Original Article

Modified population-to-physician ratio method to project future physician requirement in Thailand

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Abstract

Imbalance in the cadre mix, number, distribution, and quality of health personnel are major concerns for health planners and policy makers. Many methods were developed and used to project future supply and requirement for health personnel. Population-to-physician ratio is the simplest method used to project the future requirement. However, one of the problems with this method is the difficulty of taking into account in the projection the potential intervening effects of economic development and the health care system. This paper modified the population-to-physician ratio method, by taking into account the specific characteristics of the Thai health care system, and of the future economic scenarios to project requirements of Thai physicians over the next twenty-five years. The study reveals a requirement of 44,064 to 50,359 physicians (average 47,212), in the situation of low to high economic growth, as compared to the supply of 44,028-47,519 (average 45,774), in the year 2020. The long term (25 years) projection shows that there will be a moderate shortage of physicians (14.28%-30.34%) during the first 10 years (1995-2005). The gap will narrow down and reach a balance in the second decade with the average shortage of only 3.05% in 2020. There is thus no need to increase the current production rate of Thai physicians, as there are still vacancies in some medical schools due to the inability to recruit students who pass the MPL (minimal passing level). The language difficulties and licensing mechanisms also exclude the possibility of importing expatriates. The current and shorterm shortage may thus be appropriately solved by increasing productivity, and use of other personnel, i.e., professional nurses. The more important issue is the maldistribution of physicians. However, due to the dynamicity of the situation, it is recommended that continuous intermittent attempts are needed to update the estimation.

Keywords : population ratio, physician requirement, manpower planning, health futures.

Introduction

The appropriate number of physicians in one locality or one country is of prime concern to most health planners, especially when they are planning the future development of the health care systems. It is generally accepted that labor costs usually account for more than two-thirds of all operating health costs. Thus efficient planning and implementation of health workforce supply and requirement plans is essential to the efficient development of the health care system. Generally, human resources for health (HRH) planning aims at determining appropriate cadre mix, qualifications, numbers, distribution, and management strategies for health workforces. However, there was limited success in HRH planning due mainly to a lack of, or limited support to, longterm strategic planning, unacceptable HRH plans, lack of accurate information, lack of or inappropriate planning methods, and finally lack of participation of relevant stakeholders.[(1)]

With regard to supply and requirement projections of HRH, there are several complicated methods used. For supply projections, the cohort analysis and the annual loss rate are two commonly used methods[(2)]. However, for demand side projections, at

least 4 main methods are used, i.e., population ratio method, health service target method, health needs method and health demand method[3, 4, 5]. Of these 4 methods, population-to-physician ratio is the simplest and easiest to carry out. Yet it is usually difficult to determine the appropriate population-to-physician ratio for each country's situation, and this method usually gives only aggregate figures. The appropriate population-to-physician ratio usually depends on the level of economic development and the type of health care system management in each country. Rich countries with laissez-faire health care systems, like the USA, usually require low population-to-physician ratios. However, when the US health care system became more managed, the problem of oversupply started to show[6]. Poor countries with low population-to-physician ratios may result in unemployment of doctors[7]. Physician management strategy may also affect the balance of physicians. In Indonesia, with a population-to-physician ratio of more than 6,000 : 1, compulsory public service with inadequate posts resulted in the oversupply of newly graduated physicians. Rapid expansion of medical student enrollments in Mexico during the 1970's affected a rapid decline in the population-to-physician ratio without significant expansion of the health service infrastructures. This created a severe oversupply of physicians[8]. In the 1970's, the WHO proposed the figure of 1 physician to 5,000 population as the appropriate figure[9]. In 1993, the World Development Report proposed a ratio of 1:10,000 as the minimum ratio for public health and minimum essential clinical interventions[10].

Other methods of requirement projections are more difficult and require more information. However, they may be more realistic and give more information especially on the appropriate distribution and cadre mix. Table 1 compares the strengths, weaknesses and appropriate conditions for the application of each method[11].

Table 1 Strengths, weaknesses, and appropriate conditions for application of the HRH requirement projection methods

Methods	Strengths	Weaknesses	Appropriate Conditions
Population ratio	• Long in use; • Quick, easy to apply and to understand; • Requires little information	• Desired ratio is often unrealistic; difficult to assess feasibility • "Black box" method, that is, one cannot describe or explore interactions between numbers, mix, distribution, and productivity • Base year maldistribution likely to be continued in target year	Best used in a country with acceptable health conditions, a stable health sector, and a limited capacity for planning.

