



Original Article

Supply Projections for Dentists, Thailand (2000-2030)

**Duangjai Lexomboon, B.A., D.D.S.,
Komson Punyashingh, B.Sc., D.D.S., M.P.H., Ph.D.**

Department of Community Dentistry, Mahidol University, Bangkok, Thailand

Abstract

In the 1970s, dental manpower in Thailand was found to be in short supply. In response to this shortage, both the Ministry of University Affairs (MoUA) and the Office of National Education Council (ONEC) proposed production plans to expand the supply of dentists. As a consequence, the production of dentists has been increasing dramatically over the past 20 years. Experience from many countries has shown that such a rapid expansion of supply for dentists, if not periodically evaluated, could lead to a state of oversupply.

This paper projects the supply of dentists in Thailand for the next 30 years, using the proposed first year enrollment plans of MoUA and ONEC, in order to compare future supply with the projected requirements. WHO models for projecting workforce supply and requirements and cohort retention rate method were used in this study. The student dropout rate used in this study was found to be approximately 2%, equal to the one used in MoUA plan. Estimated quinquennial retention rates for the dental workforce declined from 99% to 75% over the first 34 years following completion of training, with a maximum working life of 50 years.

The supply projections for dentists under the production plans of MoUA and the ONEC show that the population per dentist will decrease from 10,350 in the year 2000 to 6,072 and to 3,082 in 2030. The MoUA production plan projects a supply similar to the projected requirement in the next 15 years but the ONEC production plan projects an oversupply state. The current economic crisis of the country coupled with health care reform, support an increased emphasis of preventive care, which can be effectively rendered by dental nurses. Future production planning, therefore, should take into consideration the future use of auxiliary personnel and changes in dental health care provision.

Key words: dental workforce, supply projection for dentists, dentist requirement projection, cohort retention rate, dental student drop out rate, population per dentist, Thailand

Introduction

In the 1970s dentists were found to be in short supply in Thailand. As a result, plans were implemented to increase the annual output of dental graduates by increasing first year enrollments in the existing training programs and by opening new dental schools. No study of the impact of these changes and future trends has been made. A number of reports have indicated that several developed countries have gone from a period of shortage of dentists in the 1960s, to one of oversupply in the 1970s and 1980s. This was mainly due to the dramatic decrease in caries prevalence. In Thailand, all dental schools are

publicly supported and a large amount of the national budget is spent every year in producing dentists. Due to the high cost of production and long duration of training, it is important to reevaluate training needs and the long-term trend in the supply of dentists in Thailand.

During the 1960s, developed countries were aware that the oral health of their population was poor and dental manpower was in short supply. With advances in knowledge and technology, together with increases in population growth, the need and demand for oral health care increased. As a consequence, many countries adopted plans to increase the production of



dentists and to expand training programs for dental auxiliaries. Thus, in 1987, first year dental student enrollment in the USA was twice as high as in the 1960s.⁽¹⁾

However, during the mid1970s, many developed countries started to experience problems due to the overproduction of dentists. In 1984, the American Dental Association Special Committee on the Future of Dentistry recommended a reduction in national manpower production based on changing disease patterns, demand and need for dental services, manpower availability, and regional oversupply.⁽²⁾ Several dental schools closed and the number of new dental graduates fell to the 1960s level. In the UK, two dental schools stopped accepting new students in 1989 in order to achieve the 10% reduction in dentist production which was thought to be appropriate to obtain a supply and requirement balance.⁽³⁾ The Scandinavian countries also experienced problems of dentist unemployment and underutilization of active dentists around the same time.⁽⁴⁾

In Thailand in 1977, a committee appointed by the Office of the Permanent Secretary, Ministry of Public Health, conducted a study on the production and development of dental health personnel. Among important conclusions of the committee were the need to increase the production of dentists and address the maldistribution of dental personnel.⁽⁵⁾ In 1993, the Thai Dental Faculties Board held a seminar on dental health manpower. Requirement projections, using a health needs based method, for dentists, dental nurses, and dental assistants, were presented.⁽⁶⁾ Consequently, three universities opened the sixth, seventh, and eighth dental schools in 1994, 1996, and 1998, respectively. At the same time, the existing five dental schools expanded their production capacities. By 1989, the total production of dental graduates was 267, a little more than twice the number produced in 1977.⁽⁷⁾

