Baseline Projection of Requirements for Dental Health Manpower in Thailand (1995-2015 AD.)

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Abstract :

This study is intended to compare the dental health personnel supply to the requirement in each 5-year interval from 1995 to 2015. The dental health personnel supply was calculated by subtracting the annual personnel loss from the current active personnel plus the annual personnel production. The results show that there will be 10,100 dentists and 7,718 dental nurses in supply in the year 2015. The personnel requirement was calculated using 3 different techniques; the population ratio technique, the FDI/WHO technique, and the system dynamics technique. The dental personnel to population ratio of 1:5,000 was used to calculate the personnel requirement in the population ratio technique. The FDI/WHO and the system dynamics techniques calculated the personnel requirement by converting the need for service into the need for personnel. While the FDI/WHO technique calculated the need for service based on the lifetime of care for each age cohort, the system dynamics technique calculated the need for service which changed with the alternations in the input factors such as the socioeconomics of the population, the trend of oral diseases, and the structure of health care system. From these three techniques, the requirement for dentists ranges from 8,920 to 9,748 and for dental nurses ranges from 3,046 to 10,974. The results show that in the year 2015, the supply of dentists exceeds the requirement regardless of what technique is used. Similarly, the supply of dental nurses is higher than the requirement when the calculations are done using the population ratio technique and the system dynamics technique. However, the dental nurses will be in shortage according to the FDI/WHO technique. The reason for this different outcome is that dental nurses in the FDI/WHO technique provide health promotion and health education services as well as preventive and simple curative services; while in the other two techniques they provide only preventive and simple curative treatment.

Key words : dental health manpower, human resources for dental health, dental personnel requirement, dental personnel supply

Introduction

Human resources for dental health was first studied in 1973 and the personnel requirement was calculated using the population ratio method.[1] The dentist to population ratio (1:5,000) used for the calculation was arbitrarily obtained from WHO (World Health Organization) experts.[2] This method, although widely used at that time, has many disadvantages. The major one was that the calculated number of dentists was not the best representation of the manpower requirement because neither the distribution of the personnel nor different types of personnel were taken into consideration.

In 1979, Tumkosith had derived a ratio of 1:4,033 from the epidemiological data and the basic service need.[3] This method also has some disadvantages. Since the ratio was based on the basic service need which did not include any other services such as preventive service, the predicted number of dentists would not be the best representation of the needed dentists either. Moreover, any other types of personnel, such as dental nurses, dental technicians, and dental assistants, were not taken into the consideration. Later, there was an attempt to modify the Tumkosith method by including more types of dental services and dental personnel into the calculation.[4] From this approach, the dentist to population ratio was found to be 1:8,000 and the dental nurse to population ratio was 1:10,100. Corresponding to this calculation, the number of dentists produced each year was increased from 250 to 300.[12]

In 1990, Udompanich had studied the predicted dental manpower at district level using the system dynamics approach.[5] Epidemiological data was still used in this projection. Other factors were included in this study such as the effect on management and the distribution of the primary health care personnel. The dentist to population ratio was calculated to be 1:20,366 and the dental nurse to population ratio was 1:15,275.

In 1993, the Minister of University Affairs set up, after a careful study, the number of dentists to be produced each year.[6] In 1986, the dentist to population ratio, calculated from the need basis was 1:7,100 and the dental nurse to population ratio was 1:8,900.[6] However, the number of dentists has been found to be insufficient for treatment needs. Therefore, two new dental schools have been opened.

Since all previous studies have used different approaches, they produced different personnel to population ratios. However, they pointed to one direction which was the need to increase the personnel production. Since the cost of production is relatively high, the question of how many dental personnel are needed to avoid over and under production and what appropriate predicting method to use would be have been raised. This study is intended to compare the predicted dental manpower requirements from three of those previously mentioned methods when calculated under the same basic population data, same epidemiological data, same hypothesis and at the same period of time, and compare these numbers to the dental personnel supply.

Materials and Methods

1. Data Source

This study is a Historical Crossectional Study. All data used in this study were collected from the following sources:

1.1 Socioeconomic status of the population were obtained from the report of the Bureau of Health Policy and Planning, Ministry of Public Health.[7]

1.2 Epidemiological data related to oral diseases were obtained from the second, third, and fourth National Oral Health Survey.[8,9,10]

1.3 Dental Health Manpower. The data related to dental health manpower were collected from the previous dental health manpower studies[4,6,13], the report of the Ministry of Public Health[11], and the report of the Ministry of University Affairs.[12]

1.4 Population projection. The population in each age group in each 5 years from 1995 to 2015 were projected, using medium growth rate which was reported in the National Economic and Social Development Board.[13] The numbers were already adjusted for death rate of AIDS.[14]

2. Method of Estimation

These data were organized and reviewed by the investigators to see the trends of oral diseases and the estimations of dental personnel requirements supply.