Methods	Strengths	Weaknesses	Appropriate Conditions
Health needs	• Logical, consistent with professional ethics, easy to understand; • Useful for some programs such as prenatal and well-child care	• Extensive data required; changing technology requires updates; expensive. • Requires strong controls over health worker deployment and health services utilization	Best reserved for a country with a sound planning capacity, an active government policy toward health, a dominant public sector, and a relatively high public awareness of health issues.
Service targets	• Relatively easy; limited data requirements; understandable; • Can assess interactions between variables	• Potentially unrealistic assumptions may be created.	Most appropriate for lower income countries with a dominant public sector, and active government policy towards health.
Economic demand	• Economically feasible targets due to no or little change in population-specific utilization rates; • Defensible logic	• Complex, with extensive data requirements • It is a "status quo" projection since future population segments may have similar utilization rates as base year segments	Especially applicable in a country with a dominant private sector and a passive government attitude toward the delivery of health services.

During the rapid economic growth, and the rapid expansion of private hospitals in Thailand (1991-1996), there was a severe shortage of physicians especially in the rural district hospitals[12]. Two large projects to increase the production of doctors were initiated aiming at producing 640 new graduates each year[13, 14]. This is in addition to the existing number of 900 annual graduates. The population-to-physician ratio method was used to project the future requirement in order to justify the two projects. The appropriate population-to-physician ratio was then determined by comparison with more developed neighboring countries like Malaysia, Singapore, and South Korea. The figures are somewhat controversial but due to severe shortage of physicians in the public hospitals, the two projects received strong political support. These two projects were thus initiated in the midst of uncertainty about future possible over- and under- supply of physicians.

In 1997, just before the economic crisis, the Thai Medical Council initiated a project to determine the possible supply and appropriate requirement of Thai physicians over the next 25 years. A working group consisting of all stakeholders including educational institutes, planners (at MoPH and National level), users (both public and private), and supporters (Budget Bureau and Civil Service Commission)[15], was appointed to perform this function.

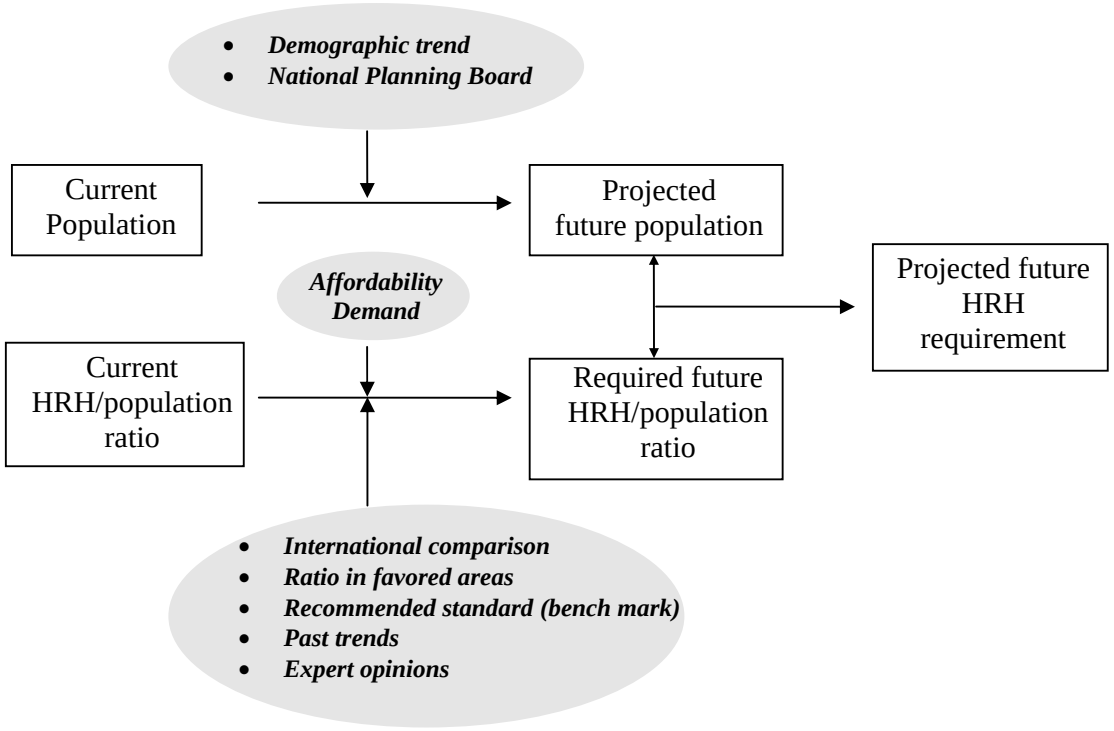
The working group used 3 methods in projecting future physicians requirement, i.e., modified population-to-physician ratio method, health service development target method, and health demand method.

