CHAPTER 4 – MATERIALS AND METHODS

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4.1 INTRODUCTION

In this chapter, the way in which data is processed to plan oral health services for KZN using the basic oral health care package is explained. The purpose of this processing was to determine the number and categories of oral health personnel required to satisfy the needs of this province. Calculations were done using the computerized oral health personnel planning model (WHO/ FDI 1989:44) for the years 2000 and 2010. Discussions were held with the Department of Health: KZN, who fully supported this project (Annexure A:166).

4.2 SOURCES OF DATA

Data was obtained from primary and secondary sources (University of Pretoria 2000:20). A primary source is the original work of the author, and is derived during the course of the study. A secondary source is about the primary source, and contains information that has been analyzed, and sometimes published by researchers.

4.2.1 DENTAL CARIES

Recent unpublished data obtained from the national oral health survey conducted in 1999/2000 was used as baseline data for this study (Department of Health 2000). It measured dental caries levels in the six, twelve and fifteen year age groups. Each region of the province was measured. This information was compared to the earlier National Oral Health Survey of South Africa (Department of Health 1994) and recent local surveys conducted in KwaZulu-Natal.

The Decayed, Missing, Filled Teeth index (DMFT) was used to measure dental caries. This index measures the resultant destruction by, and accumulated treatment for past and present dental caries (Spencer 1980:311). The decayed component (DT) can be interpreted as *unmet treatment need*, the filled element (FT) as *successful treatment done*, and the missing part (MT) as *teeth lost due to caries*.

The World Health Organization/ Federation Dentaire Internationale (1989: 44) computer model was used to calculate the number of oral health personnel required to provide the basic package. This model utilizes data for the 0-14, 15-29, 30-64 and 65+ year age groups in its calculations. Therefore the dental caries levels of the 6, 12 and 15 year age groups, of the recent national oral health survey (Department of Health 2000) were projected to the cohorts recommended for the computer model. The DMFT, filled teeth (FT) and missing teeth (MT) for the different age cohorts were calculated as follows:

Decayed, Missing, Filled Teeth (DMFT):

Step i: Calculate the difference in years between minimum and maximum ages in a particular age cohort:

Cohort	**0-14**	**15-29**	**30-64**	**65-90**
No. of years	14	15	34	25

Step ii: Calculate the difference in caries levels between two age groups for a particular cohort (obtained from Table 3.8:61).
For example: between the 12 and 15 year age groups.
DMFT (15 year) – DMFT (12 year) = 1,87-1,14 = 0,73

Step iii: Calculate the increment per year in the DMFT to project subsequent cohorts:

$$\text{Increment} = \frac{\text{Difference in caries levels}}{\text{Difference in years}} = \frac{0,73}{3} = \underline{0.24}$$

Therefore the increment per year is 0,24.

Step iv: Dental caries levels of the cohort were calculated by:

(increment X age difference) + caries level of previous cohort

Cohort	**0-14**	**15-29**	**30-64**	**65-90**
Projected DMFT	1,7	5,3	13,46	19,46

Missing Teeth (MT):

Missing teeth (MT) were calculated using the same formula:

Step i: Calculate the difference in years between the minimum and maximum ages in a particular age cohort.

Step ii: Calculate the difference in levels of missing teeth between the two age groups for a particular cohort.

This was done between the 12 and 15 year age groups.

Therefore MT (15 year) – MT (12 year) = 0,21 – 0,08 = 0,13

Step iii: Calculate an increment per year to project subsequent cohorts:

$$\text{Increment} = \frac{\text{Difference in MT}}{\text{Difference in years}} = \frac{0,13}{3} = \underline{0.04}$$

Therefore the increment per year is 0,04.

Since previous surveys (Department of Health 1994) and service provision data (Department of Health: KwaZulu-Natal 2000a:49) show that extractions were the main type of treatment performed, the *Missing Teeth* component increases significantly with age. Therefore the increment was increased by 10% for each successive cohort.

Step iv: Missing teeth of the cohort were calculated by:
(increment X age difference) + MT level of previous cohort

Cohort	**0-14**	**15-29**	**30-64**	**65-90**
Increment	----	0,04	0,14	0,24
Missing teeth	0,2	0,8	5,56	11,56

Filled Teeth (FT):

Filled Teeth (FT) was calculated using the same formula:
Step i. Calculate the difference in years between the minimum and maximum ages in a particular age cohort.

