The Effect of Additional Payment for Health Workers on Case Mix Index in Thailand: Panel Data Analysis

Sila Tonboot[a*], Kanchit Sooknak[b], Kwanpracha Chiangchaisakulthai[c] and Supasit Pannarunothai[a]

[a]Centre for Health Equity Monitoring Foundation, Thapho, Muang, Phitsanulok 65000

[b]Faculty of Business Economic and Communication, Naresuan University, Phitsanulok 65000

[c]International Health Policy Program (IHPP), Ministry of Public Health, Nonthaburi 11000

[*]Corresponding author. E-Mail address: Sila@chemf.or.th

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Abstract

The maldistribution of health resources is a challenging problem for Thailand's health system. Thus, the application of financial incentives is a choice to get through the situation. This article presents efficiency measuring of financial incentives for health workforce efficiency through the Case Mix Index as a proxy for hospital efficiency. The panel data used in this article included the Case Mix Index and financial incentives paid to health workers at ๓ hospitals during 2009-2014. A fixed effect analysis was adopted in order to control the different hospital service plans' effects and time variation. Moreover, we separated the study results into two parts. The first focused on allowance paid in fixed monthly amounts by workload criteria. The second part explored the individual effect of each financial incentive program on the Case Mix Index. The result found that the Top-up program, with a fixed monthly amount, could increase the Case Mix Index significantly. The individual program analysis found the non-private practice allowance program and P4P program conducted a critical improvement of the Case Mix Index of the hospital.

Keywords: Fixed-Effect Analysis, Additional Health Payment, Health Workforce, Case Mix Index (CMI)

Introduction

The maldistribution of health resources is a worldwide phenomenon, especially among the health workforce. In Thailand, doctors are intensely concentrated in the city rather than in rural areas because of the better living standard and higher income. Decades ago, the Ministry of Public Health (MoPH) managed this situation by providing financial incentives for staff to retain them in the rural areas (Wibulpolprasert and Pengpaibon, 2003). The additional remuneration applied as part of the payment system intended to develop health service efficiency, maintain an equitable health workforce distribution, and retain workers in the system. However, a program assessment has not been run yet.

According to the MoPH, the health resources are allocated following the health unit requirements and conditions. The health units in Thailand are comprised of four levels of service: the health center, the community hospital, the general hospital, and the regional hospital. These serve different functions as service providers in the health system. The health centers act as primary care units which offer primary health care (PHC), while community hospitals provide both PHC and secondary care. Regional hospitals are tertiary care units providing specialized care depending on their size and capacity (Jongudomsuk et al., 2015). Subsequently, service providers manage their resources according to the service plan defined by the MoPH in which hospitals are categorized into 9 groups. First, at the advanced level, is regional hospitals, which includes small and large sized hospitals (A large and A small). They provide more complicated treatment and have 800 beds or more in service. The standard level hospitals include general hospitals (both S large and S small), which provide 300 to 400 beds in service. The middle level hospital (both M1 and M2) provide 120 beds for service as community hospitals, and finally, the first level hospitals (F1 to F3 size) have 10 to 90 beds for service and are small community

hospitals. The service plans the character of health resources they can have. This relies on distinguished management, for instance, specialist doctors should exist in the regional and general hospitals, while rural community hospitals aim to retain general practitioners in the area to supply basic health care for the community. Complicated treatment at the community level will be transferred to the tertiary care unit in the network. Even though the described structure seems to serve the people well, the health workforce, in fact, is not well distributed. In some remote areas, the population per doctor is high due to geographical and social characteristics. The problem of maldistribution of the health workforce can be seen, not only in rural areas, but also in urban areas due to growing urbanization and capitalism. This causes private hospitals, who are unable to produce doctors, to offer lucrative benefits for medical workers and leaves a significant gap between the wages offered by government and private hospitals.

To subdue this problem, the MOPH proclaimed additional payments for health workers following certain conditions such as a non-private practice allowance paid for medical doctors, dentists, and pharmacists who agree not to engage in private practice. Moreover, a pay-for-performance scheme, overtime pay, and other kinds of workload payments were added up to relieve the scarcity of workers in almost every department in the hospital. To maintain the number of health workers proportionated to the high workload per head in the hospital, additional remunerations were announced in order to retain them, as well as to attract them to work the excessive workload. The payment was supported by the government and it was expected to raise the service quality, efficiency, and to retain the existing workers.