This paper reports the results of the modified population ratio method. It also compares the requirement projection with the previous supply projection figures[2].

Methods

Generally, estimation of future requirements of health personnel by the population-to-physician ratio method is achieved through estimating future population and appropriate future population-to-physician ratio (Figure 1). The figures of estimated future population divided by the projected population-to-physician ratio yield the future physician requirement.

Figure 1 Requirement projection by the HRH/population ratio method[11].



1. Estimation of future population

A thirty year (1990-2020) projection of the future Thai population was carried out in 1991 by the Human Resources Planning Subcommittee under the National Economic and Social Development Board[16]. Three scenarios were developed, i.e., low, medium, and high population growth rate. Owing to the high prevalence of HIV/AIDS during the past decade, the projected figures are also adjusted for deaths from HIV/AIDS. In this paper, we use only the figures in the medium growth rate scenario for the projection.

2. Estimation of appropriate future population-to-physician ratio by adjusted global average figures (Figure 2)

In most cases an appropriate future population-to-physician ratio can be estimated by several methods, i.e., in comparison with other countries, using a ratio from one of the better geographical areas in the country, past trends, a recommended ratio (e.g. WHO or World Bank), and finally, expert opinion.

In this study we estimate the future population : physician ratio **by taking into account the Thai health care system and the future economic status.**

2.1 **Determining the relationship between the population-to-physician ratio and the GDP per capita (ppp-purchasing power parity) at global level.**

Figures from the 1997 World Development Indicators of the World Bank[17] were used to plot the relationship between the population-to-physician ratio and GDP per capita (ppp) of most countries in the world, and an exponential curve was drawn by using a power model in Excel.

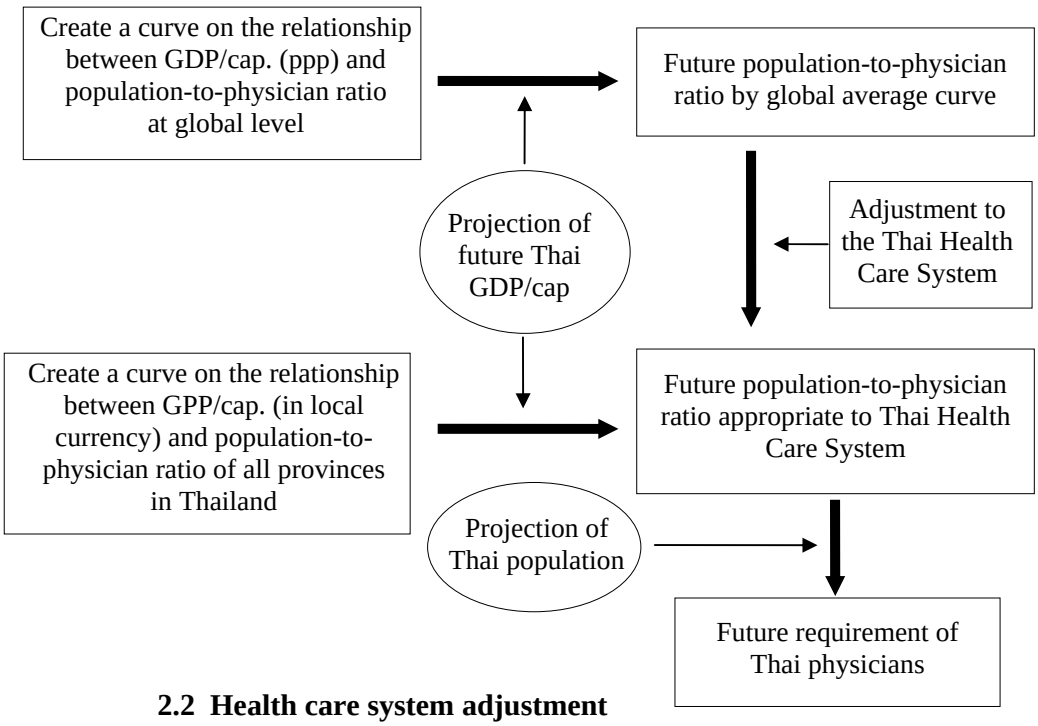
This curve can take into account the appropriate population-to-physician ratio for each level of economic development, under a global average for the various health care systems. The figures of GDP per capita adjusted for the purchasing power (ppp) were used to reflect the real economic status.

