Oral health manpower projection methods and their implications for developing countries: the case of Zimbabwe

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Manpower projections for oral health are generally held to be more accurate than those for other health sectors since the diseases involved and their treatment times can be predicted more precisely. Nevertheless most oral health manpower projections are either overestimates or are not in line with the resources of individual countries, especially in developing countries.

Zimbabwe was taken as the study case, and oral health manpower projections were made using two of the most commonly employed methods and one new approach. The projections obtained using the three methods were all different, and even the lowest projection is beyond the resources of the country. It is recommended that in making oral health manpower projections, the facilities available to accommodate these personnel should also be taken into account.

Introduction

A trained manpower is a country’s most precious resource, since without it other resources can neither be exploited nor used properly. The role of trained manpower is even more important in the health sector than in any other. Provision of health care depends primarily on trained staff, and their salaries usually account for more than two-thirds of health budgets (1).

Health manpower planning is a process of estimating the number of persons, and the kinds of knowledge, skills, and attitudes they need in order to achieve predetermined health targets, and ultimately health status objectives. Such planning also involves specifying who is going to do what, when, where, and how, for what population groups or individuals, and with what resources, so that the knowledge and skills necessary for adequate performance can be made available according to the policies and time schedules. The planning must be a continuous and not a sporadic process, and requires constant monitoring and evaluation.

The goal of health manpower planning is to ensure the provision of the most economical combination of manpower skills needed for the effective, efficient, and safe provision of health services that can be provided within the available resources for both the long and short term. The optimum solution does not involve the highest proportion of health professionals, but rather uses manpower whose qualifications reflect the population’s needs and demands, at a cost that is compatible with the financial resources of the country (2).

Notwithstanding the great importance of manpower to the health sector, relatively little attention is paid to manpower planning. This leads to a waste of resources; for example, hastily constructed health facilities that lack the staff to run them, or rapidly expanded educational establishments that produce more individuals than health services can absorb (1). It is therefore imperative that manpower planning be an integral part of the overall health planning venture.

Manpower projection methods

Many methods have been designed for estimating the requirements of various health manpower categories (3). Hall has classified these into four broad categories, as discussed below (4).

Population ratio method. An observed or desired manpower/population ratio is fixed for each manpower category (e.g., one nurse per 1000 population, one volunteer health worker per 600 population, etc.). The only data required are population projections. More sophisticated versions focus on projections for particular target populations (e.g., under-5-year-olds).

Service targets approach. In this approach the primary focus is on setting targets for the production and delivery of health services. The approach is theoretically identical to the manpower/population ratio...
method, but in practice is more likely to consider appropriate manpower mixes for particular services in more detail.

**Health needs approach.** This is an extension of the service targets approach that seeks to answer what kinds, amounts, and quality of service are required to maintain a given health status. A prerequisite is an assessment of the needs for preventive services for target populations, the incidence and prevalence of illnesses, the quantity of curative services for each illness, and the health workers required to carry out each service.

**Economic effective demand approach.** In this approach, services are planned to meet what will be demanded. The method requires observation and quantification of present demand (possibly in a number of different categories, e.g., maternal and child health (MCH), outpatients, inpatients, etc.), projection to a target year (which may require scrutiny of determinants of demand and expected changes), and the translation of the demand for services into that for manpower. The approach makes no attempt to influence demand itself, and may use standard manpower/service mixes.

Each of the above methods has its advantages and disadvantages, and none appears to be ideal; many studies have employed more than one approach (3). All methods ignore the interdependence of demand and supply in the health sector. A distinction must be made between needs and demand, even though there are no universally accepted criteria for determining needs. Prediction of attrition rates presents a further problem, since for the health sector loss of manpower to the private sector is also included in the prediction of attrition rates.

All of the above-mentioned factors, compounded by the time delay in training personnel, make health manpower projection a difficult and time-consuming process. For an accurate projection, a large and sophisticated data set is required.

**Dental manpower projections**

In recent years oral disease processes have become better understood and improved methods for their assessment developed. As a result there are now more reliable data with which to estimate oral health needs more accurately and to assess disease trends (5). Also, dental manpower estimates can be made more precisely than those for most other health sectors (6).