Since 2001, the MOPH had already made announcements of additional top-up payments for the health workforce. During more than a decade of top-up payment support to staff, the effect of the program was rarely evaluated. The evaluation tracked back to 1982-1997 (Suraratdecha and Okunade, 2006) when they attempted to measure operational efficiency in Thailand's health care system using production function to calculate results. The measurement also focused on heath resource inputs, for example, health workers, capitals, and medical technology in those period with an interesting finding that Nurse offered highest marginal products (MPs) to the health system. Puenpatom and Rosenman (2008) later investigated the impact of capitated-based Universal Health Coverage (UC) using Data Envelopment Analysis. They performed before-after analysis and finding that economic status was having high correlation with efficiency. In a glance, the question of how effective the capital investment in health care system after 2009 was still not yet answered, how well the health workforce retention program performed. Thus, the objective of this study is to explore the effect of top-up payments on the health workforce in government hospitals in the different service plans. The study picked sample hospitals from 8 provinces, with a total of 96 hospitals in Thailand, and quantitative data retrieved from the DRG database during 2009-2014.

Methods and Materials

Data

Type of Additional Remuneration for the Health Workforce

Since 1967, the MOPH has implemented various financial strategies to allure medical staffs to work in rural areas. The financial support has been provided to recipients with conditions such as voluntary scholarships or compulsory scholarships with bonded public service, financial incentives, increased tuition fees and payback by rural public work, including health care financing reforms (Wibulpolprasert and Pengpaibon, 2003; Henderson and Tulloch, 2008). In this paper, we focused on the financial incentive strategies existing during 2001 to 2015.

From 2001 to 2014 the MOPH issued a total of 9 declarations related to health workforce payments to reduce the gap in wages for inter-professionals and intra-professionals between public and private hospitals. The details of additional remunerations topped up from their civil servant salaries are briefly described in table 1.

Table 1 Additional Remuneration Implemented by the Ministry of Public Health during 2001-2013

No	Type of Payment	Paid to	Purpose	Remark
1	Overtime Payment (Pay Per Shift)	Staff in the Hospital	Retention	Cancelled Issue 1 Replaced by Issue 5
2	After office-Hour Outpatient Clinic Compensation	Doctors, Dentists, Pharmacists, Nurses, and Support Workers	Retention	Cancelled Issue 1 Replaced by Issue 5
3	Evening/Night Shift for Nurses	Nurses	Retention	Cancelled Issue 1 Replaced by Issue 5
4	Autopsy Performing Allowance	Doctors (Including Pathologists)	Retention, Efficiency, Equity	Cancelled Issue 1 Replaced by Issue 5
5	Specialist Doctor Compensation	Specialist Doctors in Shortage Fields	Retention, Efficiency, Equity	Cancelled Issue 1 Replaced by Issue 5
6	Lump Sum Allowance	Doctors, Dentists, Pharmacists, Nurses	Retention, Efficiency, Equity	Cancelled Issue 4 Replaced by Issue 8
7	Non-Private Practice Allowance	Doctors, Dentists, Pharmacists	Retention, Efficiency, Equity	Currently Using
8	Health Prevention and Promotion Allowance	Workers in the Health Prevention and Promotion Program	Efficiency	Cancelled Issue 1 Replaced by Issue 5
9	Additional Top-Up for Workers in the Community Hospital and Health Center	Workers in Community Hospitals and Health Centres	Retention, Efficiency, Equity	Cancelled Issue 6 Replaced by Issue 8
10	Additional Top-Up for Workers in the Regional Hospital and General Hospital	Workers in Tertiary Hospitals and General Hospitals	Retention, Equity	Cancelled Issue7 Replaced by Issue 8
11	Pay for Performance (P4P)	Workers in the Hospital	Efficiency	Currently Using

The payments listed in table 1 can be grouped into two types; a fixed monthly payment added on to their salaries at a fixed rate and a workload-based payment depending on their working performance and workload volume. The fixed monthly payment was called a "top-up" and was comprised of autopsy-performing allowance (4), shortage of specialist compensation (5), lump sum allowance (6), non-private practice allowance (7), additional top-up for community hospitals and health centres (9), and additional top-up for regional and general hospitals (10). The workload-based payment was comprised of overtime payments (1), after office-hour outpatient clinic compensation (2), evening/night shift for nurss (3), and pay for performance (11).