Step ii: Calculate the difference in levels of filled teeth, e.g. this was done between the 12 and 15 year groups.
Therefore FT (15 year) – FT (12 year) = 0,08-0,05 = 0,03

Step iii: Calculate an increment to project subsequent cohorts:

$$\text{Increment} = \frac{\text{Difference in FT}}{\text{Difference in years}} = \frac{0,03}{3} = 0.01$$

Therefore the increment is 0,01.

The previous oral health survey (Department of Health 1994) and service provision data (Department of Health: KwaZulu-Natal: 2000a:49) show that the number of fillings performed are very low. However the number

still increases with age, but at a lower rate. Therefore the ratio was increased for each successive cohort by five percent.

Step iv: Filled teeth of the cohort were calculated by:

(increment X age difference) + FT level of previous cohort

Cohort	**0-14**	**15-29**	**30-64**	**65-90**
Increment	----	0,01	0,06	0,11
Filled teeth	0.08	0,23	2,27	5,02

The dental caries projections for the various age cohorts as used in the computer model are summarized in Table 4.1:

TABLE 4.1 - Dental caries projections for age cohorts used in this study

Age cohorts	0-14	15-29	30-64	65+
Decayed Missing Filled Teeth (DMFT)	1.7	5.3	13.6	19.5
Missing Teeth (MT)	0.2	0.8	5.6	11.6
Filled Teeth (FT)	0.1	0.2	2.3	5.0
New Fillings Teeth (NFT)	1.0	2.7	7.5	5.3
Replacement Fillings Teeth (RFT)	0.5	1.4	9.3	4.9
New Fillings Surfaces (NFS)	1.5	4.9	18.8	13.3
Replacement Fillings Surfaces (RFS)	0.8	2.5	23.3	12.3
Extractions (E)	0.2	0.6	4.8	6.0

(Calculations according to WHO/ FDI computer model 1989:44)

These projections (Table 4.1) were compared to the dental caries levels obtained for the various age groups of the National Oral Health Survey of South Africa (Department of Health 1994) in Table 4.2.

TABLE 4.2 - Dental caries status for different age groups in South Africa

Age (Years)	Blacks	Coloureds	Indians	Whites	Total
20-24	5,3	11,2	5,9	9,6	6,8
25-29	6,8	16,4	7,9	11,6	8,7
30-34	9,0	21,2	10,2	18,9	12
35-44	9,9	24,6	11,9	19,9	13,8
45-54	13,7	26,1	14,6	23,5	17,5
55-64	16,9	28,4	18,1	26,3	20,6

(Department of Health 1994)

DMFT levels in this survey were slightly higher than those obtained in the projections in Table 5.1, as derived from the recent national oral health survey (Department of Health 2000). These findings are consistent with the dental caries status of the six, twelve and fifteen year age groups, where the recent survey showed lower DMFT levels than the previous one (Table 3.8:66).

4.2.2 Periodontal Disease:

The periodontal status was obtained from primary data obtained from the national survey carried out in 1999/2000 (Department of Health 2000). This was compared to the previous national survey (Department of Health 1994).

The index used is the Community Periodontal Index of Treatment Needs (CPITN). This index was developed by the WHO for epidemiological surveys of periodontal health and treatment need (Ainamo, Barmes, Beagrie, Cuttress, Martin and Sardo-Infirri 1982:281).

Codes used for measuring periodontal disease are translated into treatment needs as represented in Table 4.3.

TABLE 4.3 - Codes used in the Community Periodontal Index of Treatment Need

Periodontal Status	Code	Code	Treatment Need
No signs of disease	0	0	No treatment
Gingival bleeding after gentle probing	1	I	Improvement in personal oral hygiene (Code 1)
Supra- or sub-gingival calculus	2	II	I + Scaling (Codes 2 & 3)
Pathologic pockets 4-5mm deep	3		
Pathologic pocket 6 mm or deeper	4	III	I + II + Complex Treatment (Code 4)

(Ainamo et al. 1982:281)

4.2.3 Preventive Care

Preventive care for the 0-14 year age cohort would be an essential component of the human resource plan. The need for preventive care (vide 3.4.5:74) was assessed for the 5, 6, 12 and 15 year age groups from the recent national oral health survey of 1999/ 2000 (Department of Health 2000).

