	-0.159	0.073	-2.18 *	5.81	0.004
7359 (yes/no)	-0.357	0.074	-4.86 ***	6.13	0.004
Constant	2.452	0.092	26.58 ***		
n		5456			
R^2		0.182			

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

The regression model indicated that hospital level, hospital ownership, and hospital location were significantly related to LOS after adjustment for patient age and the presence of a secondary diagnosis. The findings are consistent with those reported earlier that hospital characteristics cause variations in LOS after having adjusted for differences in patient characteristics in the US.[3,4,7,8]

Hospital ownership and LOS

With respect to hospital ownership, our observation that patient LOS was expected to be shorter in private hospitals than in non-profit proprietary hospitals or in public hospitals under the case-payment system is in line with findings by Mawajdeh et al. in Jordan and by Thomas et al. and Wolinsky et al. in the US.[5,12,13] However, a recent study conducted by Huang and his colleagues failed to find a significant relationship between LOS and hospital ownership.[14] The possible reasons contributing to differences in LOS caused by hospital ownership can be attributed to financial incentives created by the prospective payment system for hospitals, to a change in physician behaviors, and to hospital efficiency.

Since hospitals are reimbursed a fixed amount for each treated patient based on codes rather than on actual resources used under case payment, hospitals have strong financial incentives to discharge patients as quickly as medically feasible; this is especially true for private hospitals.[15] Unlike public hospitals and non-profit proprietary hospitals financially supported by government funding or philanthropic donations, private hospitals have to seek any feasible means to increase revenues in order to stay competitive in the healthcare market. Consequently, private hospitals inevitably tend to shorten patients' LOS on the basis of financial considerations regardless of their health status upon discharge. The gray zones of medical judgments concerning the appropriate timing of patient discharge provide many opportunities

for profitability by private hospitals.

Physicians have also perceived increased financial pressures from hospital administrators to offer the least-expensive medical procedures after the implementation of case payment.[16] This pressure has forced physicians to change their practice behaviors in a way favorable to a hospital's finances. That the changes in physician practice patterns can result in variations in LOS was also confirmed by the findings of List et al.[17] and Fortney et al.[18]

Aside from the reasons discussed above, hospital efficiency also plays an important role in LOS. Brooks et al. indicated that providing more-efficient care is one of the major factors decreasing LOS.[19] Many studies concerning the relationships between hospital ownership and efficiency have been conducted in Taiwan. They have all consistently reported that private hospitals are more efficient than public hospitals in providing a range of medical care.[20,21] The convergent findings provide evidence that the low efficiency in public hospitals has led to longer LOSs under case payment in Taiwan. Efficiency in providing medical care is considered an important predictor of average LOS in a hospital.

Hospital Level and LOS

As expected, patients admitted to medical centers and regional hospitals had a longer average LOS than did patients admitted to district hospitals. This can partly be explained by medical centers and regional hospitals tending to receive a relatively high proportion of patients suffering from more-serious illnesses than do district hospitals. Although advanced adjustments were made in this study for patients who had a secondary discharge diagnosis, there were no means to assure that the sampled patients all had the same unmeasured severity of illness. Horn et al. reported that severity-adjusted DRGs explained 61% of the variability in resource use; a higher severity of illness undoubtedly results in a longer hospital stay.[22]

This can also partly be attributed to patient dumping. Once a hospital identifies that a pregnant woman is unprofitable, it will transfer such a patient to another hospital. Schlesinger et al. described the phenomenon of "the transfers of patients from the treating hospital to other healthcare providers solely on economic grounds" with the term "patient dumping".[23] Patient dumping might lead to an average longer LOS in medical centers compared to district hospitals.