In 2014, the introduction of the pay-for-performance policy was criticized by both workers and administrators because of the wasteful process of data collection and questions about whether it was worth boosting efficiency.

The Case Mix Index as a Proxy for Hospital Performance

The Case Mix Index (CMI) is a relative measure of patient complexity that the hospital uses all resources to treat (Fetter et al., 1980; France et al., 2001). CMI for inpatients is derived from the relative cost

weight of Diagnosis-Related Group (DRG) methodology. According to Mendez et al. (Mendez et al., 2014), the CMI was primarily designed to be a tool for hospital payment, but subsequently has been used to track disease severity. To simplify reading the CMI value, for example, a hospital with a CMI of 3.0 should cost three times higher than the hospital with a CMI value of 1 (Ozcan, 2008). However, changing in coding of the DRG could directly affect the index (Ginsburg and Carter, 1986).

To calculate the CMI, each patient firstly was classified into a manageable number of categories. Then the case in each category will be homogeneous in cost (Pettengill and Vertrees, 1982). The national relative weight (RW*i*) is created from the national average cost of treating patients in each DRG category divided by the average cost over all DRG categories.

$$CMI_h = \frac{\sum P_{ih}(RW_i)}{1/N(\sum_h \sum_i P_{ih}(RW_i)}$$

The CMI for hospital (h) can be calculated by patients (P_{ih}) in each DRG category (i) in the hospital (h) multiplied by the national normalized relative weight (RWi) associated with the category that and sum these products across all categories (Pettengill and Vertrees, 1982).

Codman, the founder of health care quality since 1914, as cited in (Hornbrook, 1982), said "What, then, are the products of a large hospital whether in the form of healed wounds, healthy babies, faithful nurses, promising young surgeons and physicians, or in more abstract form of original idea on pathology or treatment, model method of administration, or such intangible things as enthusiasm and ideals?". Klastorin and Watts (1980 as cited in Hornbrook, 1982) answered the question with the following: "the term case mix has come into general use to connote the vector of inpatient care treatment produced by the hospital". Since then, the CMI has been widely used in hospital performance assessment (Grosskopf and Valdmanis, 1987; Grosskopf and Valdmanis, 1993). It is a proxy for the output product of the hospital, a key adjustment variable used to measure efficiency.

Sample Hospitals

The data used to compare the effects of payment on hospital performance in this study were obtained from the Bureau of Policy and Strategy, MOPH, as they were used to request a budget subsidy from the Budget Bureau. The selection criteria for participating provinces included provinces that implemented varieties of payment methods, had good data available and represented the 4 regions of Thailand. Two provinces were selected from each region highlighting varieties of demography, geography, economic diversity, and the distinguished capabilities of health service delivery (with a total of 108 hospitals in Burirum, Kalasin, Lampang, Tak, Trang, Pattani, Nakonsawan, Chainat, and Chonburi). The CMI was calculated from the Thai DRG database in the aforementioned time frame of the longitudinal panel data set during 2009 to 2014.

Methods

The Effect of Aggregate Remuneration on the Case Mix Index

The paper examined the effect of additional payment on the CMI. In the review, we categorized the types of payment into two groups: a constant monthly payment added up to the salary called a "Top-Up" and a workload-based payment known as "Workload". We adopted the fixed-effect analysis to monitor the incremental results at each hospital level consisting of advanced hospitals (subdivided into A Large and A Small), standard hospitals (subdivided into S Large and S Small), medium-sized hospitals (M1, M2), and first contact hospitals (F1, F2, F3) respectively. Specialist doctors would not exist at the F2 and F3 levels, but could be found in the F1 up to the M1 levels, while fully existing at the standard and advanced levels. Thus, the model for explaining a hospital's CMI employing fixed-effect analysis can be written as:

$$CMI_{ict} = \alpha + \beta_1 TopUp_{ict} + \beta_2 Workload_{ict} + \gamma_1 X_{ict} + \gamma_2 T_t + \varepsilon_c + v_t + \eta_{ict}$$

In our assumption, the result of the analysis attempted to determine that the more government pay for the hospital, the higher complex product that should be generated. The incremental effects could be monitored through X which is a vector of control variables (hospital level). T is a vector of the year dummy, whereas β stands for the coefficient of the independent variables (Top-Up and Workload payment), γ is the coefficient of control variables. The ε_c is the interception of hospital level, v_t is the error term of year dummies, and η_{ict} is the error term of the equation. The logarithm function was opted for, since variables were non-linear (Studenmund, 2000).

