Area-based Network of Health Workers to Mitigate the Shortage of Health Workforce: A Case Mix Index Approach for Thailand

Theepakorn Jithitikulchai (jithitikulchai@hsph.harvard.edu)
Harvard T.H. Chan School of Public Health

Research

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Abstract

Background

Public hospitals under the Office of Permanent Secretary, Ministry of Public Health have critical shortage in health workers. The area-based network consolidations of public hospitals should help to enhance capacity of the health system from allocation improvement in limited resources.

Methods

This study calculates the counterfactual simulations of area-based network allocations for health workforce in 10,500 public hospitals. The network consolidations at the sub-district, district, provincial, or health-region levels allow health workforce reallocation within local network areas. This study examines improvements in the allocative efficiency from the health workforce redistribution. The workload per worker is calculated from the output measured by numbers of outpatient and inpatient cases and the input measured by numbers of health workers. Both output and input are weighted with their economic values, controlled for heterogeneity by regression analysis. The weights assigned to each outpatient and inpatient case reflect the relative health system resources predicted for each discharge. Finally, this study compares the status quo and ex ante scenarios, as before and after network consolidations.

Results

Network consolidations of the primary-level hospitals within the same district could averagely reduce workload per worker by 14%. Another practical policy option is that consolidating similar hospital levels such as primary, first-level secondary, and mid-level secondary hospitals altogether within the same district could reduce the workload per worker by 17%.

Conclusion

This study illustrates improvement in allocative efficiency of health workforce in public hospitals from the area-based network consolidations. The results provide an insightful example of efficiency gains from reallocating medical workforce within the same local areas.

Introduction

Human resource planning of a health system has an important goal of having adequate health workforce with balanced allocation [1]. Major challenges of health resource allocation in Thailand are scarcity of health workforce and inequitable access to quality health care [2]. Thailand has faced the problem of demand for health services exceeding capacity of the public health system [3].

Thailand has inadequate health workforce less than the official requirements, even though the geographical allocations of health workers have been improved significantly over the last three decades with higher workforce availability. Nevertheless, public hospitals under the Office of Permanent Secretary

in the Ministry of Public Health (MOPH) still have chronic shortages in health workforce. One of the reasons is insufficient budget [4]. Furthermore, there are geographical allocation issues such that the health workforce is more concentrated in Bangkok and big cities, and the inequity gap in proportions of targeted population to medical doctors could reach almost ten times among provinces [5].

The shortage of nurses has been a critical issue for Thai public health system, and the problem is expected to be more severe [6,7]. The nurse resignations are quite consecutively high because the health system cannot retain skilled and experienced nurses, unlike because of inadequate production of nurses in the previous three decades [8]. A study of 19,912 registered nurses revealed that 10 percent of the surveyed sample wanted to quit their career within the next two years [9]. Another study [10] found that young and less-skilled nurses have stronger intention to resign; while having less time off, less job satisfaction, or higher stress are significantly associated with probability of resignation. Other studies reported similar conclusions from community hospitals [11], a tertiary care hospital [12], and a university hospital [13].

Furthermore, Thailand will face higher demand for health workforce in different hospital levels such as primary [14] and tertiary [15]. The projections of demand and supply for medical specialists demonstrated severe shortages in almost all medical specialist professions as the consequences of aged society [16]. Therefore, here is the urgent issue for health workforce management to improve allocative efficiency, which is the government capacity to allocate limited resources to achieve desirable objectives.

Health resource planning requires not only to balance health workforce management for quantitative and qualitative goals, but also to adapt with varying health system needs. In particular, the effective reallocation for supply of medical workers in accordance with the demand of health care will lead to the more desirable clinical outcomes [17].

This study reports the area-based human resource allocation of hospitals under the Office of Permanent Secretary, the MOPH. The network consolidation should not only mitigate the health workforce shortage, but also to provide adequate quality services for people and enhance allocative efficiency of the health workers within their local areas.

The area-based network of health workforce is not a new concept for Thailand. But it has been developed and implemented by health system and medical staffs to collaborate in the district health administration systems [18–21].