2.1 Population Projection

The whole population and the population in 5 different age groups- 0-5, 6-14, 15-29, 30-59, and 60 years old and over- in the target year were estimated from the growth model.

2.2 Trend of Oral Diseases

The DMFT (decay, missing, filling) and CPI (community periodontal index) from the three National Oral Health Surveys were used to project the trend of oral diseases in each age group by using simple regression analysis.

2.3 The Supply of Dental Health Personnel

The future active supply of dental personnel was calculated by subtracting projected losses of dentists from the current active supply and the annual output of the new graduates. The number of annual output was calculated according to the production plan. Presently, there are seven dental schools which produce a total number of 360 dentists per year. After the year 2000 the number will increase to 390 dentists per year, and in 2006, it will increase to 420. The estimated annual loss due to retirement, change of profession, and death, is 2%. There are only two schools which produce approximately 210 dental nurses per year at the present time. In 1997, two more schools will be opened which will be able to produce 60 more dental nurses each year. It takes 2 years to produce each dental nurse. The estimated annual loss for dental nurse is approximately 3% due to the shift to other cadres.

2.4 The estimation of Health Personnel Requirements

Two methods of the estimation of the dental health personnel requirements, the population ratio method and the needs-based method, were used in this study.

2.4.1 Population Ratio Method

The traditional health worker to population ratio method was used. The selected ratio was 1:5,000 which was recommended by the World Health Organization in 1985.[2,15] The population in the target year was obtained from 2.1. The dental health manpower requirement in the target year was then calculated from this ratio.

The requirement of dentists and dental nurses was also calculated separately since the requirement of each type of dental personnel changes after the change in population composition. The projected prevalence of oral diseases was

converted into service requirements. The services were, then, categorized into two groups; the services which were provided by dentists and the services which were provided by dental nurses. The ratio of working-time equivalents between these two service groups were obtained and the number of dentists and dental nurses were calculated from this ratio.

2.4.2 Needs-based Method

The calculation of dental health personnel requirement in this method was based on the need for services. The prevalence of dental diseases in each age group was calculated from the trend of the diseases which was previously obtained from 2.2. The prevalence of the diseases in the target year was converted to service needs, and the service needs were further converted to personnel requirements using the productivity norms.[16]

The personnel requirement was also calculated from the demand for service, which was the actual number of services that patient received. The percentage of the demand for service out of the need for service was, first, estimated by the expert committee. The demand for service of each age group was calculated in this manner and the personnel requirements were calculated from these numbers.

Two techniques of the needs-based method, the FDI/WHO (Federation Dentair Internationale/World Health Organization)[15] and the System Dynamics Modeling Technique[5], were used in this study to find the personnel requirements based on service need and demand for service.

1) FDI/WHO technique

In this technique, the projected population was divided into five age groups which were 0-5, 6-14,15-29, 30-59, and 60 years and over. The dental service need was calculated on the basis of lifetime of care for each age cohort. The service need also includes the need for maintenance care, repeated care and replacement care. The work provided by dental nurses in this technique includes simple curative, preventive, health promotion, and health education services.

2) System Dynamics Model[5, 21]

A complex model was used to predict service needs in each age group in this technique. The model explained the change in behavior of treatment need according

to the changes in the input factors such as treatments, socio-economic factors, trend of oral diseases, and structure of health service. However, the projected service need was converted into manpower requirements in the same manner as in the FDI/WHO technique. Unlike in the FDI/WHO technique, the work provided by dental nurses in this technique included only the simple curative and preventive services.

3. Assumption in the Study

3.1 The projection of dental health manpower used in this study is based on the baseline projection which assumes the continuation of present and foreseeable trends in expansion, deployment and use of health workers. In the present system, most dental services are provided by dentists and dental nurses. While dentists work either in private clinics or in hospitals, dental nurses can only work for government in the hospitals or health centers and provide only simple work and preventive services. All other work are provided by dentists

3.2 The second assumption is that an average worker works 6 hours a day and 230 days a year.

Results

1. Population Projection

Population projections with medium growth rate are shown in Table 1. The population was 59.4 million in 1995, and it will be 69.6 million in 2015. The population in 0-5 years group and 6-14 years group have been steadily decreasing. The population in these two groups together will be 14.4 million in 2015. However, the population in older ages, 30-60 and 60 or over, will increase to 39.4 million in 2015. The changes in population composition have effects on the pattern of oral diseases.