The Effect of Detailed Remuneration on the Case Mix Index

In order to monitor the effect of each remuneration through the hospital efficiency proxy, CMI, we performed another model as shown below and selected only each remuneration plausibly influencing CMI. The natural logarithm function also applied to this equation, similar to the previous one. The model took before-after time series analysis to state the effect of the application of the P4P scheme in the health system during 2013 to 2014. The equation also used case control variables to monitor the differentiation between the hospitals which opted to participate or not participate in the P4P scheme by using a dummy variable.

$$CMI_{ict} = \alpha + \beta_1 Noclinic_{ict} + \beta_2 NurseOT + \beta_3 OT_{ict} + \beta_4 dummyP4P_{ict} + \beta_5 dummySP_{ict} + \gamma_1 X_{ict} + \gamma_2 T_t + \varepsilon_c + v_t + \eta_{ict}$$

The above equation attempted to explain how the results of additional payments of each type affected the CMI of the hospital while we controlled both hospital level factors. The Noclinic variable stands for the non-private practice allowance paid by the MoPH. The NurseOT means the overtime payment for the nurses who worked the evening and night shifts. OT represents the overtime payment for other staff who worked during after office hours. P4P represents the payment according to the performance they did, and SP stands for the specialist doctor compensation. The reason for analyzing only 2013 and 2014 data is because the P4P program started in 2014. To analyze before and after the program's application could imply how effective the program is. Thus, β is the coefficient of the independent variable. γ_1 is the coefficient of the control variables known as hospital level and γ_2 is the coefficient of time after the P4P program.

We displayed our plot of variables and the descriptive statistic results in figures 1 and 2, and tables 2 and 3. From our assumption, we expect that the larger hospital levels should have higher budget spending due to a group of specialist doctors and higher technology treatments being delivered, consequently leading to the higher CMI in comparison with the lower hospital levels. The descriptive statistics were not robust enough for data from M2 to A Large hospitals due to fewer numbers of observations. The average value of workload payment in the S Small hospitals was not always higher than M1 which may cause the estimated result to be not best fitted to the model. Incidentally, adoption of natural log overcomes this problem as well as the heteroscedasticity assumption.

We tested the classical assumption of the multiple regression model to have the best estimated coefficients and none was rejected. The multicolinearity test, done by using the Variance Inflation Factor (VIF), and the Durbin-Watson test were carried out to see the serial correlation of the independent variables and error terms.