Jithitiikulchai (2020) [22] studied the area-based network consolidations for health workforce in public hospitals to understand the shortage situation of each medical professions and estimate the shortage mitigation from network reallocations. However, Jithitiikulchai (2020) [22] considered each medical profession such as doctor, nurse, dentist, pharmacist, and others. Thus, this former research did not consider the aggregated output of health care service delivery units relative to the total health workforce, but only analyzed by medical profession based on number of health workforce relative to minimum manpower requirement.

Therefore, this study endeavors to measure whether and how the area-based resource allocation at different levels of hospital services and administrative areas could mitigate the shortage in health workforce by considering the pooled health workforce. The research outcomes could provide an evidence to support the decisions on policy options to solve the health workforce shortage problems. This analytical application could be a useful example for other countries having shortage in health workforce for public hospitals.

Methods

The network consolidations are the area-based health system management that allows flexibility in health workforce reallocation to correspond the needs of population health within local administrative-area network areas at the district, provincial, or health-region levels.

This study considers network consolidations from different hospital classifications:

1. All hospital levels

2. Only the same hospital level

3. Similar hospital levels

3.1) Type A: {Primary and First-level Secondary} and {Mid-level Secondary, High-level Secondary, and Tertiary}

3.2) Type B: {Primary, First-level Secondary, and Mid-level Secondary} and {High-level Secondary and Tertiary}

The area-based network simulation is developed to quantify the hospital output and allocated to health workforce within the network. This approach is an application of gatekeeper concept to manage resources in according to the demand for health care service and the workforce supply capacity within each network.

The analysis compares workload per worker between (a) the hospital-level averages (status quo) and (b) the area-based network averages after consolidations at different administrative-area levels (ex-ante).

The key concept to measure output in this study is the weighted aggregation of medical treatment cases, where weights are the average medical costs incurred in the same hospital level. The hospital output is defined as the aggregation of the medical treatment cases weighted with the corresponding average costs.

This concept used to measure output is the case mix index (CMI) which provide reference for the standard inpatient costs for the diagnosis related group (DRG) as the adjusted relative weight (adjRW) [23]. However, this study directly calculated the average costs for outpatient and inpatient treatments with the regression analysis at different five hospital levels. But the same concept applies for both outpatient

and inpatient cases to reflect the relative resource allocated for each discharge. Thus, the outpatient and inpatient cases can be weighted and aggregated as the hospital or network outputs.

The average costs of each treatment case are determined from the relevant attributes such as principal diagnosis (PDx), sex and age of patients, service time, service type, insurance type, total number of days admitted (only inpatient treatments), hospital, and health region. The cost regression functions which assign a relative value to each medical treatment case are calculated separately for outpatient and inpatient services at five different hospital levels. More details are available in Table S1 of Supplementary Material.

For the input factor, this study considers numbers of health workers by different professions, which are weighted by average hourly earnings and average work hours per week. Thus, the aggregation of the weighted numbers of health workers is the total workforce of hospitals or area-based networks.

The workload per worker is calculated from total output divided by total workforce. The workload per worker is then normalized by the average cost for outpatient treatments at the primary hospitals. Therefore, the results of average workload per worker are comparable using the same measurement unit as the numbers of outpatient cases from the primary-level health care service. Lastly, this study compares workload per worker for the hospital-level before network consolidations (status quo) and the network consolidations at different administrative-area levels (ex-ante).

Data

Numbers of each medical profession such as doctor, nurse, dentist, pharmacist, and other medical professions are the hospital-level data from the Human Resource Management Division of the Office of the Permanent Secretary, the MOPH.

The case-based data from the Information and Communication Technology Center of the MOPH covers principal diagnosis (PDx), sex, age, service time (office hours or after hours), service type (walk-in, referral, etc.), insurance type (Universal Coverage Scheme, Civil Servant Medical Benefit Scheme, Social Security Scheme, and others), total number of days admitted (inpatient treatments only), and costs of each treatment case.