2. Trend of Oral Diseases

In the next 2 decades, prevalence of oral diseases in the country is shown to be steadily declining. As shown in table 2, dental caries prevalence in populations less than 30 years of age decreases while in the older age groups it slightly increases. Periodontal diseases, as in table 3-6, have a tendency to decline in the younger populations.

However, periodontal diseases and the excluded sextant in working ages and in the elderly are still very high.

3. Supply of Dental Health Personnel

The supply of dentists and dental nurses are shown in Table 7. In the 1995, there were 4,973 dentists in the whole country and the number will increase to 10,100 in 2015. The estimated loss from the profession is 2% per year. Therefore, there will be 9,898 active dentists remaining.

The supply of dental nurses is less than dentists. As shown in the table 7, there were 1,367 dental nurses in the whole country in 1995, and by the year 2015 there will be 7,718 dental nurses. The estimated lose is 3% per year or 231 persons by the year 2015 higher than the dentists due to the shift of dental nurses to other cadres.

4 Requirement projection

4.1 Population Ratio Method

The Projection of dental health manpower requirements by this method is shown in Table 8. The requirement of dental health personnel in 1995 was 11,180 and will increase to 13,918 in 2015.

When the requirements of dentists and dental nurses are calculated separately, the requirement for dentists in 2015 will be 9,768 and for dental nurses will be 4,150. The requirement of dental nurses decreases from 5,393 in 1995 to 4,150 in 2015; while requirement of dentists increases from 6,487 to 9,768. This is a reflection of the change in the pattern of diseases and services; prevalence of complicated diseases increases with time, while simple diseases decrease with time.

4.2 Needs-Based Method

4.2.1 FDI/WHO Technique

The results of the projection by this technique are shown in table 9. In 2015, the requirement for dentists will be 17,511 and for dental nurses will be 17,498. However if the need is weighted by the demand for service of each age group, the requirement for dentists will drop to 9,748 and to 10,974 for dental nurses. The table

also shows the requirements according to the treatment needs and demand-weighted needs. The requirements calculated from the demand for treatment in each age group, 0-5, 6-14,15-29,30-60, and 60+, are 100, 100, 40, 50, and 35 percent of the requirement calculated from the treatment need, respectively.

4.2.2 System Dynamics Model

The results of projection using the system dynamics model are shown in table 10 and 11. The result shows that in 1995 it required 129,800 dentists and dental nurses to provide all services for the entire population. The number will decrease to 114,700 in 2015 because of the overall decline in oral diseases. However , these numbers correspond to the personnel needed for all dental problems that currently exist and to be taken care of within one year. After that year, 102,600 dentists and dental nurses will be in excess since it requires only 11,970 dentists and dental nurses for the maintenance care.

Table 11 shows the requirement for dentists and dental nurses in the year 2015. A total of 72,630 dentists and specialists and 41,960 dental nurses are required for complete treatment of oral diseases in the year 2015. When the need is weighted by demand for service in each age group, the requirement for dentists and dental nurses go down to 45,900 and 29,630 respectively. For maintenance care, only 8,924 dentists and 3,046 dental nurses are required. Thus, if the present dental health status of Thai population is quite acceptable, the requirement of dental health personnel will be that required for maintenance care.

Conclusion and Discussion

1. Projection of dental health manpower requirements for Thailand in the year 2015

The three techniques used in the requirements projection give a wide range of numbers for dental health manpower. Base-line projections of the manpower is shown in table 12. The range of numbers of manpower spans from 13,874 persons by the ratio technique, to 11,970 persons by system dynamics technique.

Eventhough the system dynamics technique gives a very high number of dental manpower, the requirement for maintenance care is relatively low. The number of dentists are 9,768, 9,748, and 8,924 from the calculation of the ratio, FDI/WHO and system dynamics techniques, respectively. These numbers correspond to 1:7,124, 1:7,139 and 1:7,798 dentist to population ratios accordingly.

If a person visits a dentist 1 time per year and a dentist can see 10 patients per day, each year a dentist can see approximately 2,300 patients. However, the average dental visit for the Thai population is estimated to be 0.3 time per year per one person. This number is the requirement estimated from the demand-weighted need of the Thai population. From this estimation, the dentist to population ratio is calculated to be 1:7,590. The ratios of 1:7,124, 1:7,139 and 1:7,798 from the three techniques are reasonable and appropriate for the country.