These increases in the rates of producing dentists reflect plans formulated by the Ministry of University Affairs (MoUA) and the Office of

National Education Council (ONEC). The MoUA need-based plan proposed the production of 360 dentists per year in 1996-2000, 390 in 2001-2003, and 420 in 2004-2007⁽⁸⁾. A study by ONEC in 1998, which used a dentist to population ratio of 1:5,000 in determining the requirement, indicated that the dentist workforce was still under supplied and a more rapid increase in production was introduced.⁽⁹⁾

Whether these current production plans will create an oversupply or under supply situation in the next 30 years is still unanswered. In order to avoid the same oversupply of dentists after a rapid increase in dentist production as evidenced in many developed countries, it is necessary to balance the supply of dentists against the projected requirement. The World Health Organization (WHO) Models for projecting workforce supply and requirement were introduced in 1997 to help planners and decision-makers to generate and test the relative merits of alternative scenarios in health service provision.⁽¹⁰⁾ The advantage of using this model to project supply is that it allows the use of cohort retention rates, which is a more accurate method than the annual loss rate method in determining supply. Moreover, the model allows easy balancing of supply to requirement using various scenarios. This paper will project the supply of dentists during the period 2000 to 2030 using cohort retention rates and the student intakes proposed in the MoUA and ONEC production plans. These supply projections are then compared with requirement projections to foresee future over or under supply of dentists.

The objectives of this study are:

1. to project and compare the supply of dentists in Thailand using the cohort retention rate method under the current production plans of the Ministry of University Affairs and the Office of National Education Council.
2. to compare these supply projections with three requirement projections.

Materials and Methods

The WHO models for projecting workforce supply and requirements version 3.0 will be used for the supply projection. This model will give out profession loss rates, number of dentists lost from the profession, total number of active dentists, percent change of active dentists per year, and health worker indices such as average age of worker, worker per 10,000 population, and population per worker.⁽¹¹⁾ This study is for a 30 year projection with the base year 2000 and the target year 2030. The supply is calculated by adding new quinquennial cohorts of dentists entering the supply workforce during the projection period to the base year supply of active personnel, and subtracting the probable losses of active dentists during this projection period. Two projections will be presented. One is the projection under the MoUA production plan and the other is under the ONEC production plan. A comparison of these two supply projections is made to requirement projections obtained by three methods of projection, population ratio, FDI/WHO, and system dynamics.

1. Population projection

Estimates of the population at base year and average annual growth rates for the first, second, and third decades of the study period were obtained from the Office of National Education Council.⁽¹²⁾ The estimated base year population is 61,643,798. The annual growth rates used for projection are shown in Table 1.

2. Determination of active supply at base year

The active supply at base year is determined

by subtracting the loss of personnel from all personnel entering the active workforce before the base year. The loss of personnel from the workforce is determined by the cohort retention rate method.

2.1 Number of dentists entering active supply before the base year

The numbers of dentists entering the profession each year over the past 50 years are taken from the record of dentist licensure of the Thai Dental Council.⁽⁷⁾ The Thai Dental Council grants a lifetime dental license to all new graduates from Thai dental schools and foreign trained graduates who pass Thai dental board examinations.

2.2 Number of dentists lost from supply before base year

The number of dentists lost from the dental workforce prior to the base year is determined by comparing the number of past dental graduates by year of graduation with the number of dentists still active in the workforce by year of graduation. The number of dentists still active in any particular year is estimated using cohort retention rates. No data relating to the actual age composition of the dental workforce were available. Delphi technique was used to estimate these cohort retention rates.⁽¹³⁾ Six cohort groups were formed which were 0-9, 10-19, 20-29, 30-39, 40-49, and 50-54 years since completion of training. The retention rates of the first 4 cohort groups were obtained from 4 consultative panels. The last retention rate, 50-54 years after complete training, was zero since there were only 9 dentists registered for license. Eight of them have passed away and the remaining one was not in the active workforce. Each consultative panel comprised three staff of the Faculty of Dentistry, Mahidol University whose years since complete training corresponded to the cohort group. The representatives were asked to complete the retention rate table. The percentage of dentists who were still in practice in each age group was the final agreed number of the group.

Table 1 Population annual growth rate for Thailand.