The average hourly earnings and work hours per week of each medical profession are calculated from the Labor Force Survey (LFS) 2001Q1 to 2018 Q1 of the National Statistical Office. The regression functions of hourly earnings and work hours per week controlled for heterogeneity in age, gender, education, urban and rural areas, and province. The estimated hourly earnings and work hours per week are fixed at the year 2018. The hourly earnings were adjusted by temporal and spatial deflators. The health workers are selective by the ISCO-88 codes for the workers aged 15–64 employed in the public sector. The weights as adjustment factors are reported in Table S2 of Supplementary Material.

Results

The results are based on 10,500 public hospitals under the Office of the Permanent Secretary, MOPH across geographical units and health regions. The output in this study is based on 284,273,598 outpatient discharges and 18,971,271 inpatient discharges in the budget year 2019. The outpatient and inpatient cases are weighted with their average costs. The average costs are controlled through linear regression estimations separately for different five hospitals levels. Tables S3-S4 in the Supplementary Material reports the regression results of cost of outpatient and inpatient cases.

The aggregations of weighted average costs of both outpatient and inpatient treatments in each hospital are normalized with the average cost of outpatient treatment in primary hospitals and resulted with 1,011,431,677 normalized outpatient discharges in primary hospitals as the standardized output unit as outpatient cases. There are 157,508 health workforce which were calculated from numbers of workforce in different health professions weighted with their work hours per week and earnings per hour. Therefore, the output per worker has been normalized as the workloads of outpatient cases in primary hospitals for comparisons of the hospital-level averages (status quo) and the averages after consolidations (ex-ante).

The results of networking all public hospital levels combined altogether illustrates that the networking at the district levels can reduce the average workload per worker about 12% on average, as shown in Table 1. The consolidations at the province and health region levels could reduce by 9% and 3%. However, the network at the sub-district level has no impacts on average.

Table 1
Area-based network allocation of all service levels

All Hospital Levels	Units	Workforce	Normalized OP cases	OP cases per worker	Reduced OP cases per worker
Hospital	10,500	250	2,553,796	6,783	
Sub-district	7,025	259	2,625,666	6,763	0.3%
District	878	426	3,804,529	5,998	11.6%
Province	76	2,786	19,080,767	6,200	8.6%
Health region	12	13,448	84,338,899	6,576	3.1%
Thailand	1	157,508	1,011,431,677	6,421	5.3%

Note: The reduced outpatient cases per worker in percentage is the fraction of the average cases per worker after consolidation (ex-ante) compared to the average cases per worker of hospitals (status quo).

However, the networking within the same hospital level provides various results as shown in Table 2. Consolidating at the primary level, networking at the district, province, and health region levels could reduce workload per worker by 14%, 20%, and 26%, respectively. For the first-level secondary hospitals, area-based networking cannot reduce the workload. For the mid-level secondary hospitals, networking at the province and health region levels could reduce workload per worker by 11%. For the high-level

secondary and the tertiary hospitals, the area-based network consolidations cannot improve the workload per worker.

Table 2
Area-based network allocation by each service level

Levels	Units	Workforce	Normalized OP cases	OP cases per worker	Reduced OP cases per worker
1. Primary					
Hospital	9,609	2	12,348	6,739	
Sub-district	6,548	4	20,870	6,730	0.1%
District	877	34	182,626	5,795	14.0%
Province	76	414	2,307,027	5,389	20.0%
Health region	12	2,212	10,738,358	4,986	26.0%
Thailand	1	26,750	123,386,219	4,613	31.6%
2.1 First-level Secondary					
Hospital	508	75	371,240	4,741	
Sub-district	508	75	371,240	4,741	0.0%
District	502	76	377,815	4,738	0.0%
Province	66	776	4,567,067	4,910	-3.6%
Health region	12	3,291	15,547,739	4,812	-1.5%
Thailand	1	35,396	169,074,541	4,777	-0.8%
2.2 Mid-level Secondary					
Hospital	264	105	404,464	4,306	
Sub-district	264	105	404,464	4,306	0.0%
District	260	108	411,322	4,307	0.0%
Province	65	605	2,228,892	3,831	11.0%
Health region	12	2,445	8,802,865	3,814	11.4%
Thailand	1	24,266	90,084,282	3,712	13.8%

Note: The reduced outpatient cases per worker in percentage is the fraction of the average cases per worker after consolidation (ex-ante) compared to the average cases per worker of hospitals (status quo).

