

## EFFECT OF A PROSPECTIVE PAYMENT SYSTEM ON AGRICULTURE HEALTH VILLAGES

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**ABSTRACT.** *A prospective payment system (PPS) was introduced in Taiwan to reduce the overall inflation of health care expenses. Although many reports have emerged of “patient dumping” into agriculture health villages under the PPS, little is known regarding changes concerning particular reimbursed categories. Through big data analysis of 1 million patients by using the Taiwan National Health Insurance Research Database, we identified patients admitted for tonsillectomy. We examined changes in hospital costs, admission rates, and lengths of stay in agriculture health village hospitals before and after the introduction of the PPS. A total of 111 patients were included in the fee-for-service phase and 549 in the case-based payment (CBP) phase. No significant differences were noted in age or sex between the payment phases. Admission rates did not differ significantly between the payment phases. The mean length of stay shortened from  $4.75 \pm 2.40$  to  $3.95 \pm 2.87$  days after the introduction of the CBP system, a significant reduction of 16.8%. A strong positive correlation between the medical cost per patient admitted to agriculture health villages and the set rate of reimbursement was also noted.*

**Keywords:** Prospective payment system, Agriculture health village, Big data analysis

**1. Introduction.** The three dimensions of smart health care are sustainable living space, culture-oriented science and technology, and ecofriendly agriculture. With a rapidly aging population, rapid innovation in medical treatment, and new medical technology, health care spending has grown precipitously over the past 20 years [1,2]. To slow the growth of health care expenditure, reducing health care costs has become a critical concern for most countries.

The main reasons for this growth in expenditure are rapidly aging demographic structures and the high costs of newly developed medicines and medical technologies [3]. Thus, reducing medical care expenditure to reasonable levels has become an important focus for many countries.

Since 1995, Taiwan has implemented the National Health Insurance (NHI) program, which is a single-payer social insurance system. The program covers 99.6% of the population in Taiwan (approximately 2,375,000 people). The NHI has signed contracts with 93% of hospitals and clinics, including agriculture health villages [4]. A characteristic of the NHI is positive accessibility which refers to having a comprehensive population coverage rate, short waiting times for medical consultation, low costs, and a complete data collection system for planning and researching health policies [4,5]. Since the implementation of the NHI program, both revenues and expenditures have grown. However, the increase

in medical expenditure has been considerably higher than that in revenues from insurance premiums. Thus, the system has encountered an annual deficit since 1998. The major causes of rapid growth in expenditures include longer average life expectancy and a decreased birth rate, which have led to a rapidly aging population [4]. To solve its financial problems, the NHI has reduced its expenses and increased insurance premiums.

During the initial period when the NHI program was implemented, medical care benefits were based on a fee-for-service (FFS) payment model. Agriculture health villages were reimbursed according to medical services they provided. In the NHI system, no upper limit existed for patients' utilization rate of agriculture health villages. The calculation of FFS payments based on services provided by agriculture health villages provided such villages an inborn incentive to offer more services. This meant that care providers might offer unnecessary medical services to patients, resulting in inefficient health care [4,6]. Similarly, Medicare in the United States previously used a retrospective cost-based payment model, which saw hospitals' costs grow faster than overall inflation [7]. To resolve this and enhance medical efficiency, since 1983, Medicare has used a prospective payment system (PPS) [8,9]. In Taiwan, the NHI chose to introduce a case-based payment (CBP) system for patients hospitalized in agriculture health villages. CBP is a type of a PPS that is classified according to cases under which hospitals are reimbursed only a fixed amount from a planned rate [5].

From the perspective of economy, in the PPS, when a medical provider's behavioral model is based on the minimum payment with a positive gap between the maximum insurance benefits and service costs, payment of a fixed amount serves as an incentive for hospitals to enhance their efficiency and shorten patients' length of stay (LOS) in order to reduce the maximum care costs and increase the number of hospitalized patients, thereby increasing revenue [10].

After implementing the PPS, the admission of patients with severe medical problems increased hospitals' medical costs. Thus, to lower these losses, many agriculture health villages avoided admitting patients with severe conditions, which resulted in patient dumping. Many studies have examined this phenomenon [11-15]. However, little research has been conducted on the effect of implementing the PPS on medical costs, admission rates and LOS. Furthermore, most studies were short-term observations. By examining NHI data regarding tonsillectomy, this study explored changes in medical costs, admission rates, and LOS before CBP was introduced and in the 10 years following its introduction in Taiwan. Changes before and after the implementation of CBP were compared to determine the long-term effect of the PPS on medical behavior through 10 years of long-term longitudinal observation.