Traditionally, the dentist/population ratio has been used to project manpower requirements. Some countries have projected their dental manpower requirements using the health needs approach. In 1989 a WHO/Fédération dentaire international (FDI) Joint Working Group formulated a method that quantifies the need for oral care in communities and the amount that an oral health care personnel can be expected to achieve. Once assessed, the need is converted into the number of full-time oral health personnel required to provide the calculated level of care. The method is sufficiently flexible to permit calculation of both the manpower requirements at the current level of demand and that which may arise in response to future goals and objectives (5).

**The case of Zimbabwe**

**Situation analysis.** Presented below are projections of the oral health manpower requirements for Zimbabwe in relation to the national oral health goals for the year 2000, determined using three of the methodologies described above.

1) **Manpower.** Details of the oral health manpower resources in the country in 1988 are shown below.

- Total number of registered dentists: 130, of whom 113 were practising, as follows:
  - government dentists (five Zimbabweans), 30;
  - private sector, 80;
  - city health department, 1; and
  - medical school, 2.

The discrepancy between the number of registered dentists and those in practice arises because some dentists have maintained their registration status, although not resident in the country. The total includes three specialists in community dental health and one maxillofacial surgeon, all of whom work in the public sector. The government dentists are employed in central, provincial, or district hospitals. All privately practising dentists are located in four major urban areas. There is an urban bias in manpower and facilities in both the private and government sectors since all hospitals in Zimbabwe are located in cities or towns; however, the catchment areas of these facilities, especially the district hospitals, are predominantly rural.

- Total number of dental therapists in 1988: 35, all of whom were practising, as follows:
  - Ministry of Health, 24;
  - city health department, 6; and
  - armed forces, 5.

By law, all dental therapists have to work for a government agency. Initially, dental therapists are
being employed in central, provincial, and the larger district hospitals, but the goal is to place them in all hospitals as soon as possible.

- Total number of dental hygienists: 12, all of whom are employed in the private sector in the major cities.

- Total number of dental technicians: 19, employed as follows:
  - Ministry of Health, 5;
  - armed forces, 2; and
  - private sector, 12.

All dental technicians are located in the four major urban areas of the country.

- Dental assistants—total number, not known.

Trained on the job, the dental assistants work both in the private and public sectors.

- Total number of dentally trained state certified nurses: 300.

State certified nurses (medical assistants), at rural/community health centres have for some time received a short course in exodontics, and receive a certificate if they successfully complete a practical/verbal test. These individuals are currently being recalled in small groups and trained for 6 weeks (three separate sessions) in the identification of oral diseases and in preventive dentistry. They form the primary health care (PHC) level of oral health services in Zimbabwe.

2) Facilities. Although most communities in Zimbabwe have available space with piped water, electricity, and are accessible by road, there is still an acute shortage of health facilities with functional dental clinics (in 1987 there were 3 such clinics in central, 8 in provincial, and 8 in district hospitals). Lack of appropriate equipment, because of shortages or restrictions on foreign exchange, and inadequate numbers of trained manpower result in insufficient oral health services in the country.

Goals and objectives for the year 2000

Oral health goals in Zimbabwe are subject to change because a complete national oral health plan has not yet been completely drawn up. As the plan takes shape, more goals may be added, while others may be found to be irrelevant and omitted. As discussed below, goals are divided into primary, secondary, and tertiary, according to their perceived importance.

Primary goals

The current primary goals, which are shown below, are those whose fulfilment is considered to be essential for the extension of dental services to everyone in the country.

- As soon as sufficient data are collected, the percentage of 5–6-year-olds expected to be caries-free will be set.
- The national average for DMF teeth (D = number of carious teeth; M = number of missing teeth; F = number of filled teeth) will be no greater than 1.5 at 12 years of age (it is currently 1.3; an allowance for a rise has been made because of increased sugar consumption since independence).
- Gingival bleeding will occur, on average, in no more than one sextant of 12-year-olds.
- 55% of 12-year-olds will have a score of not greater than zero on the community periodontal index of treatment needs (CPITN) scale.
- Among 15-year-olds, gingival bleeding (CPITN score, 1) will occur, on average, in no more than 0.7 of a quadrant.
- 40% of 15–19-year-olds will have no sextant of their mouths that scores higher than zero on the CPITN scale.
- 90% of 18-year-olds should have all their teeth.