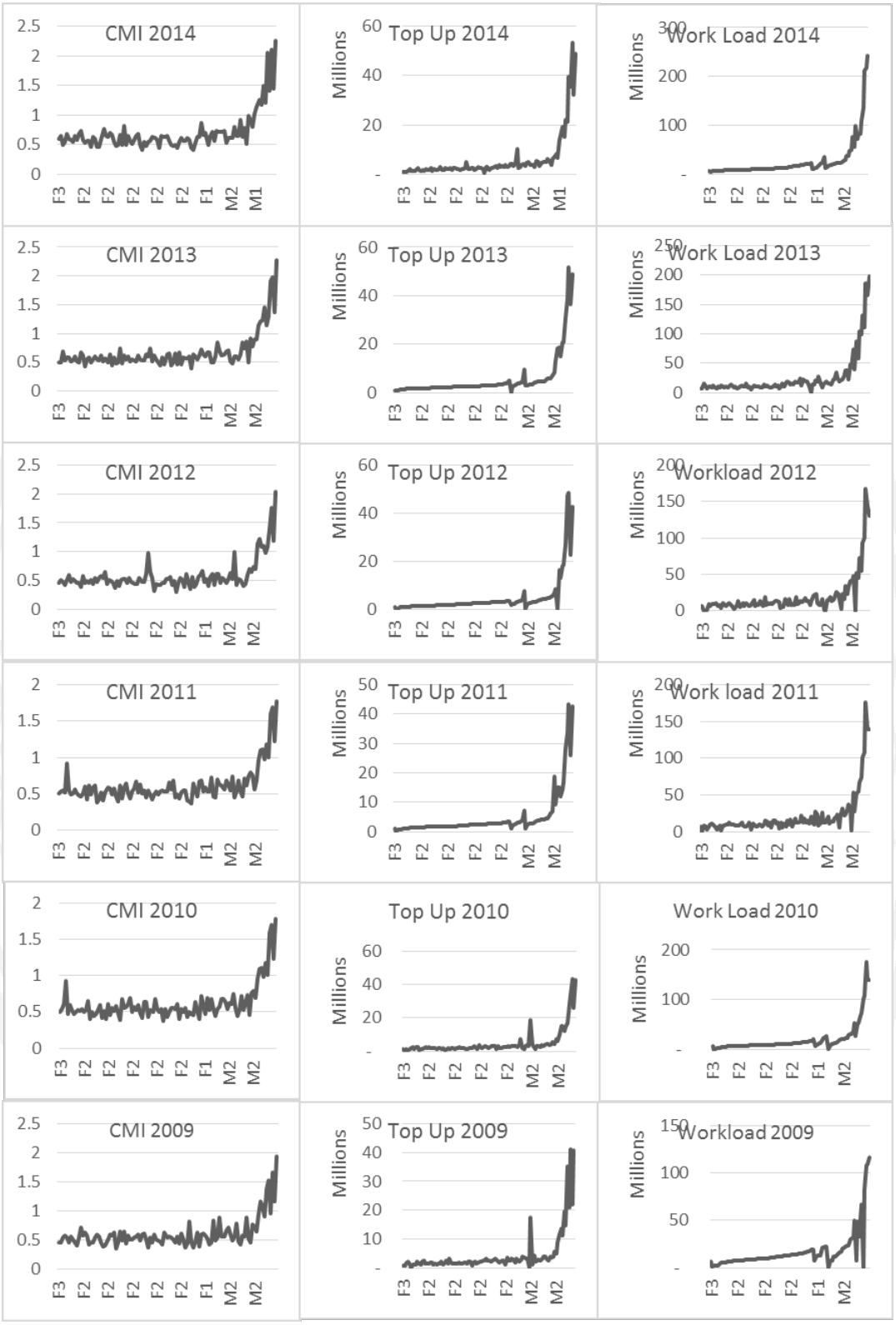

Figure 1 Distribution of Variables in the Aggregate Model Sorted by Hospital Level

Table 2 Descriptive Statistics of Aggregate Remuneration

HOSPITAL LEVEL	N	CMI				TOP UP (X000 BAHT)				WORK LOAD (X000 BAHT)			
		Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD
A LARGE	12	1.16	2.28	1.68	0.44	22,032	48,933	36,072	10,039	108,644	242,283	160,093	41,789
A SMALL	18	0.96	2.09	1.56	0.35	20,922	55,344	38,540	9,820	458	210,992	122,560	49,528
S LARGE	18	0.92	1.50	1.16	0.16	11,199	23,285	17,247	3,701	33,397	104,676	67,040	18,542
S SMALL	11	0.94	1.26	1.14	0.11	11,706	19,091	16,047	2,326	7,333	99,496	48,981	27,833
M1	6	0.65	1.01	0.80	0.15	8,246	14,044	10,423	2,395	48,354	78,712	63,561	14,304
M2	106	0.39	1.32	0.64	0.15	1,005	18,896	4,467	2,357	1,333	50,251	22,869	10,296
F1	53	0.41	0.87	0.59	0.11	1,064	10,467	3,744	1,913	812	35,172	16,396	6,666
F2	408	0.28	1.04	0.53	0.09	181	5,048	2,115	740	1,174	23,743	10,793	4,155
F3	6	0.45	0.59	0.50	0.05	882	1,178	988	111	6,470	6,797	6,614	124

*The exchange rate is 1 USD per 34.83 Thai Baht

Table 3 Descriptive statistics of detailed remuneration

SERVICE PLAN	N	NOCLINIC (X000 BAHT)				NURSE OT (X000 BAHT)				OT (X000 BAHT)			
		Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD
A LARGE	3	10,315	11,046	10,725	374	20,081	28,457	25,023	4,387	136,860	169,808	153,103	16,479
A SMALL	6	6,305	14,590	10,442	3,437	8,173	20,714	12,460	4,601	52,541	165,032	110,714	39,467
S LARGE	4	3,125	7,045	4,168	1,920	6,936	48,768	23,833	20,573	35,358	51,181	43,012	8,583
S SMALL	4	4,100	5,194	4,712	555	6,717	10,029	8,360	1,773	31,562	77,731	50,054	22,465
M1	2	3,645	3,980	3,813	237	3,737	4,762	4,249	725	70,167	71,955	71,061	1,265
M2	36	700	2,205	1,523	357	432	5,003	2,023	1,045	12,916	43,865	23,700	8,470
F1	11	835	1,750	1,198	288	847	2,941	1,569	735	11,836	33,735	19,104	6,257
F2	134	225	1,630	795	250	46	10,056	1,065	1,094	2,101	21,824	10,907	3,669
F3	2	355	435	395	57	242	325	284	59	6,228	6,471	6,350	172