**2. Materials and Methods.** The NHI Research Database (NHIRD) contains detailed medical claims data for reimbursements of the NHI's 23.75 million enrollees. The NHIRD datasets are deidentified by scrambling the identity codes of both patients and medical facilities.

In this population-based retrospective cohort study, data were obtained from 1 million representative enrollees randomly selected from the NHIRD by Taiwan's National Health Research Institutes by using a systematic sampling method. The sampled base of inpatient medical claims comprised 5% of the entire NHIRD. This subgroup was representative in terms of age, sex, and costs to the population enrolled in the NHI program.

The sampling period was from March 1997, the available start of the NHIRD, to February 2009. All patients admitted for tonsillectomy (procedure code: 71006) during this period were included. There were two study phases: the FFS payment phase (March 1997-February 1999) and the CBP phase (March 1999-February 2009). CBP for tonsillectomy was implemented in Taiwan in March 1999. CBP was set at a predetermined fixed reimbursement rate by the Bureau of NHI (now known as the NHI Administration) based

on the type of the surgical procedure, regardless of the total medical cost and without stratification according to the severity of the illness or other health-related factors.

**3. Statistical Methods of Big Data Analytics.** Descriptive and frequency statistical analyses were performed using SAS 9.4. (SAS Institute, Cary, NC, USA). The demographic characteristics of patients who underwent tonsillectomy included the ratio, mean, range, and standard deviation (SD) for sex and age, number of physicians performing the procedure, and number of admitting agriculture health villages [16]. Descriptive statistics are represented as the mean  $\pm$  SD for continuous variables and as the percentage for categorical variables. An independent sample *t* test was employed to analyze differences in data between the FFS and CBP phases, which included continuous demographic variables, number of patients, LOS, and medical costs; the chi-square test was utilized to compare differences in categorical variables between the payment phases. The medical costs of agriculture health villages were adjusted for inflation by using the consumer price index. The Pearson correlation analysis was used to determine the relationship between total medical costs and fixed reimbursement amounts for tonsillectomy.  $P < 0.05$  was considered statistically significant.

TABLE 1. Demographics of patients admitted for tonsillectomy in agriculture health villages during the FFS and CBP phases

	FFS phase 1997-1998 ( <i>n</i> = 111)		CBP phase 1999-2008 ( <i>n</i> = 549)									
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Year												
No of patients	52	46	49	47	66	47	43	46	56	65	69	61
Gender												
Male	27	20	23	19	30	30	19	23	29	38	38	33
Female	25	26	26	28	36	17	24	23	27	27	31	28
Age (years)												
Mean	30.9	33	29.7	31	28.8	31	31.7	30.6	26.6	27.8	28.8	30.4
SD	14.6	15.3	15.2	16.1	15.7	16.1	18.3	19.7	15.5	19	18.9	17.5
Range	5.2-74.8	5.8-69.5	4.3-62.5	3.6-72.0	1.0-67.6	4.7-69.5	4.0-79.7	4.2-76.3	3.5-65.8	3.2-82.7	3.1-76.1	4.8-69.8
No of hospitals	26	26	24	26	32	28	24	28	30	30	34	29
No of physicians	42	45	43	39	48	38	35	40	46	54	55	53

$P = 0.0005$

**4. Results.** A total of 660 patients admitted for tonsillectomy were identified from the inpatient NHIRD dataset from 1997 to 2008 (Table 2). Of these, 111 and 549 patients admitted to agriculture health villages were included in the FFS and CBP phases, respectively; their mean ages were  $32.0 \pm 15.0$  and  $29.5 \pm 17.3$  years, respectively, and 42.3% and 51.4% of patients in the FFS and CBP phases, respectively, were men. No significant differences in age or sex were noted between the payment phases ( $P = 0.22$  and  $P = 0.82$ , respectively). Moreover, no statistical difference was noted in terms of admission rates between the FFS and CBP phases ( $P = 0.09$ ).