The requirement for dental nurses ranges from 4,150 to 10,974. The numbers, calculated from population ratio and system dynamics, which are 4,150 and 3,046, are much lower than from the FDI/WHO technique. The reason is that the FDI/WHO technique assumes that dental nurses provide both curative, preventive, health education and health promotion services, while the other two techniques assume that dental nurses provide only simple curative and preventive care. This projection of FDI/WHO seems to be valid for the country since dental nurses in Thailand provide curative, preventive, health education and health promotion services.

2. Comparing between 3 techniques of requirement projection

The three techniques give different results in the requirements for manpower since their underlying concepts are different. The ratio method is very easy to handle and understand. However, there is a question of what ratio should be used in order to give the best estimate of personnel requirements for Thailand. Fortunately, the ratio of 1:5,000 which is used in this study gives good estimates for the demand-weighted need for services in this country.

The FDI/WHO technique also has some disadvantages. The technique is rather complicated and requires a lot of assumptions. Most of these assumptions are still not well studied. For example, this technique uses synthetic aged-cohorts to calculate the need for services. However, the trend of oral diseases in Thailand shows a slow decrease. Therefore this technique may very well overestimate the personnel requirement in the target year. This technique has been used previously in 1986[4] and 1993[6] which gave the dentist to population ratio of 1:8,000 and 1:7,100 respectively. These ratios are consistent with 1:7,139 which is obtained from this study.

System dynamics technique requires a complex computer model to project the requirement. The model adjusts the number of personnel requirements when there are changes in the input factors such as changes in disease prevalence, population, economic status, etc. Moreover, the results from this technique can be difficult to interpret and inconsistent. Furthermore, a change in the input factor can result in a significant change in the number of personnel required. For example, the study for personnel requirement in Chiengmai[5] by this technique gave a ratio of 1:20,366, while the ratio for the whole population of the country in this study is 1:7,798.

3. Comparing between supply and requirement

Table12 shows the comparison between supply and requirement of dentists and dental nurses in the year 2015. The requirement in this table is obtained from the FDI/WHO technique. In the next twenty years, there will be a slight oversupply of dentists ; the country will have 352 dentists or a 4% surplus. Moreover, the growth rate of the dentists in this country exceeds the population growth rate. On the contrary, the requirement for dental nurses is far more than the production. The table shows that dental nurses will be in short supply by 3,250 persons. These results indicate that expansion in the production of dentists should be carefully studied beforehand and the increase in dental nurses production should be considered. Moreover, the problem of temporary shortages of dentists should be corrected by distributing more services to dental auxiliary personnel. As indicated by the study by Aker , about 67% of a dentist's work can be delegated out to auxiliary personnel[17] , and most of the treatment for Thai people can be provided by dental nurses.[8]

Finally, the increase in production of dental nurses has some advantages over the increase in production of dentists. It takes less time and cost for training a dental nurse than a dentist. Moreover, the dental nurses are better distributed than the dentists because they can only work for the government.

Table 1 Population projection from 1995 to 2015

Age group	Population (x 1,000)				
	1995	2000	2005	2010	2015
0-5	5,699	5,453	5,240	5,084	4,925
6-14	10,880	10,480	10,180	9,831	9,494
15-29	16,970	17,160	16,900	16,380	15,780
30-60	21,060	26,640	26,200	28,540	30,140
60+	4,816	5,614	6,657	7,791	9,247
Total	59,400	62,340	65,180	67,630	69,590

Table 2 Trend of caries experience (DMFT) in 1995-2015

Age group	1984	1989	1994	Trend (slope)	2015
0-5	-	4	3.4	-0.12	0.7
6-14	1.5	1.5	1.6	+0.01	1.8
15-29	3	2.7	2.4	-0.06	1.1
30-60	5.4	5.4	6.5	+0.11	8.4
60+	16.3	16.2	15.8	-0.05	14.8

Table 3 Trend of the average sextant with calculus (CPI 2) in 2015

Age group	1984	1989	1994	Trend (slope)	2015
0-5	-	-	-	-	-
6-14	3.6	3.6	3.5	-0.01	3.2
15-29	4.6	4.0	4.3	-0.03	3.5
30-60	3.8	4.0	3.4	-0.04	2.7
60+	1.3	1.8	2.0	+0.07	3.6

Table 4 Trend of the average sextant with moderate periodontal disease (CPI 3) in 2015