Teaching Status and LOS

This study also reveals that there was no significant relationship between LOS and whether a hospital was a teaching hospital for patients undergoing a vaginal delivery. This indicates that patients undergoing a vaginal delivery stayed in teaching hospitals the same amount of time as in non-teaching hospitals. This result is not consistent with the finding of Rosenthal et al. that risk-adjusted LOS was 9% lower among patients in major teaching hospitals relative to non-teaching hospitals.[7] A possible explanation may be that teaching hospitals have seriously ill patients, but due to their good management strategies such as implementation of clinical pathways or evidence-based medicine, the average length of time patients need to recover in teaching hospitals is almost the same as that in non-teaching hospitals. Many studies have supported that the implementation of clinical pathways is related to reduced LOSs.[24-26] Further research using patients treated under other case-payment items is needed to clarify the relationship between LOS and the teaching status of hospitals.

Hospital Location and LOS

Another noteworthy finding is that patients admitted to hospitals located in central or southern Taiwan had shorter LOSs than did patients admitted to hospitals located in northern Taiwan. One possible explanation is that there is a high density of hospitals concentrated in northern Taiwan compared to central or southern Taiwan. For example, 4300 of 16,168 hospitals and clinics in Taiwan are located in Taipei City and Taipei County (Department of Health, 2000). Competitive pressures may encourage hospitals in northern Taiwan to accommodate patient preferences for longer LOSs. Otherwise, they may be faced with loss of patients or be forced to close because of failure to provide the most cost-effective treatments. This postulation is supported by the finding of Robinson et al. that competitive pressures lead to longer LOSs.[27]

Overall, the power of the data used in this study is approximate to 1. Therefore, we are able to reject the null hypothesis when it is false. In other words, very small differences could reach statistically sig-

nificance in the analyses used in this study.

Conclusions

Traditional cost-based reimbursement was blamed for wide variations among hospitals for treating similar diagnoses. However, this study demonstrates that wide variations in LOS still exist among hospitals in Taiwan under the financial incentives offered by the case-payment system. Proprietary hospitals and district hospitals have significantly shorter LOSs than do public hospitals and medical centers. Concerns have been raised about whether the overall quality of hospital care for inpatients has declined due to the short LOSs in proprietary hospitals and district hospitals. Therefore, it is recommended that the BNHI develop a national system like peer review organizations in the US to monitor the discharge status of patients whose care is paid for under case payment and to oversee certain hospitals which have unusually short LOSs.

Limitations

There are several limitations to this study. First, the findings of this study are limited to patients undergoing a vaginal delivery, so they cannot be generalized to other case-payment disease items. Further research using other case payment items is needed to explore the relationships between LOS and hospital characteristics. Second, this study was designed as a cross-sectional study rather than a longitudinal study, so cause-effect relationships cannot be determined. Future research should focus on a longitudinal study to further explore the relationship between LOS and hospital characteristics. Finally, patient identification information is not released to the public in this database for confidentiality concerns, and this prevents researchers from exploring the relationships between maternity LOS and infant outcomes. Further research is needed to explore the possible effects of a reduction in maternity LOS on the health status of infants.

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論病例計酬制度下住院天數與醫院特性關係之研究：以自然生產爲例

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背 景： 自台灣全民健康保險開始就已實施論病例計酬制度，本研究選擇自然生產之病人，探討在論病例計酬制度下住院天數與醫院特性的關係。

方 法： 本研究使用由國家衛生研究院發行的1999年全民健康保險學術研究資料庫的次級資料，合乎選擇標準的自然生產病人共有5456位。以複迴歸分析以探討住院天數與醫院所有權、醫院層級、醫院所在地及是否爲教學醫院之關係。

結 果： 結果發現在控制病人年齡及有無次診斷後，醫院所有權、醫院層級、和醫院所在地與住院天數有統計上的顯著關係。對自然生產之病人而言，私立醫院病人的住院天數比公立醫院及財團法人醫院短；醫學中心和區域醫院病人的住院天數比地區醫院長；北部醫院病人的住院天數比中部及南部醫院長。

結 論： 在論病例計酬制度下，住院天數與醫院特性之間確實有關聯性存在，建議中央健康保險局成立類似美國同儕審查組織的機構來監控有不正常住院天數的醫院，以確保病人權益。

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關鍵字： 論病例計酬，住院天數，自然生產。

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