Regarding medical costs, significant differences were found in surgical fees, laboratory test fees, and pharmaceutical fees between the FFS and CBP phases. The mean expenditure for surgical fees increased significantly from NT\$5211 in the FFS phase to NT\$8995 in the CBP phase, an increase of 72.3% ( $P < 0.001$ ). Costs for laboratory tests increased by 31.6% from NT\$2349 in the FFS phase to NT\$3092 in the CBP phase ( $P = 0.003$ ). A highly significant 70.6% reduction in the cost of pharmaceutical fees from NT\$3099 to NT\$1817 was observed ( $P < 0.001$ ). Table 3 lists the total medical costs and main cost

TABLE 2. LOS for tonsillectomy in agriculture health villages in the FFS and CBP phases

Length of stay (days)	FFS phase (1997-1998)		CBP phase (1999-2008)									
	Mean	SD	Mean					SD				
	4.75	2.40	3.95					2.87				
Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Mean	4.8	4.8	4.2	3.5	3.7	3.4	4.0	5.5	3.6	3.9	3.6	4.4
SD	2.5	2.3	2.3	1.4	1.4	1.1	3.6	5.2	1.9	3.7	1.7	3.6
Range	2-18	1-16	1-14	2-11	1-10	2-7	1-22	0-24	1-14	1-30	2-12	1-22

$P = 0.0005$

TABLE 3. Total medical costs per patient and main cost items (consumer price index-adjusted) of agriculture health villages in the FFS and CBP phases

Medical costs (NT dollar)	FFS phase 1997-1998 ( $n = 111$ )		CBP phase 1999-2008 ( $n = 549$ )		$P$ value
	Mean	SD	Mean	SD	
Total medical costs	22962	9983	28201	24774	0.010
Physician fee	1424	650	1444	958	0.468
Ward fee	4184	2295	4223	3430	0.787
Laboratory tests fee	2349	1614	3092	3073	0.003
Image tests fee	442	1977	581	2541	0.179
Surgery fee	5211	3769	8995	9351	< 0.001
Anesthesia fee	6589	2349	7244	3343	0.053
Pharmaceutical fee	3099	3620	1817	3167	< 0.001

$P = 0.010$

items (adjusted for inflation) of agriculture health villages per patient during the FFS and CBP phases.

Total medical costs increased alongside reimbursement rates for tonsillectomy. A strong positive correlation between total medical costs and reimbursement rates was noted ( $P = 0.009$ ). Figure 1 shows the relationship between agriculture health villages' total medical cost per patient and the set reimbursement amount for tonsillectomy.

**5. Discussion.** The results of the present study showed that compared with the FFS phase, LOS was lowered significantly by 16.8% in the CBP phase ( $P = 0.0005$ ). This finding is consistent with the results of previous studies [13-17]. The results indicate that the PPS improved the efficiency of agriculture health village hospitals. This was also the case for Medicaid in the United States, wherein LOS decreased after the introduction of the PPS [6,7]; Guterman and Dobson reported that in 1984, the second year after the PPS was introduced, Medicare LOS was lowered by 9% [8].

After Medicare implemented the PPS, the medical costs of agriculture health villages grew at a slower rate. From 1980 to 1984, the medical expenditure increased by 6.9% annually. However, from 1984 to 1987, such expenditure only grew by 4.0% annually [12]. The present study found that in Taiwan, the average cost of hospitalization for tonsillectomy patients admitted to agriculture health villages increased by 22.8% ( $P = 0.01$ ) in