Secondary goals

The secondary goals, i.e., that 75% of the total DMF among 12-year-olds will be composed of the carious component, can be achieved through curative and rehabilitative activities. This represents a reduction of 10 percentage points from the current 85% level.

Tertiary goals

The tertiary goals are concerned mainly with the administrative and legislative activities outlined below.

- All central, general, and district hospitals will have functional dental clinics. This represents an increase from the current 16 to approximately 41 dental clinics.
- All primary schools and maternal and child health clinics will provide at least two lessons in oral health per year.
- A standardized system for monitoring and evaluating the results and implementation of the oral health plan will be established.
- Piped water in the major and other cities with less than the recommended optimum level of fluoride will be fluoridated if and when possible.
Oral health manpower requirements

Details of the oral health manpower requirements determined using various approaches are outlined below.

Dentist to population ratio approach

In this method, the ratio of the number of dentists to the total population is arbitrarily set. The ratio chosen varies from country to country, takes no account of other oral health personnel (auxiliaries), and is open to a variety of political influences.

The following relationship is used to determine the number of dentists \( N \):

\[
N = P \times r
\]

where \( P \) is the population and \( r \), the required ratio.

Currently (1988), there are 113 practising dentists in Zimbabwe (population, 8,639,674), making the ratio of the number of dentists to population, 1:76,457.

The projected manpower requirement for 2002, based on a population of 12,482,434 and a ratio of 1:20,000, is 624 dentists.

This method ignores sectoral and geographical variations. Only 30 of the 113 dentists in Zimbabwe are currently employed by the government. Both private and government dentists are located mainly in urban areas, and hence this approach ignores the needs of almost 75% of the population, who live in rural areas.

Ignored also are the various categories of oral health auxiliaries (35 dental therapists, 12 dental hygienists, and 300 dentally trained state certified nurses). The total number of oral health personnel (including dentists) is therefore 460. At present, the ratio of oral health personnel to the population is 1:18,782.

In terms of dentists alone, Zimbabwe will therefore need an additional 511 by the year 2002 (based on the 1987 level), i.e., 34 new dentists a year.

Health needs/services approach

In view of the goals and objectives for oral health and the data available on oral health needs, the duties of oral health personnel will include those outlined below.

Oral health surveys. The planning of an organized oral health service must be based on the epidemiological profile of the population. Also, constant evaluation of the services will be required to check whether the set objectives are being met. These activities require oral health surveys that will be carried out by suitably trained dentists.

The total time required per year to carry out these surveys is estimated to be 960 hours (120 hours per province) divided up as follows:

- 5–6-year-olds (8 provinces): 5 days each × 8 hours per day = 320 hours;
- 12-year-olds (8 provinces): 5 days each × 8 hours per day = 320 hours; and
- 15–19-year-olds (8 provinces): 5 days each × 8 hours per day = 320 hours.

Oral health education. Oral health education is needed to increase awareness about dental disease in the population and to prevent such disease. A total of 10,853 hours has been estimated to carry out educational activities, as follows:

- 466 MCH clinics (six visits per year), 1.30 hours per clinic = 4194 hours;
- 4439 primary schools (two visits per year), 1.30 hours per school = 6659 hours.

Initially, these activities will be carried out by dental therapists, but as soon as nondental personnel are identified and trained, the therapists will concentrate more on clinical duties.

More visits per year have been allowed for MCH clinics because of the vast exposure to health educational efforts that can be achieved there.

Treatment of 12-year-olds. Caries is largely a disease of childhood; intervention on early carious lesions is therefore economical and has a long-term benefit. Good oral hygiene practices introduced at an early age, and checked regularly, will result in an adult population with good oral health.