4.2.4 HIV/ AIDS

Since KZN has the highest incidence of AIDS in South Africa, information obtained in the situation analysis was used in the human resource plan.

4.2.5 Trauma and Injury

Due to the high levels of trauma and injury in this province, calculations would be included for the emergency care of maxillo-facial injuries at all levels of the district health system.

4.3 PLANNING APPROACHES USED

A combination of the health-needs, service targets and the demand-based approaches was used in this study in order to achieve a comprehensive workable plan.

4.3.1 HEALTH-NEEDS APPROACH

In the first stage of this study, baseline data was established for the planning process. The health needs approach was used to determine the *optimal number* of oral health personnel required to provide the complete package to the state-dependent population for the year 2000. The optimal number was compared to the existing number of oral health personnel in this province.

4.3.2 SERVICE TARGETS APPROACH

This method was used for the long term plan, that would optimally utilize all existing human resources. Referring to the literature review (vide 2.4.3:31), a special feature of this method is that it is *micro-analytical*, which means that each component activity of the package can be regarded separately (Hall 1978:67). Target groups were chosen from the situation analysis, and procedures of the package were selected for the special needs of these groups.

4.3.3 DEMAND-BASED APPROACH

This approach was used to calculate the number of human resources required to provide emergency care for the relief of pain and sepsis for the long term. This is because policy documents (Department of Health 1997) recommend that at least a *minimal level* of oral health care should be available to anyone who demands it.

The human resource requirements for fillings were also calculated by this method for the entire population in the long-term plan. Fillings will be provided for the entire population, as demand for care will greatly decrease, due to the implementation of water fluoridation and other preventive efforts.

4.4 CALCULATION OF HUMAN RESOURCES

4.4.1 PROCEDURE FOR CALCULATIONS

The WHO/ FDI manual (1989) was used together with the WHO computer programme to calculate human resource requirements for KwaZulu-Natal.

The programme can be adapted to a specific situation as it allows the planner to alter one, a few, or many data elements. When data is fed into this programme (input), it automatically calculates the number of human resources required as full-time equivalents.

Selection Criteria:

- It can be adapted to special situations in a country, e.g in this study, preventive care was calculated for a developing country, and restorative care for a country with a stable caries level.
- Additional time can be allocated to special group care for target groups, e.g. AIDS patients, AIDS orphans, the large disabled cohort, and the increasing elderly population.
- This model allows for the *selection* and *deletion* of specified treatments, from a large range of routine oral health procedures.

- The need for care can be calculated for the present situation, and in relation to future national goals. Therefore the process usually involves two or more sets of calculations.

The age cohorts used in this model are 0-14 years (school-based programmes), 15-29 years (transition from school to alternatively funded services), 30-64 years (continued alternatively funded services) and 65 years and over (special programmes for the elderly).

Data input include:

- Decayed, Missing and Filled Teeth - calculated from the recent national oral health survey, and projected for the different age cohorts (vide 4.2.1:89).
- Missing Teeth – as above.
- Filled Teeth – as above.
- Number of sextants needing scaling (vide 3.4.3:72)
- Percentage population for each recommended procedure
- Time and frequency of procedure
- Percentage demand for care

Calculations are based on a 1750-hour working year, with a fifteen-year replacement period for restorations. Each of the procedures prescribed in the basic oral health care package were analyzed separately for the different age cohorts used in this study. Estimations were initially prepared for services needed per person, expressed in minutes, for each of the procedures covered in the package. It was then divided by the number of years in a cohort to reach minutes per person per year.

4.4.2 LIMITATIONS OF THE MODEL:

- Calculations are made for the general population, and do not take into account variations of need of different communities e.g. urban, semi-urban and rural. There are significant differences in disease levels among these groups. There is also diversity in the availability of care, treatment expectations and the use of services (WHO/ FDI 1989:38).

  However, this study will serve as a baseline provincial oral health policy document. Subsequently, each district would conduct its individual situation analysis to determine its special requirements. Resources can then be allocated to the different districts for the specific needs, determinants and circumstances of each community (Department of Health 2001).

- This model may over-project for human resources resulting in a surplus of personnel. This is because of a lack of awareness in oral health care in many sectors of the population (vide 3.7.3:85).