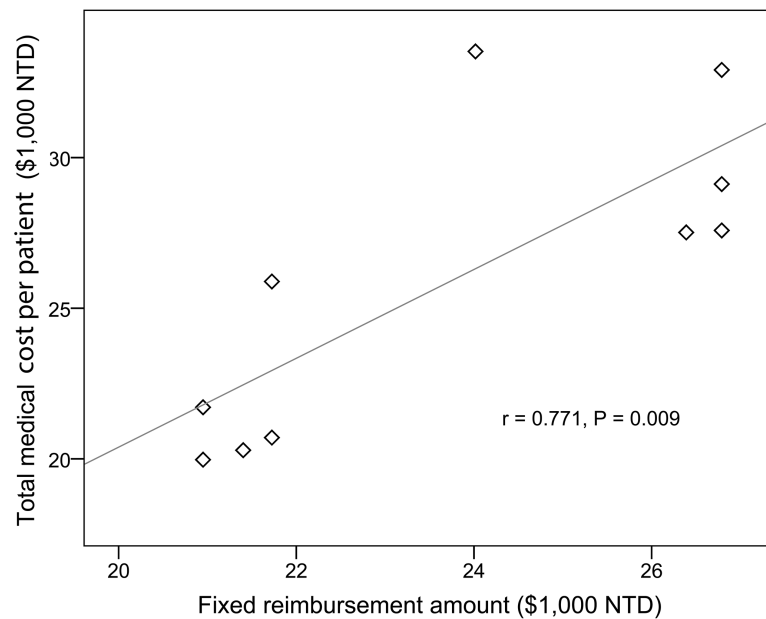


FIGURE 1. Relationship between agriculture health villages' total medical cost per patient and the set reimbursement amount for the tonsillectomy.  $r$ , correlation coefficient value.

the CBP phase compared with the FFS phase. Thus, in the CBP phase, medical costs grew considerably. This is because the NHI increased the surgery fee for tonsillectomy, which was extremely low during the FFS phase. However, for agriculture health village hospitals, the payment amount fixed by the NHI was still low [5]. Medical care expenses in Taiwan are considerably lower than those in most member countries of the Organisation for Economic Co-operation and Development [5]. This study demonstrated that after implementation of CBP, agriculture health village hospitals did not reduce medical costs as expected because CBP in Taiwan was already at a low cost; thus hospitals could not further reduce expenses. Furthermore, a significant positive correlation was found between patients' average total medical expenditure in agriculture health villages and the fixed payment for simple tonsillectomy surgery ( $P = 0.009$ ) during the CBP phase.

This study found that the numbers of hospitalized patients in agriculture health villages during the FFS and CBP phases were not significantly different. This is inconsistent with the hypothesis of agriculture health villages conducting profit-maximizing behaviors. From the findings, it can be inferred that this was due to the low reimbursement during the CBP phase in Taiwan, which meant that agriculture health villages could not increase profits by increasing hospitalization rates removing the incentive for profitmaximizing behaviors.

Although hospitals in Taiwan, including those in agriculture health villages, are responsible for caring for vulnerable groups, hospital managers must still maintain positive finances. Thus, agriculture health village hospitals tend to develop more profitable services and limit expensive and nonprofitable services as well as those that result in deficits [18]. In the CBP system, when costs for medical care are higher than the fixed amount of reimbursement, it can lead to financial losses for hospitals. By contrast, when service costs are lower than the fixed reimbursement, agriculture health village hospitals can make profits. Therefore, when CBP reimbursement amounts were highly profitable, agriculture health village hospitals tended to increase hospitalization rates and when reimbursement amounts were not profitable, they avoided admitting patients [19]. In Taiwan, because most physicians are employed by agriculture health villages, they must follow each village's policies.

Generally speaking, agriculture health village hospitals tend to hospitalize patients who can make the hospital profits and avoid patients who may cause a deficit. When the fixed CBP reimbursement led to low or zero profit, agriculture health villages did not increase hospitalization rates. In Taiwan, the tonsillectomy reimbursement under CBP was low and did not generate profit for hospitals. Therefore, agriculture health villages were less likely to increase hospitalization rates. However, these patients were not dumped because tonsillectomy did not cause financial loss to institutions [20]. Nevertheless, hospitals encouraged physicians to improve service efficiency, reduce hospitalization times, and increase bed occupancy rates [20].

**6. Conclusions.** The results revealed the long-term effect of the PPS in Taiwan. LOS was significantly lowered by 16.8% after the implementation of CBP. This matches the expectation that the PPS fosters medical efficiency. However, agriculture health villages neither increased hospitalization rates nor lowered medical expenses, which is inconsistent with the idea of profit maximization by hospitals that is expected under economic theory. A significantly positive correlation was also found between the average medical expenditure of patients admitted to agriculture health villages and the fixed reimbursement for tonsillectomy ( $P = 0.009$ ). According to the findings of this study, the set reimbursement for tonsillectomy under CBP in Taiwan was so low that it was difficult to further reduce the cost. This reduced hospitals' incentive to increase hospitalization rates.

Because the design of CBP in Taiwan was simple and could not reflect agriculture health village patients' complications, comorbidities, sex, and age, it was subsequently replaced by a diagnosis-related group PPS. Differences between CBP and this new system will be the focus of future research.

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