The estimation of future economic growth in Thailand was then carried out by using the figures from the Central Bank of Thailand [18] and the opinion of experts in the working group.

From the projected figure of future GDP per capita (ppp) of Thailand, the future appropriate population : physician ratio was determined by plotting on the curve.

However, this curve reflected a global average health care system. Thus the resulting population-to-physician ratio needed to be adjusted to the health care system of Thailand.

Figure 2 Modified population-to-physician ratio method.



2.2 Health care system adjustment

The estimation of physicians requirement in the Thai health care-system in 1995 was carried out using the standard norms of both public and private

facilities. This figure, divided by the 1995 Thai population, gives the population-to-physician ratio appropriate for the Thai health care system **in 1995**.

The Thai health care system adjusted population-to-physician ratio was then compared with the 1995 population-to-physician ratio from the curve (global average) as determined in 2.1. This comparison gives an **adjustment factor** which can be used to adjust the future global average population-to-physician ratio (from 2.1) into one that is appropriate for the Thai health care system.

The methods in 2.1 and 2.2 thus take into account both the economic status and health care system in estimating the appropriate future population-to-physician ratio for Thailand.

3. Estimation of appropriate future population-to-physician ratio by using Thai provincial average (Figure 2)

Using the Thai figures in 1995, the Gross Provincial Product (GPP) per capita (in Baht) was plotted against the requirement adjusted population-to-physician ratio of each province from the health resources survey. The total physicians from the 1995 health resources survey, divided by the total 1995 physician requirement (from 2.2), gives the adjustment factor used for adjusting the survey data of each province into the requirement data to be plotted on the curve. This relationship is used to estimate the population-to-physician ratio appropriate for the estimated future GDP per capita.

4. Estimation of future physician requirement

Division of the estimated population (from 1) by the appropriate future population-to-physician ratio (from 2.2 and 3) results in the future physicians requirement.

5. Comparison between supply and requirement

Requirement figures are then compared with the future supply estimations from the previous study [2] to indicate any imbalances.

Results

1. Projection of future population

Table 2 shows figures for the future Thai population (adjusted for deaths from HIV/AIDS) estimated to the year 2020. The figures in the medium population growth rate scenario are used in this study.

Table 2 Projection of future Thai population, 1995-2020. (adjusted with deaths from HIV/AIDS)

Year	Population by different growth rates (millions)		
	Low	Medium	High
1995	57.51	**59.40**	58.63
2000	59.24	**62.41**	61.56
2005	61.02	**65.03**	64.64
2010	62.85	**67.23**	67.87
2015	64.73	**69.08**	71.27
2020	66.67	**70.50**	74.83

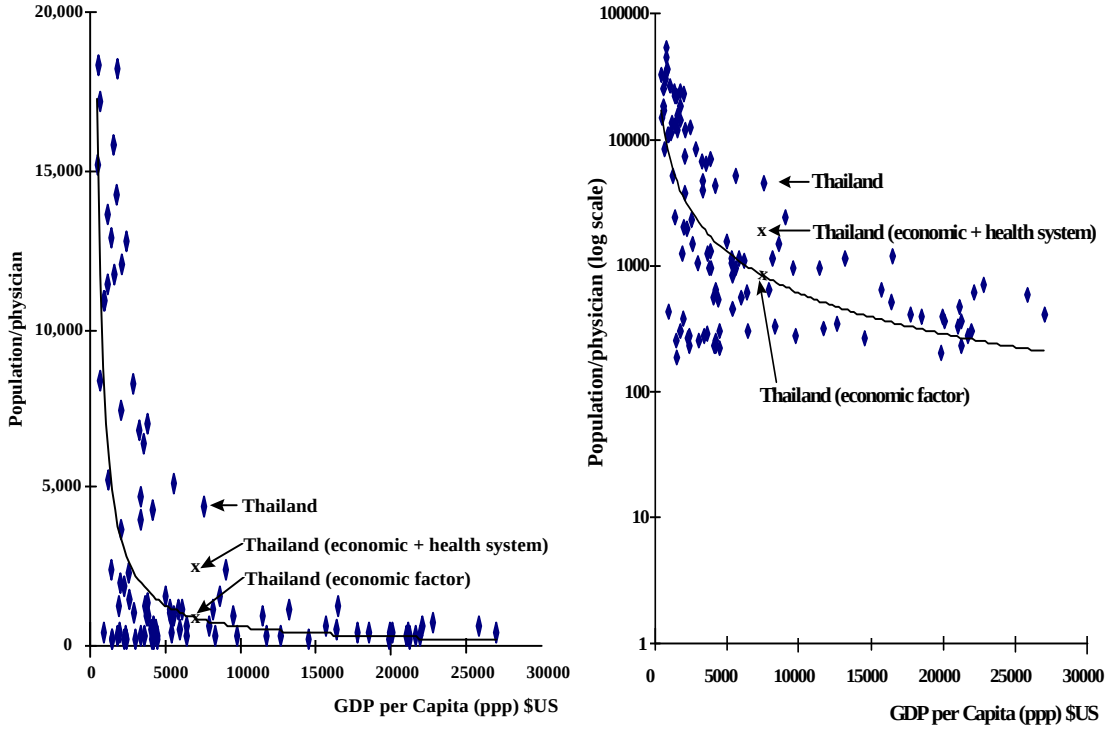
Source : National Economic and Social Development Board[16], 1992.