In order to reduce the decay (D) component of the DMF score for this age group from the current 85% to 75%, some teeth will have to be extracted (planned, 10%), while others (90%) will have to be filled. Dental calculus will be removed by scaling and polishing. Dental therapists will be expected to perform all these procedures (a total of 136,013 hours for the projected population of 294,242 12-year-olds by the year 2002), as follows:

- extractions (target: DMF = 1.5, through extraction of 10% of decayed teeth), 20/60 hours or 20 minutes = 3678 hours;
- fillings (target: DMF = 1.5, through filling 90% of decayed teeth), 30/60 hours or 30 minutes = 49,653 hours; and
- prophylaxis (scaling and polishing) (target: 56.2%), 30/60 hours or 30 minutes = 82,682 hours.
The times for each procedure include also an allowance for the time lost between patients.

Emergency treatment. Because dental services were not and are still not available to the majority of Zimbabweans, there is a backlog of untreated dental problems that require emergency care.

Such treatment includes temporary dressings, fillings, extractions (both simple and complicated), root canal treatment, and treatment of oral pathology and of trauma. This work will be shared between dentists and dental therapists, the latter carrying out the routine work of fillings, dressings, and extractions, and the dentists providing the more complex treatment. A third of the total time for emergency treatment is ascribed to dentists and the rest to dental therapists, since the latter do not receive training in complex treatment, and a third of the patients who come for emergency care present with such problems. The time estimated for the emergency treatment of the projected population of Zimbabwe by the year 2002 (12.682 million) is 422 748 hours per annum, based on 10% of the population who need such treatment.

Administrative aspects. Administrative duties are estimated to take up 25% of dentists' total time and 15% of the dental therapists' time.

This time is required by dentists (total, 35 117 hours per year) to supervise the community oral health services and the staff who provide them. The administrative responsibilities of the dentists also include evaluation of programmes and reporting their activities to superiors.

The administrative duties of the dental therapists, include supervising primary health care workers and their activities, reporting to the dentists, and collaborating with other health and non-health workers (total time per year, 64 516 hours).

Total time requirements. The total time required for staff to carry out all the above-mentioned duties, categorized on the basis of the goal for oral health by the year 2000 in Zimbabwe, amounts to 670 207 hours. Of this, 176 993 hours are allocated to dentists and 493 214 hours to dental therapists. Each dentist and dental therapist is assumed to work 1832 hours per year (8 hours per day × 5 days per week × 52 weeks = 22 days' vacation × 8 hours = 9 days' national holiday × 8 hours).

Number of dentists. To perform the 176 993 hours of work per year estimated above for dentists requires a total of 96 persons (176 993 hours/1832 hours per worker). Currently, the Ministry of Health employs 30 working dentists, only five of whom are Zimbabwean. Therefore, 91 dentists are required to be trained (96 - 5).

Number of dental therapists. To carry out the 493 214 hours of work per year estimated, 270 dental therapists are required (493 214 hours/1832 hours per worker). Currently, 24 dental therapists are employed by the Ministry of Health, while a further six work for city health departments. A total of 240 (270 - 30) dental therapists are therefore required.

Other personnel requirements. The following individuals will also be required:

- teachers in dental therapy school (one full-time dentist and four dental therapy tutors);
- senior administrators (two dentists); and
- two maxillofacial surgeons.

An overall total of 96 dentists (91 + 5) are therefore required together with 244 dental therapists (240 + 4). To meet these projected manpower requirements over 15 years (1987-2002) necessitates that 96/15 = 6.4 (7) dentists and 244/15 = 16.3 (16) dental therapists be produced per year.

The points outlined below, which have been omitted from the analysis so far, must also be taken into account.

- The above calculation ignores the role of dentally trained state certified nurses, who are working at the primary health care level and currently perform extractions only. A training programme has been set up to train these nurses in preventive dentistry; they will gradually take over the community dental health education component and are already contributing towards emergency treatment needs by performing extractions. It has been suggested that these nurses should also receive training in prophylaxis and that they could carry out scaling using hand instruments and apply temporary dressings to carious lesions after excavation of cavities. This should considerably reduce the workload of referral centres and hence affect the above-mentioned manpower projections. More detailed data on the present and projected tasks of these personnel would permit more accurate predictions to be made.
- Since it is planned to employ two maxillofacial surgeons, adjustments will have to be made to the estimates for emergency treatments that involve surgery (in 1986 surgical procedures accounted for almost 12% of all dental procedures in Zimbabwe).
- Although it was estimated that 10% of the country's population needs emergency dental care, this proportion is likely to decrease over the years.
- With increasing emphasis on oral health education, account will have to be taken of greater...
demand for restorative care. Trends will have to be observed and the future demand projected to permit a more accurate calculation of staffing levels.