Levels	Units	Workforce	Normalized OP cases	OP cases per worker	Reduced OP cases per worker
2.3 High-level Secondary					
Hospital	84	510	4,338,017	6,405	
Sub-district	84	510	4,338,017	6,405	0.0%
District	84	510	4,338,017	6,405	0.0%
Province	61	756	6,118,850	6,266	2.2%
Health region	12	2,950	20,184,971	6,638	-3.7%
Thailand	1	35,280	199,036,643	5,642	11.9%
3. Tertiary					
Hospital	35	1,158	13,086,724	10,359	
Sub-district	35	1,158	13,086,724	10,359	0.0%
District	35	1,158	13,086,724	10,359	0.0%
Province	34	1,166	13,126,641	10,360	0.0%
Health region	12	3,567	33,872,948	11,851	-14.4%
Thailand	1	35,816	429,849,992	12,002	-15.9%

Note: The reduced outpatient cases per worker in percentage is the fraction of the average cases per worker after consolidation (ex-ante) compared to the average cases per worker of hospitals (status quo).

For the networking of similar hospital levels, there are two options as illustrated in Table 3a-3b. The results show that both options of network consolidations for the similar hospital levels could reduce the average workload per worker for the lower hospital levels which are {Primary and First-level Secondary} of Option A and {Primary, First-level Secondary, and Mid-level Secondary} of Option B. When combined at the district level, Option A could reduce the workload by 13%, while Option B could reduce the workload by 17%, on average.

However, both options for the upper hospital levels, such as {Mid-level Secondary, High-level Secondary, and Tertiary} of Option A and {High-level Secondary and Tertiary} of Option B could not reduce the average cases per worker.

Table 3
a: Area-based network allocation by clustered service level (Option A)

Levels	Units	Workforce	Normalized OP cases	OP cases per worker	Reduced OP cases per worker
Primary and First-level Secondary					
Hospital	10,117	17	85,747	6,306	
Sub-district	6,803	20	100,532	6,283	0.4%
District	878	76	403,343	5,512	12.6%
Province	76	1,085	6,111,913	5,076	19.5%
Health region	12	5,249	26,157,213	5,038	20.1%
Thailand	1	62,146	292,460,760	4,706	25.4%
Mid-level Secondary, High-level Secondary, and Tertiary					
Hospital	383	697	7,273,117	7,644	
Sub-district	383	697	7,273,117	7,644	0.0%
District	376	708	7,327,152	7,674	-0.4%
Province	76	1,814	13,319,879	7,423	2.9%
Health region	12	8,683	61,598,598	7,900	-3.3%
Thailand	1	95,362	718,970,917	7,539	1.4%

Table 3
b: Area-based network allocation by clustered service level (Option B)

Levels	Units	Workforce	Normalized OP cases	OP cases per worker	Reduced OP cases per worker
Primary, First-level Secondary, and Mid-level Secondary					
Hospital	10,381	28	125,298	6,046	
Sub-district	6,940	32	142,042	6,022	0.4%
District	878	104	510,207	4,999	17.3%
Province	76	1,522	7,812,893	4,792	20.7%
Health region	12	7,388	34,320,695	4,748	21.5%
Thailand	1	86,412	382,545,042	4,427	26.8%
High-level Secondary and Tertiary					
Hospital	119	916	9,825,265	8,885	
Sub-district	119	916	9,825,265	8,885	0.0%
District	116	940	10,003,507	8,977	-1.0%
Province	76	1,306	13,061,744	8,989	-1.2%
Health region	12	6,388	55,692,574	9,367	-5.4%
Thailand	1	71,096	628,886,635	8,846	0.4%

Note: The reduced outpatient cases per worker in percentage is the fraction of the average cases per worker after consolidation (ex-ante) compared to the average cases per worker of hospitals (status quo).

Discussion

The area-based networks can redistribute the health workforce to provide health care services with better flexibility in resource management. From a practical perspective, networking the primary-level hospitals within the same district could reduce workload per worker by 14% on the national average. Another feasible policy option is consolidating the similar hospital levels such as primary, first-level secondary, and mid-level secondary hospitals which could reduce the workload per worker by 17%.