2. Estimation of appropriate future population-to-physician ratio by adjusted global average figures.

2.1 Relationship between population-to-physician ratio and economic status at a global level

Figure 3 shows the exponential curve of the relationship between population-to-physician ratio and GDP per capita (ppp) of most countries in the world, both on the linear and log scale. The curve was plotted by using a power model in Excel. This curve will be used to estimate the appropriate future population-to-physician ratio from the figures of estimated future GDP/capita (ppp). It is clear from the curve that Thailand is an outliner as compare to most other countries. This explains the current severe shortage of physicians in Thailand.

Figure 3 Relationship between physician density and economic status.



Source : World Development Indicator 1997 [17].

NB. Those with population-to-physician ratio of more than 15,000 : 1 are not shown in the left figure.

2.2 Estimation of future economic status

The GDP per capita (ppp) of Thailand in the next 25 years was estimated as shown in Table 3. Two scenarios for economic growth from the year 2000 were projected, i.e., the high growth (7% per year), and the low growth (5% per year). These figures are based on the fact that the Thai economic growth averaged at 7.8% per year during the past 30 years[19]. The two rates assume that the current economic crisis will be largely resolved in a few years.

Table 3 Estimation of future GDP per capita for three scenarios of economic growth rate (in $US),1995-2020.

Year	Baht		$US			
			GDP/cap		GDP/cap (ppp)	
	high	low	high	low	high	low
1995	60,436	60,436	2,315	2,315	6,806	6,806
1996	75,525	75,525	3,021	3,021	8,791	8,791
1997	75,223	75,223	1,672	1,672	6,325	6,325
1998	69,205	69,205	1,730	1,730	6,544	6,544
1999	69,897	69,897	1,747	1,747	6,603	6,603
2000	71,295	71,295	1,782	1,782	6,735	6,735
2005	99,995	90,993	2,499	2,274	7,997	7,277
2010	140,248	116,132	3,506	2,903	10,518	8,706
2015	196,705	148,217	4,917	3,705	12,293	9,206
2020	275,889	189,167	6,897	4,729	15,516	10,636

NB : 1. Estimated and projected growth rate in local currency in 1997, 1998, 1999, 2000 are -0.4%, -8.0%, +1.0% and +2.0%, respectively. The high and low growth rates are 7% and 5%, respectively, and are used after the year 2000.

2. The exchange rates are 1 $US = 25; 45; and 40 Baht in 1995-1996; 1997; and from 1998 on ward, respectively.

3. The ppp values are obtained by using purchasing power parity factor, determined by experts' opinions.

2.3 Estimation of future population-to-physician ratio

The estimated figures of future GDP/capita (ppp) from Table 3 (in $US) were plotted on the curve in Figure 3, and the appropriate global average population-to-physician ratios for Thailand were estimated (Figure 3 and Table 5). These ratios now need to be adjusted to the situation of the Thai health care system.

2.4 Adjustment of the global average population-to-physician ratio to the Thai health care system

(1) Estimation of the 1995 physician requirement for the Thai health care system

Table 4 shows the estimated requirement of Thai physicians under the current health care infrastructures (1995). The standard staff norms were used in the calculation[20].

Table 4 Requirement of Thai physicians in 1995.

Infrastructure	Physician requirement
MoPH	13,195
MoUA* and other ministries	5,850
Private clinics	2,437
Private hospitals	3,162
Total	**24,644**

*MoUA = Ministry of University Affairs (all 10 public medical schools).

(2) Estimation of the appropriate population :physician ratio in 1995 according to the Thai health care system

This ratio is determined from the 1995 population (Table 2) and the 1995 estimated physician requirement (Table 4). The calculated ratio is 59,401,000 ÷ 24,644 or 2,410 : 1.