The above estimates are based on existing facilities; however, with a projected 69% increase in the population of Zimbabwe by 2002, more facilities will have to be made available.

**WHO/FDI manpower projection approach**

An estimation procedure ("Health through Oral Health"), based on the report of the WHO/FDI Joint Working Group 5 (7), has been developed and a computer program written to perform the necessary calculations. This program converts oral health needs into full-time equivalents of oral health personnel and, based on this, calculates the level of care needed. As input, the program requires data collected by oral health needs assessment surveys.

For Zimbabwe, all the necessary data are not yet available. Nevertheless, we have carried out the following calculations: the first using WHO/FDI time schedules for each procedure; and the second using time schedules assessed in the field. The program calculates the workload for each category of personnel. Only the manpower projections for dental therapists have been calculated in relation to the goals and objectives of the oral health needs of Zimbabwe. The results of the calculations are shown below.

**Manpower projections for the year 2002 using the WHO timings.**

1) *Health education, excluding MCH clinics* (6–12-year-olds, 5 minutes per person per year): 96.

2) *Treatment of 12-year-olds* (5.5 minutes per person per year): 15.

3) *Emergency treatment for 10% of the population*: 143.

4) *Administration*: 38.

5) *Total dental therapist requirement*: 292.

This amounts to 292–30 = 262/15 = 18 dental therapists per year for a 15-year plan.

**Projections using time schedules recommended by the Chief Dental Officer, Zimbabwe.**


- Time required: 6.7 minutes per person per year.
- Total number of hours required: \( (6.7 \times 1850371)/60 = 206625 \) (for 1992); \( (6.7 \times 2111883)/60 = 235827 \) (for 2002).

- No. of personnel required: \( 206625/1832 = 113 \) (for 1992); \( 235827/1832 = 129 \) (for 2002).

- The number of women of child-bearing age and their attendance at maternal and child health clinics are needed to calculate the manpower requirement for preventive measures for this group.

2) *Treatment of 12-year-olds (excluding surgical care).*

- Time required: 5.9 minutes per person per year.
- Manpower requirements: \( (5.9 \times 251776)/(60 \times 1832) = 14 \) (for 1992); \( (5.9 \times 294242)/(60 \times 1832) = 16 \) (for 2002).

3) *Emergency treatment and simple care (fillings, extractions, and scaling).*

- 10% of total treatment need (excluding surgical care) = 1.98 (i.e., 2) minutes per person per year.
- Time and number of personnel required: 326 027 hours, 178 persons (1992); 411 920 hours, 225 persons (2002).

4) *Administration.*

- 15% of total time: 48 persons per year (for 1992); 56 persons per year (for 2002).

5) *Total dental therapist requirement (excluding MCH clinics health education).*

- For 1992: 353.
- For 2002: 426.

This amounts to \( 426 – 30 = 396/15 = 26 \) dental therapists per year for a 15-year plan.

Projections for prosthetic and orthodontic care were not included since these services are not provided by dental therapists. The total time required for such care could not be calculated because the proportion of the population in each cohort was not available. This calculation places more emphasis on preventive measures, since such systems should be preventively orientated. A total of 96 to 129 full-time dental therapists will be required if the WHO/FDI approach is used, while the health needs approach requires only six therapists to carry out this task. This large discrepancy arises because the latter approach is facility based, while the WHO/FDI is based on the time required per patient.

**Discussion**

All three methods for determining health manpower projections indicate that a minimum of 16 dental
therapists will have to be produced every year to fulfill the requirements in Zimbabwe. A minimum of seven dentists a year will also be required.

Health manpower planning should be carried out as a part of overall planning. Manpower projections should be made in relation to the facilities available. This is all the more true with projections for oral health. The methods we have discussed do not take into consideration the cost of equipment for dentists and dental therapists. Zimbabwe will require 23 new dental units each year for these personnel; each unit costs a minimum of US$ 25,000 (Z$ 50,000) to install and US$ 5000 (Z$ 10,000) per annum to operate it (1988 conversion rates). Even if the minimum projections are used, US$ 690,000 (Z$ 1.38 million) will be required just to equip these personnel, apart from the cost of training them. This is approximately half the allocation on capital expenditure of the country’s health budget. If training costs, wages and maintenance of equipment are also taken into account, almost 20% of the government’s total health expenditure will go towards oral health. Use of such a large proportion of total health expenditure on oral health is neither feasible nor acceptable, even for an industrialized country, and in Zimbabwe would be unthinkable.