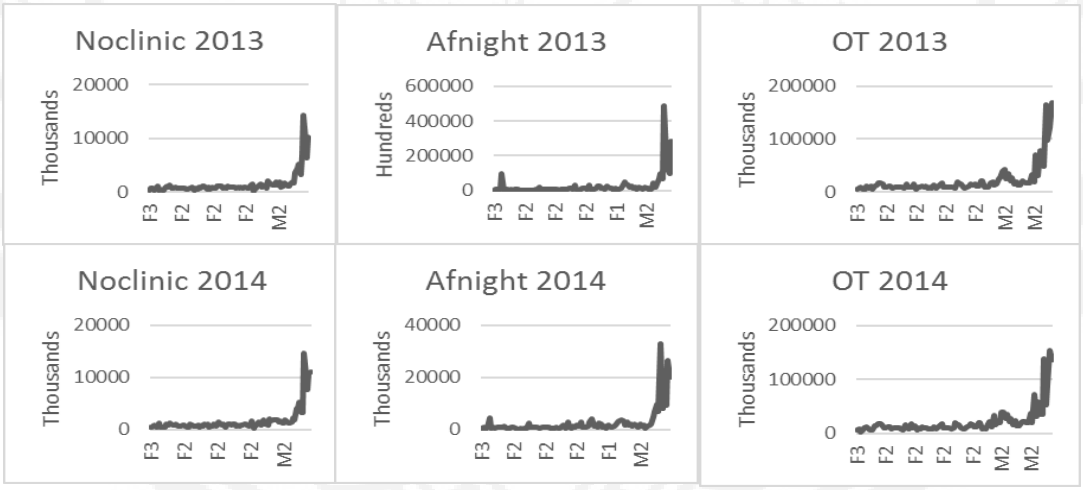

Figure 2 Remuneration Sorted by Hospital Level

Results

The Effect of Aggregate Remuneration on the Case Mix Index

The hospital CMI could be explained by the independent variables in the model in table 4 at about 80 percent (R-Square 0.80). The coefficient of the estimation implied that 1 percent of the Top-Up payment could increase the hospital CMI by 0.04 percent. The workload-based payment has a negative effect on CMI, but it is not statistically significant. The largest hospital (A Large) had the highest CMI and respectively lowering as the level of the hospital went down.

Table 4 The Fixed Effect Analysis of Aggregate Remuneration on CMI

Variable	Coefficient	Sig.
Intercept	0.96979	0.000324 ***
Log Top Up	0.043144	0.003051 **
Logworkload	-0.003374	0.751911
A Small	-0.122989	0.010359 *
S Large	-0.488027	< 2e-16 ***
S Small	-0.50799	< 2e-16 ***
M1	-0.828934	< 2e-16 ***
M2	-0.950387	< 2e-16 ***
F1	-0.99192	< 2e-16 ***
F2	-1.029224	< 2e-16 ***
F3	-1.03347	< 2e-16 ***
Y2010	0.003479	0.842036
Y2011	-0.029027	0.098751
Y2012	0.014208	0.420619
Y2013	0.056538	0.001686 **
Y2014	0.082372	6.3e-06 ***

Baseline: Hospital Level Compared with A Large, Year Compared with 2009

Significant Code: ***0.001, **0.01, *0.05.

R-Square: 0.8068

F-Statistic: 173.1

The Effect of Detailed Remuneration on the Case Mix Index

We applied another model in order to monitor the results before and after the P4P implementation, which was widely debated among the hospital administrators and workers. We also explored the effects of the payments of the specialist doctor compensation on the CMI increment. The results in table 5 show that the independent variables model explained 81 percent of CMI, while the other 19 percent was influenced by unknown factors. The non-private practice allowance (Noclinic) for doctors, dentists, and pharmacists offered a good return in the CMI for the hospitals in the sample ($p < 0.01$), while the evening/night shift for nurses and the overtime pay (OT) for hospital stafs reported negative impacts to the CMI during 2013 and 2014 ($p > 0.05$). The hospitals with the P4P implementation had a 0.076 percent increase on the CMI ($p < 0.01$). In general, a year after the P4P policy in the health system, the CMI increased by 0.017 percent ($p > 0.05$).