The network consolidations are based on some assumptions that health workers could simply move within the network. However, the health service units are practically independent to each other on

planning, budgeting, and performance assessment. Furthermore, current health system does not allow such flexibility to reflect in promotion and career path for public health workers in Thailand.

Therefore, this requires what Leerapan et al. (2018) [24] proposed as “major reforms of MOPH care delivery models” such that the health care delivery units can adjust and adapt their resources and services in corresponding to the population health needs. This includes the capacity reallocation of health care delivery teams to enlarge in the areas with excess demand and to reduce in the areas with excess supply. This proposal of “major reforms of MOPH care delivery models” is consistent with the allocative efficiency, such that the health system has management capacity to establish and prioritize objectives to shift health system resources in corresponding to numerous impediments and targeted result accomplishments.

Noree et al. (2017) [25] defined distinguished properties of the desirable health care delivery system as a seamless health service network of an integrated system of primary, secondary, and tertiary hospitals. Pooling resources and planning through the management information system within local network are important for a strong referral healthcare management system with gatekeeper. Both Leerapan et al. (2018) and Noree et al. (2017) [24–25] are aligned with the goal of the “value-based health care” concept [26–27], which is a health care delivery model to maximize the value of care for patients and minimizing the cost of health care.

As the quantitative evaluations in this study are based on the results at average, this study provides value to some extent for the policy options for allocation of public health workers to mitigate workforce shortage. However, a good policy is not one-size-fits-all. It requires decentralization for the provincial and district health systems to have their own autonomy over decision-making and equipped with accountability to monitor and evaluate their performance through the health resource information system.

The area-based heath care delivery management such as the district or provincial level could add commuting burden to the health workers. Therefore, we should have financial incentives, career advancement mechanism, and team development programs, among others to facilitate the local health care system development.

Furthermore, the political economy analysis of area-based network development could be useful to define political strategies to reduce the opponent force and enhance the supports among stakeholders within the health system.

Finally, any countries with the community health network policies should have a national strategic plan for area-based health care delivery system development that is aligned with the national human resource plan of their health system.

Limitation

First, this study has some limitations on total output calculations. Health workforce positions have responsibility not only on treatment service delivery used in this study. They also have some other tasks such as health promotion and disease prevention services, and administrative works, among others. Due to data limitations, this study cannot consider other tasks beyond the outpatient and inpatient discharges.

Second, the area-based network consolidations at the district, provincial, and health-region levels in this study implicitly assumed that the health workforce can move freely withing the network to serve the local health care needs. However, the calculations are only for technical results for the policy makers to consider policy and program options on human resource management. It requires considerate evaluations of positive and negative externalities potentially occurred to the health workers within each hospital and local area. The practical possibilities in author's opinion are to consolidate primary hospitals within each district (which has already been practiced), similar hospital levels within each province, or mixed of both. The final decisions should be considered together by health provincial office, health district offices, and hospitals.

Lastly, the value in health care this study used the value of each treatment service deliverable case as the unit cost in general economic sense. However, Porter (2006, 2010) [26–27] suggested that achieving goal of health care delivery requires that the value should be defined as the health outcomes achieved per every monetary unit spent. Therefore, relevant research in the future can measure the value of each discharge with the framework for performance improvement in health care that create value for patients, measured by the outcomes achieved, not inputs nor volume of services delivered.

Conclusion

This study evaluates the shortage mitigation and efficiency gain from the area-based network of health workers for the hospitals. The analytical results confirm improvement in allocative efficiency of health workforce in public hospitals from network consolidations.

Abbreviations

CSMBS: Civil Servant Medical Benefit Scheme; MOPH: Thai Ministry of Public Health; PDx: principal diagnosis; SSS: Social Security Scheme; UCS: Universal Coverage Scheme

Declarations

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Availability of data and materials

The datasets used for this study are available from the corresponding author upon reasonable request and with the authorized approvals from the government offices which own the original raw data.

Author’s contributions

TJ solely worked on the study.

Ethics approval and consent to participate

Not applicable as secondary and anonymous data was used in the study.

Consent for publication

Not applicable.

Competing interests

The author declares to have no competing interests.

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