Decade	Year	Annual growth rate (%)
First	2000	1.10
Second	2010	0.64
Third	2020	0.38

Source: Office of National Education Council⁽¹²⁾.

3. Determination of numbers of new personnel entering the workforce

The number of new personnel entering the workforce supply came from two sources; the new Thai graduates and the foreign-trained graduates. The number of new Thai graduates was determined by subtracting the number of dropouts from the number of students entering the first year of training. The estimated numbers of students in the first year class for all schools were taken from the MoUA production plan and the ONEC production plan (see Table 2). The estimated dropout rate, calculated from the enrolment year of 1989, to the most recent class that graduated (enrollment year 1994), is based on the records of three dental schools which had been in operation for at least six years. The number of foreign-trained dentists entering the workforce each year was taken from the register of licensure. During 1951-1989, the total number of foreign graduates was only 27 dentists, while from 1990-1997 the total number was 48 dentists. The number of foreign-trained dentists entering the workforce each year used in this projection was the average of the period 1990-1997, and was found to be equivalent to approximately 6 dentists per year.

4. Determination of loss of active personnel during projection period

The number of active personnel lost from the dental workforce during the projection period is determined by the cohort retention rates. Under the assumption that there is no forthcoming factor that affects the rate of loss from the active supply, the same retention rates that are used in the determination of base year supply are used to determine losses during the projection period.

5. Requirement projection

Projections of the requirement for dentists are taken from a previous study by Punyasingh⁽¹⁴⁾ which used three different methods of projection: population ratio method, the Federation Dentaire Internationale/World Health Organization (FDI/WHO) method, and a system dynamics modeling technique.

Results

1. Number of dentists entering active supply before the base year

The number of dentists entering the profession each year over the past 50 years is shown in Table 3 and Figure 1. The numbers of dentists entering the workforce before 1973, when there were only two dental schools producing dentists, are less than 100 dentists per year. Over the following 10 years the number of new graduates doubled to about 200 dentists per year. For the period 1987-1998, the average

Table 2 Proposed production plan for dentist by Ministry of University Affairs and Office of National Education Council.

Ministry of University Affairs		Office of National Education Council	
Year	Number of first year students (1)	Year	Number of first year students (2)
1996-2000	360	1998-2001	474
2001-2003	390	2002-2006	680
2004-2007	420	2007-2011	928
2008-2030*	420	2012-2030*	928

Note: * indicates years after the proposed production plans which use same production rates as the last year in the plans .

Source: (1) number of first year students comes from reference 8.

(2) number of first year students comes from reference 9.

annual number of new graduates increased to more than 300 dentists. This rapid increase in the number of new graduates was the result of the expansion in production capacity of existing dental schools and students starting to graduate from newly opened dental schools.

Figure 1 also shows an unequal distribution of male and female dentists. The numbers of male and female graduates were approximately equal before 1992. Since then, female graduates

have increasingly out-numbered male graduates. In 2000, the number of female graduates is about three times the number of male graduates.

2. Number of dentists lost from supply before the base year

Table 4 shows the Delphi consultation estimates of cohort retention rates for each 5-year period since graduation. In this table 75 per cent of dental graduates are still in the active

Table 3 Number of new dental licensees according to place of training (1938-1998).

Year	Number of dentists received license		
	Total	Location of training	
		National	Overseas
1938 - 1948	68	44	24
1947 - 1958	124	123	1
1957 - 1968	356	347	9
1967 - 1978	877	873	4
1977 - 1988	1,728	1,717	11
1987 - 1998	3,058	3,008	50
1999 - present	701	701	0
Total	6,966	6,867	99

Source: Number of new dental licensees comes from the Thai Dental Council⁽⁷⁾.

Figure 1 Number of new dental licensees displaying sex distribution (1938-1998).

dental workforce 30-34 years after entry. Within the next five years the percentage of dentists still working drops dramatically to 10%. After fifty years in practice the percentage of dentists remaining in the workforce is virtually zero.

3. Student dropout rate

The estimated student drop out rate was found to be approximately 2%. This dropout rate of 2% is used for the entire projection period under the assumption that factors that affect the dropout rate remain unchanged.

4. Supply projection under the Ministry of University Affairs plan

The projection of active workers and population per worker ratios based on the MoUA plan are shown in Table 5. The number of dentists

Table 4 Estimated cohort retention rates.