Table 5 The Fixed Effect Analysis of each Remuneration on the CMI

Variable	Coefficient	Sig.
Intercept	0.555	0.384
Log Noclinic	0.108	0.0059 **
Log Nurse OT	-0.028	0.083556
Log OT	-0.064	0.103231
A Small	-0.147	0.153604
S Large	-0.496	0.000008***
S Small	-0.536	0.000008***

Table 5 (Cont.)

Variable	Coefficient	Sig.
M1	-0.652	0.000004***
M2	-1.011	2.03E-16***
F1	-1.099	3.02E-16***
F2	-1.195	2.97E-17***
F3	-1.197	1.63E-10***
Y2014	0.017	0.401868
Dummy SP	-0.008	0.778
DummyP4P	0.076	0.001***

Baseline: Hospital Level Compared with A Large, Year 2014 Compared with 2013

Significant Code: ***0.001, **0.01, *0.05

R-Square: 0.810

F-Statistic: 56.805

Discussion

Thailand attempted to overcome the maldistribution of health resources by providing financial incentives for health staff with multiple objectives: retaining the workforce in rural areas, increasing efficiency in the health system, having a competitive compensation rate for workers in the public sector while considering the inter-professional inequity gap. Moreover, another additional payment supported the workers who devoted themselves during the scarcity of the workforce, especially for nurses. Our findings interestingly pointed out that the evening/night shift for nurses (NurseOT), the overtime pay (OT), and the specialists in shortage fields compensation had negative impacts on the Case Mix Index, while Noclinic and P4P had positive impacts for the Case Mix Index which lead to the discussion as follows.

As CMI is a relative measure of patient complexity that the hospital uses all resources to treat, following our reviews, the workload for health staff may not reflect this measure's complexity for diseases where the movement of CMI has no relationship to the additional payment programs. These resulted in the negative coefficients for evening/night shift for nurses (NurseOT) and OT since both of types of payment objectives are to have workers for increasing workload conditions and both are time-based incentives, as most hospitals have a low workload when contrasted with their working time. However, the negative result of the specialist in shortage fields compensation (DummySP) was unexpected. From the service plan review, specialist doctors are concentrated at referral hospitals, which mean that the more specialists they have, the more complicated treatment they could provide for the public. However, our results remain inconclusive due to insignificance for the hospitals who had specialist doctors. The situation may be from the different types of specialists existing in the hospitals, for instance, the radiology specialists and nuclear medicine physicians who were working with high technology equipment could accelerate the CMI, while others could not.

The analysis of our results of the P4P application in Thailand is in accordance with another study which showed that using incentives does have an effect on the productivity and motivation of workers (Gaynor and Pauly, 1990; Meessen et al., 2007; Glickman and Peterson, 2009; Eijkenaar, 2012; Eijkenaar et al., 2013). Nevertheless, the efficiency in some programs is still unclear in many countries. Eijkenaar et al. revealed that many studies failed to find the effects of P4P programs (Glickman and Peterson, 2009; Eijkenaar et al., 2013). This may be caused by the lack of certain indicators for measuring efficiency

(Robinson et al., 2009). Using the CMI provided only a dimension of performance measurement. This issue was also raised among the medical staff about the methodology to measure the ideal performance equitably between inter and intra professions. The P4P program practiced in Thailand was criticized for its unreasonable budget allocation, its workload increasing from data collection by health staff, and the delayed payment of the program. Thus, the program has been run voluntarily in some hospitals and may cause hospital selection bias.

Conclusion and Suggestion

To conclude, the estimated results of the aggregated effects of budget spending by the Ministry of Public Health on the health workforce revealed that the Top-Up payment had a positive effect on the CMI while the Workload payment had the opposite effects on the CMI. For individual issues, No Clinic and P4P could increase the CMI of the hospital significantly. However, to conclude that the specialist in shortage fields compensation, the evening/night shifts for nurses (NurseOT), and overtime payment were unsatisfactory for health investment seemed awkward. Since the payments made to workers on the evening/night shift for nurses as well as workers obtaining overtime pay were implemented to try to fill the gap of health worker scarcity and the question of the robustness of the number of hospital observations still needs to be clear. Further study may look closer at this and try to cover every province in Thailand instead of using a sampling process.

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