- This model does not take into account the capacity of training institutions for oral health personnel in the country.

4.5 FORMULATION OF HUMAN RESOURCE PLAN

The human resource requirements were considered together with modifying factors obtained in the situation analysis. Targets and objectives were set for the provision of oral health care in this province. The various options were appraised, and the human resource plan was formulated. This would ensure an equitable distribution and efficient utilization of all oral health personnel in meeting the oral health needs of

the province. The plan was prepared for implementation in two phases, i.e. short and long-term.

4.6 SUMMARY

After a thorough appraisal of the literature and situation analysis, the materials and methods used in the study were discussed. The WHO/ FDI (1989) manual and computer programme were used to calculate the number of oral health personnel in this study. Dental caries projections for age cohorts used by this model were performed. From this information, a human resource plan for KwaZulu-Natal was devised.

CHAPTER 5 - HUMAN RESOURCE PLAN FOR KWAZULU-NATAL

CHAPTER 5 - HUMAN RESOURCE PLAN FOR KWAZULU-NATAL

5.1 INTRODUCTION

The situation analysis provides a comprehensive overview of conditions in the province of KwaZulu-Natal, and the human resource situation for oral health care. It reveals a gross shortage and inequitable distribution of all categories of oral health personnel in each region of this province. The WHO/ FDI manual and computer model (1989) were used to calculate the human resource requirements for the human resource plan.

5.2 CALCULATION OF OPTIMAL NUMBER OF PERSONNEL

Baseline data was obtained for this study by using the Needs-Based Approach (vide 2.4.2:26), in order to determine the *degree* of shortage of oral health personnel in this province. Calculations were done to determine the *optimal* number of personnel required for carrying out *all* procedures in the basic oral health care package for the year 2000 for the state-dependent population (Table 5.2 a-d).

These results would be compared to the existing number of personnel before formulating the human resource plan.

5.2.1 MANUAL CALCULATIONS FOR PROCEDURES PRESCRIBED IN THE BASIC ORAL HEALTH CARE PACKAGE

Preventive Care

Calculations were made for preventive care for all age cohorts, using the formula:

$$\text{Time per person per year} = \frac{\text{Time required X frequency of programmes}}{\text{Number of participants}}$$

0-14 year cohort:

Groups

Time per cohort = 15 mins/group X 1.0 = 15 minutes

Individuals

Time per cohort = 15 minutes X 4.0 = 60 minutes

Time per person per year = $\frac{15 + 60 \text{ minutes}}{15 \text{ years}}$ = 5 minutes/ person/ year

15-29 year cohort:

Individuals

Time per cohort = 15 minutes X 5.0 = 75 minutes

Time per person per year = $\frac{75 \text{ minutes}}{15 \text{ years}}$ = 5 minutes/ person/ year

30-64 year cohort:

Individuals

Time per cohort = 15 minutes X 1.0 = 15 minutes

Time per person per year = $\frac{15 \text{ minutes}}{34 \text{ years}}$ = 0.4 minute/ person/ year

65-80 year cohort:

Individuals

Time per cohort = 15 minutes X 1.0 = 15 minutes

Time per person per year = $\frac{15 \text{ minutes}}{15 \text{ years}}$ = 1.0 minute/ person/ year

Emergency Care for the relief of pain and sepsis

Calculations for emergency care include dental extractions and surgical care. Additional time for surgical care was included in these calculations due to the high level of trauma, crime and violence in KZN (vide 3.3.7:63).

Extractions

Calculations were done by using the formula:

$$\text{Time per person per year (minutes)} = \frac{\text{Time X Frequency}}{\text{Number of years in the cohort}}$$

where:

Frequency is determined by the computer model by inputs of DMFT, MT and MT.

Time estimates are obtained from the WHO/ FDI (1989) recommendations for these procedures, which are 7.5 minutes per extraction.