Years since completing training	% Actively working in health services
50-54	0
45-49	2
40-44	5
35-39	10
30-34	75
25-29	80
20-24	80
15-19	85
10-14	90
5-9	98
0-4	99

Table 5 Supply projection for dentists under Ministry of University Affairs Plan (2000-2030).

	Grads in 5-Year Cohort	Estimated cohort graduates active in the year						
		2000	2005	2010	2015	2020	2025	2030
1955	46	1	0	0	0	0	0	0
1960	83	4	2	0	0	0	0	0
1965	174	17	9	3	0	0	0	0
1970	261	196	26	13	5	0	0	0
1975	392	314	294	39	20	8	0	0
1980	682	546	546	512	68	34	14	0
1985	849	722	679	679	637	85	42	17
1990	1,180	1,062	1,003	944	944	885	118	59
1995	1,475	1,446	1,328	1,254	1,180	1,180	1,106	148
2000	1,732	1,715	1,697	1,559	1,472	1,386	1,386	1,299
Past Grads =	6,874	6,021	5,583	5,003	4,326	3,577	2,666	1,522
2005	2,058	0	2,068	2,047	1,883	1,780	1,677	1,677
2010	2,058	0	0	2,067	2,047	1,882	1,779	1,676
2015	2,058	0	0	0	2,067	2,047	1,882	1,779
2020	2,058	0	0	0	0	2,067	2,047	1,882
2025	2,058	0	0	0	0	0	2,067	2,047
2030	2,058	0	0	0	0	0	0	2,067
New Grads =	10,290	0	2,068	4,115	5,997	7,776	9,453	11,129
Total active =		6,021	7,651	9,118	10,323	11,354	12,119	12,652
Percent lost over preceding five years		-	5.3%	6.1%	7.6%	8.3%	9.6%	10.8%
Average age of workers		29	30	31	32	33	34	34
Population per worker		10,350	8,603	7,625	7,114	6,501	6,276	6,072

in the active workforce in year 2025 (12,524) is about twice that of the base year (6,021 in year 2000). The population per worker ratio at the base year is 10,238:1 and the ratios decrease to 5,913:1 and 5,157:1 over the next 20 and 30 years, respectively.

Percentage losses of dentists from one quinquennial year to the next rise from 5.7% (2005 compared with 2000) to 9.3% (2030 compared with 2025). The average age of active dentists increases in the next 30 years from 29 years in the base year to 34 years in year 2030.

5. Supply projection under the Office of National Education Council plan

Supply projection under the ONEC

production plan is shown in Table 6. This projection of the supply of dentists shows a threefold increase in the total number of active dentists in 20 years time (6,021 dentists in 2000 to 18,866 dentists in 2020). The population per worker ratios over the next 20 years (3,885:1) and 30 years (3,023:1) show substantial decreases from the base year (10,238:1).

Percentage losses of dentists from one quinquennial year to the next rise from 5.0% (2005 compared with 2000) to 5.8% (2030 compared with 2025). The average age of active dentists remains relatively constant at around 29 years until 2020 then rises to 33 by the year 2030.

Table 6 Supply Projection for Dentist under Office of National Education Council Plan (2000-2030).

	Grads in 5-Year Cohort	Estimated cohort graduates active in the year						
		2000	2005	2010	2015	2020	2025	2030
1955	46	1	0	0	0	0	0	0
1960	83	4	2	0	0	0	0	0
1965	174	17	9	3	0	0	0	0
1970	261	196	26	13	5	0	0	0
1975	392	314	294	39	20	8	0	0
1980	682	546	546	512	68	34	14	0
1985	849	722	679	679	637	85	42	17
1990	1,180	1,062	1,003	944	944	885	118	59
1995	1,475	1,446	1,328	1,254	1,180	1,180	1,106	148
2000	1,732	1,715	1,697	1,559	1,472	1,386	1,386	1,299
Past Grads =	6,874	6,021	5,583	5,003	4,326	3,577	2,666	1,522
2005	3,332	0	3,329	3,296	3,029	2,863	2,696	2,696
2010	3,332	0	0	4,532	4,486	4,122	3,895	3,668
2015	4,547	0	0	0	4,532	4,486	4,122	3,895
2020	4,547	0	0	0	0	4,532	4,486	4,122
2025	4,547	0	0	0	0	0	4,532	4,486
2030	4,547	0	0	0	0	0	0	4,532
New Grads =	21,521	0	3,329	7,828	12,047	16,003	19,732	23,399
Total active =	6,021	8,912	12,831	16,373	19,581	22,398	24,922	
Percent lost over preceding five years		-	4.7%	4.7%	5.8%	6.4%	7.2%	7.5%
Average age of workers		29	28	28	29	30	31	33
Population per worker		10,350	7,386	5,419	4,485	3,770	3,395	3,082