Initially, Zimbabwe should therefore aim at manning and equipping the main health facilities with oral health services by the year 2000: 21 district hospitals and one central hospital still have no such facilities. To move towards a more geographically equitable distribution, a third cadre of dental personnel should be introduced. Medical assistants trained in exodontics, preventive dentistry, temporary fillings, and scaling by hand instrument would represent such a group of oral health personnel. Their training would take 6–9 months and they should work full time in oral health services since experience indicates that if they are employed only part time they will tend to concentrate on extractions alone.

There should be one dentist in at least 50% of the district hospitals; two at the provincial level (one of whom will be in charge of oral health services for the province); and 3–4 dentists at the central level. For each dentist there should be two dental therapists, and a dentally trained medical assistant at each of the community/rural health centres. Until sufficient dentists are available, the district level could be manned by senior dental therapists. The manpower projections for the year 2000 are as follows: a total of 43 dentists; 122 dental therapists; and upgrading the 300 medical assistants at present trained in exodontics to dental assistants trained in basic restorative and preventive dentistry and training a further 60. With the present manpower levels, the output of personnel for a 15-year plan would be to train 2–3 dentists and 7 dental therapists per year as well as to upgrade 20 medical assistants and train four new ones every year. The oral health goals for Zimbabwe should be reformulated, taking into account the manpower projections we have made here and the availability of facilities.

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Résumé

Méthodes de prévision des effectifs des services de santé bucco-dentaire et leurs incidences pour les pays en développement: le cas du Zimbabwe

Il existe plusieurs méthodes de projection des besoins en personnel de santé bucco-dentaire. La plus classique est celle du rapport dentistes/population, mais certains pays ont recouru à la méthode des besoins sanitaires. La dernière en date fait appel à l’informatique; elle a été récemment mise au point par un groupe mixte de travail constitué par la Fédération dentaire internationale et l’Organisation mondiale de la Santé (FDI/OMS).

Les projections des besoins du Zimbabwe en personnel de santé bucco-dentaire rapportées dans l’article ont été établies, dans l’optique des objectifs fixés en la matière pour l’an 2000, à l’aide des trois méthodes précitées.

Pour la méthode fondée sur le rapport dentistes/population, on a choisi arbitrairement une valeur de 1:20 000; compte tenu des projections démographiques pour l’an 2000, on a estimé qu’il faudrait 624 dentistes.

Pour l’approche fondée sur les besoins en services sanitaires, une certaine durée a été prévue pour chaque intervention et des projections ont été établies pour les enquêtes sur la santé bucco-dentaire, l’éducation pour la santé et les traitements. Les interventions thérapeutiques d’urgence ont été réparties entre dentistes et hygiénistes dentistes. Les prévisions obtenues par cette méthode se sont établies à 96 dentistes et 244 hygiénistes dentistes.

Pour la méthode FDI/OMS, on a utilisé deux temps estimatifs de traitement recommandés l’un par le Directeur des services bucco-dentaires du pays et l’autre par l’OMS. On a ainsi calculé une durée estimative par personne et par an et obtenu, pour les besoins en personnel, une prévision de 426 dentistes et de 292 hygiénistes dentistes.
Aucune des projections précitées ne tient compte du fait que le personnel bucco-dentaire a besoin d'installations et d'un matériel coûteux. Un calcul simple fondé sur le coût des équipements a montré que même la plus modeste des prévisions relatives au personnel de santé bucco-dentaire absorberait près de la moitié des dotations en capital du budget de la santé.

Une solution plus réaliste est apportée par les projections des structures sanitaires. Un calcul effectué suivant cette approche a montré que deux à trois dentistes et sept hygiénistes dentaires de plus par an suffiraient pour satisfaire les besoins du Zimbabwe.

References