(3) Calculating the adjustment factor to transform the global average population-to-physician ratio for Thailand to the ratio appropriate for the Thai health care system.

The global average population-to-physician ratio for Thailand in 1995, determined from the curve in Figure 2, was estimated at 1,200:1. Thus the ratio appropriate for the Thai health care system (from (2)) is 2,410 ÷ 1,200, or approximately 2 times higher than the number from the global average ratio. This figure of 2 was used as an adjustment factor to transform the estimates of future global average population-to-physician ratio for Thailand into appropriate population-to-physician ratio for the Thai health care system (Figure 3 and Table 5).

3. Estimation of appropriate future population-to-physician ratio by using Thai provincial average

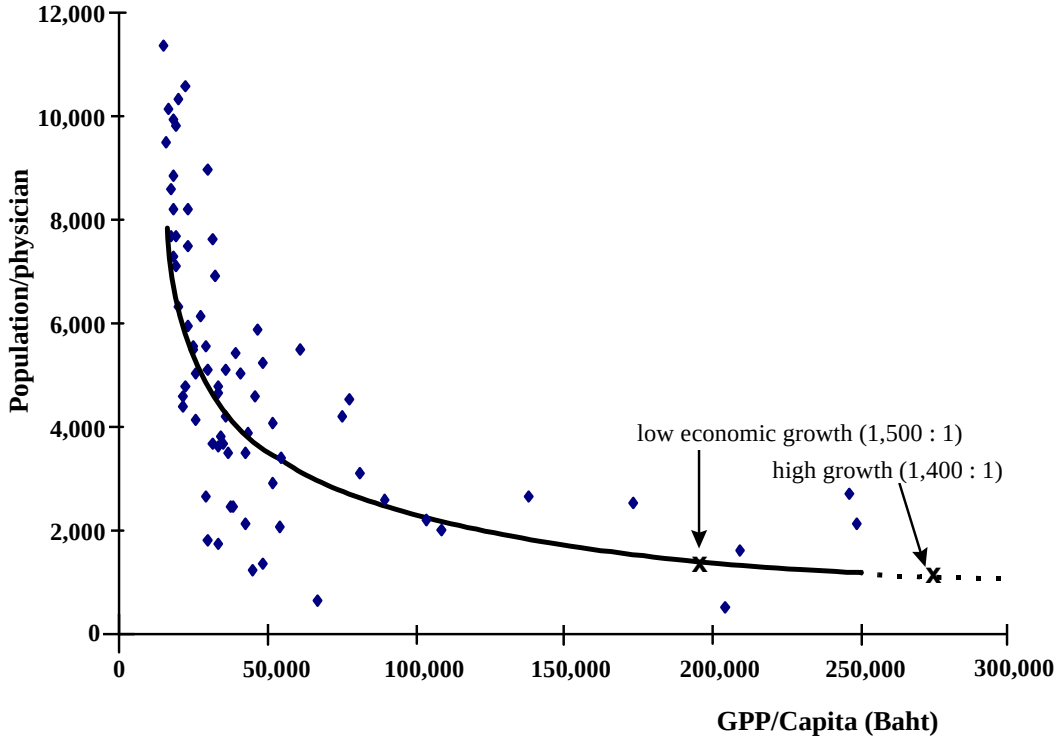
3.1 Relationship between gross provincial product (GPP) per capita and provincial population-to-physician ratio

Figure 4 shows such a relationship. The total number of physicians from the 1995 health resources survey was only 14,181, or 0.57 times of 24,644, the 1995 requirement (Table 4). Thus the figure of 0.57 was used to adjust all provincial population-to-physician ratios from the survey to the requirement figures. This curve is also plotted using a power model in Excel. It is clear from the curve that there are severe inequities both in the distribution of income and physicians. The curve also shows more or less the same relation as the global picture (in Figure 3).

3.2 Estimation of appropriate future population-to-physician ratio

The estimated future GDP per capita (in Baht) in Table 3 is plotted in Figure 4 to determine the appropriate future population-to-physician ratio (Table 5). It is quite clear that the figures derived are not much different from those that are derived from 2.4 (3) above.

Figure 4 Relationship between Gross Provincial Product (GPP) per capita and requirement of population-to-physician ratio in Thailand, 1995.



Source : 1. Population-to-physician ratio of all the provinces is derived from the Health Resources Survey, MoPH, 1995, adjusted for the 1995 physician requirement figures (an adjustment factor of 0.57).