Age group	1984	1989	1994	Trend (slope)	2015
0-5	-	-	-	-	-
6-14	0.1	0	0	0	0
15-29	0.3	0	0.1	-0.02	0
30-60	1.6	1.1	1.3	-0.03	0.5
60+	1.7	1.2	1.1	-0.05	0

Table 5 Trend of the average sextant with severe periodontal diseases (CPI 4)
in 2015

Age group	1984	1989	1994	Trend (slope)	2015
0-5	-	-	-	-	-
6-14	0	0	0	0	0
15-29	0	0	0	0	0
30-60	0.2	0.2	0.4	+0.02	0.8
60+	0.4	0.3	0.5	+0.01	0.7

Table 6 Trend of the average of excluded sextant in 2015

Age group	1984	1989	1994	Trend (slope)	2015
0-5	-	-	-	-	-
6-14	0.4	0.2	0	-0.04	0
15-29	0	0.2	0	+0.003	0.06
30-60	0.2	0.2	0.2	0	0.2
60+	2.6	2.6	2.2	-0.02	1.4

Table 7 Supply projection of dental health manpower from 1995 to 2015.

Year / Parameters	1995	2000	2005	2010	2015
Number of dentists	4973	6187	7441	8840	10100
Number of dental nurses	1367	2744	4651	6301	7718
Dentists + Dental nurses	6340	8932	12090	15140	17820
Drop out number of dentists	99	123	148	176	202
Drop out number of dental nurses	41	82	139	189	231
Dentist : Pop^n	119444	10075	8759	7650	6890
Dental Nurse : Pop^n	43452	22781	14014	10680	9016
Dentist + Dental nurse :Pop^n	9369	6979	5390	4466	3905

Note :

1. Numbers of dentists and dental nurses in 1995, and numbers of production come from reference 6,12.

2. Drop out for Dentists = 2% /year, Dental nurses = 3%/year, (consensus from the working group for projection of dental health manpower requirement.)

Table 8 Requirement for dental health personnel from 1995 to 2015 as projected by population ratio(1:5000).

Year	1995	2000	2005	2010	2015
Dentist	6,487	7,200	8,360	9,054	9,768
Dental nurse	5,393	5268	4676	4372	4,150
Total	11,880	12,468	13,036	13,526	13,918

Table 9 Requirement for dental health personnel in the year 2015 as
projected by FDI/WHO technique.

Type	Need-based	Demand-weighted[1]
Dentist	17,511	9,748
Dental nurse	17,498	10,974
Total	35,009	20,722

1. Percentages of demand of need are 100, 100, 40, 50 and 35 for age group 0-5, 6-14, 15-29, 30-60 and 60+ respectively.

Table 10 Requirement for dental health personnel from 1995 to 2015 as
projected by system dynamic technique

Number of Dentist and Dental Nurse	1995	2000	2005	2010	2015
for treatment of all dental problems within 1 year	129,800	130,000	125,500	121,700	114,700
for maintenance care	6,164	6,551	9,272	11,710	11,970
surplus of personnel in the following year	123,000	112,900	115,800	109,700	102,600

Table 11 Requirement for dental health personnel from 1995 to 2015 as projected by system dynamics technique.

Year	Dentist			Dental Nurse		
	Need-base	Demand weight[1]	Maintenance	Need-base	Demand weight[1]	Maintenance
1995	83930	44710	4771	45270	31020	1393
2000	80870	44980	5047	48620	33050	1504
2005	78720	45510	7606	16300	31730	1677
2010	77560	46490	9296	43880	30490	2414
2015	72630	45900	8924	41960	29630	3046

1. Percentages of demand of need are 100, 100, 40, 50 and 35 for age group 0-5, 6-14, 15-29, 30-60 and 60+ respectively.

Table 12 Baseline projection of dental health manpower requirement from 1995 to 2015 by 3 techniques

Year	Pop.[n] Ratio		FDI/WHO[1,3]		System Dynamics[2]		Supply	
	Dentist	Dental Nurse	Dentist	Dental Nurse	Dentist	Dental Nurse	Dentist	Dental Nurse
1995	6487	5393	-	-	4771	1393	4973	1367
2000	7200	5268	-	-	5047	1504	6187	2744
2005	8360	4676	-	-	7606	1677	7441	4651
2010	9054	4372	-	-	9296	2414	8840	6301
2015	9768	4150	9748	10974	8924	3046	10100	7718
Ratio	1:7124	1:16768	1:7139	1:6341	1:7798	1:22846		

1. Demand weighted.

2. Maintenance care only.

3 FDI/WHO technique is not allowed to calculate at each 5 years interval.

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