6. Comparison of supply projections under the Ministry of University Affairs and Office of National Education Council Production Plan

The production scheme proposed by the ONEC projects a more rapidly increasing supply of dentists than the MoUA production plan (see Table 7 and Figure 2). In 30 years, the projected total number of active dentists under the ONEC plan is approximately twice the number resulting from the MoUA plan, or 25,184 and 13,233

dentists respectively. The population per worker under the ONEC plan decreases more rapidly in 30 years than under MoUA production plan, from 10,238 in the base year to 3,023 and 5,157 in the target year respectively. The loss rate of dentists from the active workforce under the ONEC plan is considerably lower than under the MoUA plan (5.0-5.8% ONEC compared with 5.7-9.8% MoUA). The average age of active dentists rises more rapidly under the MoUA plan than under the ONEC plan, but the differences are relatively small.

Table 7 Comparison of supply projections for dentists 2000-2030 under MoUA and ONEC production plans.

Year	Total active workers		Population per worker	
	MoUA	ONEC	MoUA	ONEC
2000	6,021	6,021	10,350	10,350
2005	7,651	8,912	8,603	7,386
2010	9,118	12,831	7,625	5,491
2015	10,323	16,373	7,114	4,485
2020	11,354	19,581	6,501	3,770
2025	12,119	22,398	6,276	3,395
2030	12,652	24,922	6,072	3,082

Figure 2 Supply projections for 2000-2030.

population per worker

Active dentists

Note: MoUA = Ministry of University Affairs production plan
ONEC = Office of National Education Council production plan

7. Comparison of supply and requirement projections

Table 8 and Figure 3 compare the two supply projections with three requirement projections. The requirement projections do not extend beyond the year 2015. In that year the

projected requirement for dentists ranges from 8,924 to 9,768, while the projected supply numbers are 10,356 for the MoUA plan and 15,292 for the ONEC plan.

The population per worker ratios in all three requirement projections at year 2015 are similar to the projected supply under the MoUA. But

Table 8 Active dentists in supply and requirement projections (2000-2030).

Year	Supply projection		Requirement projection		
	MoUA	ONEC	Population Ratio	FDI/WHO	System Dynamics
1995	-	-	6,487	-	4,771
2000	6,021	6,021	7,200	-	5,047
2005	7,651	8,912	8,360	-	7,606
2010	9,118	12,831	9,054	-	9,296
2015	10,323	16,373	9,768	9,748	8,924
Pop/worker in 2015	7,114	4,485	7,124	7,139	7,798
2020	11,354	19,581	-	-	-
2025	12,119	22,398	-	-	-
2030	12,652	24,922	-	-	-

Figure 3 Supply and requirement projections for dentists 2000-2030 displaying number of active dentists

the ONEC plan yields a much lower population per worker ratio than the three requirement projections.

Discussion and Conclusions

The number of newly graduated dentists entering the supply is determined by two main factors - the number of first year enrolments and the dropout rate. The expected annual numbers of first year enrolments are higher during the years 2001-2030 than in the previous years of 1955-2000 because both the MoUA and the ONEC plans have recommended an expansion in the production of dentists. The 2% student dropout rate assumed for projection purposes in this study is the same as that found in an earlier ONEC study covering the years 1955 to 2000. Thus the numbers of graduates entering the dental workforce is projected to rise annually throughout the projection period.

Most of the dropouts, primarily from student resignations, occur in the first two years of training. No study has been done to investigate the reason for students resigning, but experts hypothesize that re-taking the university entrance examination for different professions is the primary reason.