2. GPP/capita of all the provinces is derived from the National Income of Thailand, NESDB, 1995[22].

4. Calculation of future physician requirement

The estimates of future Thai population (in Table 2) were divided by the appropriate population-to-physician ratio for Thai health care system in Table 5. The result is the future physician requirements as shown in Table 6.

Table 5 Appropriate future Thai population-to-physician ratio, 1995-2020

Year	From global average curve				From Thai Provincial Average Curve	
	Global average ratio		Ratio appropriate to Thailand			
	high*	low*	high*	low*	high*	low*
1995	1,200 : 1	1,200 : 1	2,410 : 1	2,410 : 1	2,410 : 1	2,410 : 1
2000	1,200 : 1	1,200 : 1	2,410 : 1	2,410 : 1	2,350 : 1	2,350 : 1
2005	1,000 : 1	1,100 : 1	2,000 : 1	2,200 : 1	2,100 : 1	2,200 : 1
2010	850 : 1	950 : 1	1,700 : 1	1,900 : 1	1,750 : 1	1,950 : 1
2015	750 : 1	850 : 1	1,500 : 1	1,700 : 1	1,550 : 1	1,700 : 1
2020	700 : 1	800 : 1	1,400 : 1	1,600 : 1	1,400 : 1	1,500 : 1

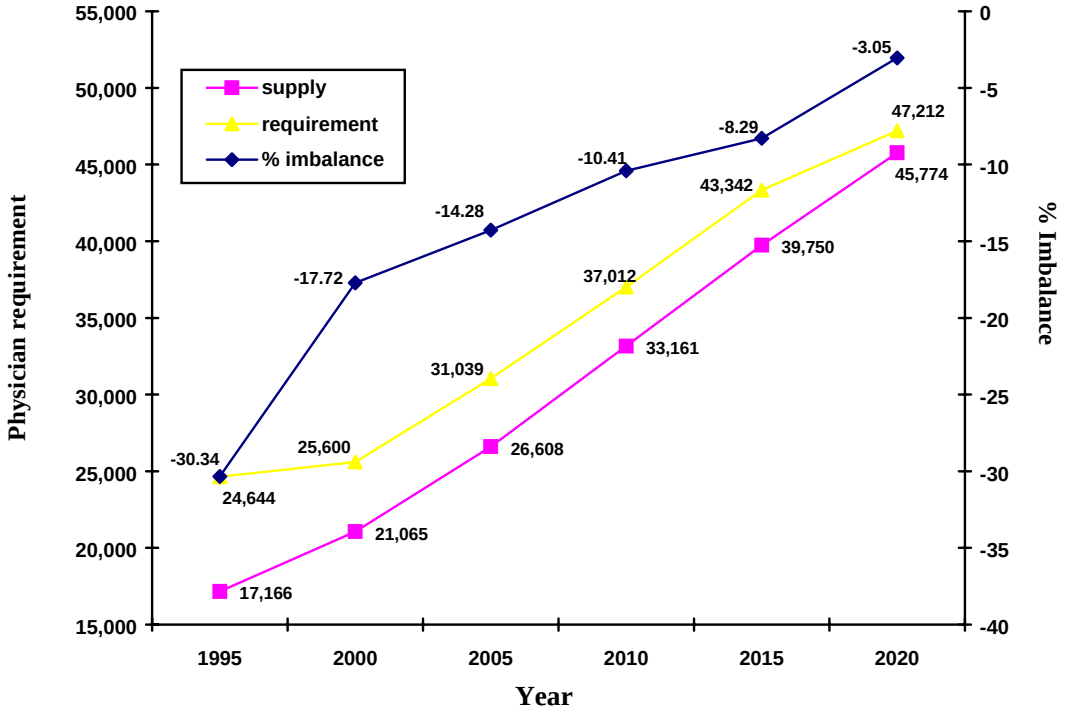
* high and low economic growth rate.

Table 6 Comparison between supply and requirement of physicians, 1995-2020.

Year	Supply (2)			Requirement			Imbalance(+or-)		
	low*	high*	average	low*	high*	average	low[a]	high[b]	average
1995	16,663	17,668	17,166	24,644	24,644	24,644	-6,958 (-28.23%)	-7,981 (-32.39%)	-7,478 (-30.34%)
2000	20,263	21,866	21,065	24,644	26,555	25,600	-2,778 (-11.27%)	-6,319 (-23.80%)	-4,535 (-17.72%)
2005	25,526	27,689	26,608	29,561	32,517	31,039	-1,872 (-6.33%)	-6,991 (-21.50%)	-4,431 (-14.28%)
2010	31,855	34,467	33,161	34,477	39,547	37,012	+10 (+0.03%)	-7,692 (-19.45%)	-3,851 (-10.41%)
2015	38,217	41,282	39,750	40,633	46,051	43,342	+649 (+1.61%)	-7,834 (-17.01%)	-3,592 (-8.29%)
2020	44,028	47,519	45,774	44,064	50,359	47,212	+3,455 (+7.84%)	-6,331 (-12.57%)	-1,438 (-3.05%)