Two techniques of estimating losses of dentists from the active supply, annual loss rate and cohort retention rate techniques, may give dissimilar supply projections under the same production plan. In 1998, the ONEC projected the supply for dentists for the years 1997-2017 using the fixed annual loss rate method. The projected number of active dentists in 2015 was 11,787 and the population per worker ratio 5,472:1.⁽⁹⁾ This projection was based on an annual loss rate of 1.5% per year. The projection in this study using proposed ONEC enrolment numbers and cohort retention rates to determine supply yields for the year 2015 results in an active dentist workforce of 15,292 and a population to dentist ratio of 4,750.

Providing that retirement is the primary reason of loss of dentists from supply, the cohort

retention rate method is more precise than annual loss rate method with marked changes in the rate of dentists entering the profession. The cohort retention rate method weights the number of dentists entering the profession each year and the number of years spent working in the profession in the estimation of loss from supply. Data for the years 1955 to 2000 showed that the number of dentists entering the profession increased significantly each decade.

To determine actual cohort loss rates for a given period one needs both cohort entry numbers and the age composition of the workforce in the last year of that period. There is no readily available method of obtaining accurate data regarding dentists who are in active practice after being licensed in Thailand because all dentists having once obtained a Thai dental license are allowed to practice anywhere in the country without having to renew their licenses. Consequently the cohort loss rates used in this study were derived from a Delphi-type consultation of expert opinion.

Although the maximum working life of dentists in Thailand is found to be relatively long, about 50 years, a very high percentage of dentists leave the active dental workforce within 35-39 years after graduation. This finding suggests that cost of production of dentists is relatively high compared to other professions since it takes six years of training for only 35 years of productive work. Besides, the overproduction may lead to a decrease in the utilization of dentists and a higher percentage of dentists leaving the profession. Therefore, dental schools must carefully plan for numbers of enrollment in conjunction with other aspects.

The increase in the production of dentists, as proposed in both the MoUA and ONEC plans, will result in a higher increase in supply than the required increase over the next 15 years. Dentist production has increased rapidly in response to the imbalance between health personnel supply and requirement in earlier years. However, the trend of dentist under supply in

earlier years will start to reverse itself over the next 10 years.

The projected supply under the ONEC production plan results in a much higher number of dentists in the year 2015 than is required by any of the three requirement projections shown in Table 8, while under the MoUA plan the projected supply is comparable to the results of all three requirement projections. These conflicting findings reflect differences in the way the two production plans were developed. The ONEC plan was targeted at the production of a dentist:population ratio of 1:5,000, a ratio proposed many years ago in a WHO publication⁽¹⁵⁾. The MoUA plan however was developed using a needs-based method of projecting future numbers of dentists required. Further more, the MoUA plan took into account the future availability of auxiliary dental personnel, while the ONEC plan did not.

Using the population ratio method to set the target for manpower production may reflect neither the need for services in a country with unstable health conditions nor limited ability to pay for and provide those services.⁽¹¹⁾ Although the National Oral Health Surveys of Thailand⁽¹⁶⁾ show that the prevalence of dental caries and periodontal diseases have increased (significance level <0.01) in the period 1984-1994 and the need for services has increased significantly, the decrease in the country's ability to pay for services provides sufficient grounds for the increased emphasis in prevention and promotion services, which are efficiently rendered by auxiliary personnel. A US study found that dental assistants were able to perform 40 % of the tasks usually performed by dentists.⁽¹⁷⁾ A study in Thailand shows that a dental nurse can provide services to patients effectively and with high patient satisfaction in uncomplicated procedures such as simple fillings, simple extractions, scaling, and preventive services⁽¹⁸⁾. Other factors that may contribute to reducing the demand for dentists' services include improvement in preventive care and increasing patient awareness of dental health, both activities in which dental

auxiliaries may be employed. Without taking the cadre mix factor into workforce planning, use of a dentist:population ratio of 1:5,000 may lead to an over-supply of dentists.

The MoUA plan appears to provide a projected supply comparable to the projected requirement over the next 15 years. In the absence of a major situational change this production plan seems to be suitable for balancing the country's dental manpower supply and requirement. However, the current economic situation of the country and the increase in prevalence of dental caries and periodontal diseases in the Thai population bring about the need to consider an alternative oral health care plan that provides quality care at the least cost. Increased utilization of primary care and the allocation of more funding to the more cost-effective care such as prevention are among options currently receiving expert attention. Careful analysis of the workforce supply and requirement implications of any proposed changes in the delivery of oral health services will be necessary to ensure the appropriate production of dentists and other dental personnel.

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