\+ = oversupply ; - = shortage ; figure in ( ) is % as compare to requirement
* high and low estimate
a = low requirement compare to high supply
b = high requirement compare to low supply

Figure 5 Comparison between average supply and requirement of physicians in Thailand



5. Comparison between supply and requirement

Figure 5 and Table 6 also compare the supply[(2)] with the requirement figures. It is quite clear that between 1995-2010, there will be an initial moderate shortage of physicians, from an average shortage of 14.28% to 30.34%, even with economic crisis. The shortage will gradually decrease and may tends towards oversupply by the end of the next 25 years, especially in the scenario of low requirement and high supply.

Discussion

This paper demonstrates an attempt at projecting future physician requirement by innovatively modifying the population-to-physician ratio method, taking into account the future economic status and the health care system of Thailand. Two methods were used. The first method employs the relationship between global figures of GDP per capita (ppp) and the population-to-physician ratio. The second method employs the relationship between Thai figures of GPP per capita and the provincial population-to-physician ratio. Both relationships are used to project future population-to-physician ratio based on projections of future economic status. This is the first attempt at systematising the population-to-physician ratio method for HRH planning.

The two methods of adjustment yielded similar results. It was found that over the next twenty-five years (year 2020), Thailand will require a population-to-physician ratio of between 1,400:1-1,600:1. This means a physician requirement of 44,064-50,359 (an average of 47,212). Comparison with the future supply shows that, in spite of the economic crisis, there will still be moderate shortage of physicians especially during the first 10 years (1995-2005). However, the gap decreases gradually and in the last 10 years, there may be possibility of a small oversupply. The oversupply can occur if there is low economic growth (with low requirement figures) with a low loss rate of physicians (which means higher supply).

It is also clear from data in Figure 3 that for the population-to-physician ratio in 1995, Thailand is an outliner as compared to other countries. While the 1995 population-to-physician ratio from the health resources survey, was 4,180 : 1, the ratio determined from the curve (in relation to 1995 GDP per capita) was 1200 : 1, a more than three fold difference. This explains the severe shortage of physicians in Thailand during the period of rapid economic growth. And due to this severe shortage in 1995, the supply of physicians will continue to be inadequate even after 5 years of economic downturn, with the resultant stable requirement of physician.

This innovative method demonstrates a uncomplicated way of estimating future physician requirements. Although this method only yields aggregate figures, it may also be used to estimate requirements for specific provinces or regions in a country if the future economic status of these provinces or regions can be estimated. This will reflect the geographical distribution of the physician requirement. However, it cannot estimate requirements for different sectors (public/private) or different institutes (e.g. MoPH, Medical schools, Social Security, and private hospitals).

This study suggests that the current rate of physician production is quite adequate for the next 25 years. Any new project to increase the production rate of physicians should be considered carefully as it may lead to a future surplus of physicians in Thailand.

The current and the near future shortage of physicians may be solved by increasing the productivity of physicians, e.g. through increasing incentives for non-official hours services, or the use of professional nurses to take care of some basic

medical services. As there are still vacancies in the medical schools due to the fact that not enough students passed the MPL (minimal passing level) in the entrance examination, there is no need to expand places in the medical schools. Other measures, such as hiring of expatriates may not be feasible in this period of economic crisis, as well as because of language problems. The more important questions are the maldistribution and appropriate competency of the physicians, rather than overall quantitative adequacy.

However, due to the many uncertainties inherent in any longterm projection, periodic projections, and projections with other methods, such as health services target method and health demand method, are essential to confirm the projection and adjust for intervening socio-economic changes.

Conclusion

An innovative method to improve the projection of future physician requirement by the population-to-physician ratio method was developed by taking into account the future economic status and the specific health care system. The method was applied to the Thai situation and projected to reflect a moderate shortage, even in the period of economic crisis, over the next 15 years. The supply and requirement at 20-25 years will be almost in balance and thus there is no need for increasing the production rate of physicians at least over the next decade. The current and short-term moderate shortage should be solved by increasing productivity and some shift of responsibility, rather than by expanding the student enrollment, or importing of expatriates. Continuous intermittent projection and solution of the problems of maldistribution are essential for the appropriateness of the future health care system development.

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