0-14 year cohort:

$$\text{Time per person per year} = \frac{7.5 \text{ X } 0.2}{15} = \frac{1.5}{5} = 0.1 \text{ minute/ person/ year}$$

15-29 year cohort:

$$\text{Time per person per year} = \frac{7.5 \text{ X } 0.6}{15} = \frac{4.5}{15} = 0.3 \text{ minute/ person/ year}$$

30-64 year cohort:

$$\text{Time per person per year} = \frac{7.5 \text{ x } 4.8}{34} = \frac{36}{34} = 1.0 \text{ minute/ person/ year}$$

65-80 year cohort:

$$\text{Time per person per year} = \frac{7.5 \text{ X } 6.0}{15} = \frac{45}{15} = 3.0 \text{ minutes/ person/ year}$$

Surgical Care

Surgical care was calculated from a fixed amount of time allocated per person per year, which is:

- 0-14 year cohort = 60 minutes for 5% of the cohort
- All other cohorts = 150 minutes for 5% of the cohort

It is calculated from the formula:

$$\text{Time/ person/ year} = \frac{\text{Time (minutes) X percentage population}}{\text{Number of years in the cohort}}$$

0-14 year cohort:

$$\text{Time per person per year} = \frac{60.0}{15} \times \frac{5.0}{100} = 0.2 \text{ minute/ person/ year}$$

15-29 year cohort:

$$\text{Time per person per year} = \frac{150.0}{15} \times \frac{5.0}{100} = 0.5 \text{ minute/ person/ year}$$

30-64 year cohort:

$$\text{Time per person per year} = \frac{150.0}{34} \times \frac{5.0}{100} = 0.2 \text{ minute/ person/ year}$$

65-80 year cohort:

$$\text{Time per person per year} = \frac{150.0}{15} \times \frac{5.0}{100} = 0.5 \text{ minute/ person/ year}$$

Periodontal Care: Scaling of teeth

Time estimates for scaling for the different age cohorts were obtained by using the CPI data for mean number of sextants needing scaling (Department of Health 2000). These levels were increased by five percent for each successive cohort. The percentage population requiring different types of periodontal care was also obtained (Table 3.14:72).

According to the WHO/ FDI (1989:51), the recommended scaling time per person per year is five minutes per sextant per individual. This was calculated by the formula:

Scaling time per person per year = $\frac{W \times T(S) \times PS(i)}{N}$

where: *W* is the number of sextants needing scaling,
T(S) is the minutes for scaling per sextant,
PS(i) is the number of sessions per cohort for scaling,
N is the number of years in the cohort.

0-14 year cohort:

Time/ person/ year = $\frac{2.6 \times 5 \times 2.0}{15}$ = 1,7 minutes/ person/ year

15-29 year cohort:

Time/ person /year = $\frac{3,1 \times 5 \times 4,0}{15}$ = 4,1 minutes/ person/ year

30-64 year cohort:

Time/ person/ year = $\frac{3,6 \times 10,0 \times 5,0}{34}$ = 5,1 minutes/ person/ year

65-80 year cohort:

Time/ person/ year = $\frac{4,1 \times 10,0 \times 4,0}{15}$ = 10,9 minutes/ person/ year

Restorative Care

Calculations were only made for those procedures contained in the basic package, which included one to three surface fillings and fissure sealants. However fissure sealants were only calculated for the 0-14 year cohort. Time estimates recommended by the WHO/ FDI (1989) for restorative care are:

- Fissure sealants - T(ARR): 5 minutes per ARR
- New Fillings Teeth - T(NFT): 15 minutes per NFT

Frequency was determined by the calculations done by the computer model using the DMFT, MT and FT.

The WHO/FDI (1989:33) made the following assumptions in the calculations for restorative care:

- *For all cohorts, with respect to the permanent dentition, the total DMF is accounted for by FT, plus ½ MT, plus the sum of the teeth to have, or which have had non-interventive care.*
- *MT entries assume that half the teeth had been previously filled. FT entries are reduced in comparison to cumulative NFT figures by ½ MT.*

New 1-3 surface fillings:

New fillings were calculated by: Time (minutes) X Frequency / Number of years in the cohort

0-14 year cohort:

Time/ person/ year = $\frac{15 \text{ minutes X } 1,5}{15}$ = 1,5 minutes/ person/ year

15-29 year cohort:

Time/ person /year = $\frac{15 \text{ minutes X } 4,9}{15}$ = 4,9 minutes/ person/ year

30-64 year cohort:

Time/ person/ year = $\frac{15 \text{ minutes X}18,8}{34}$ = 8,1 minutes/ person/ year

65-80 year cohort:

Time/ person/ year = $\frac{15 \text{ minutes X}13,3}{15}$ = 13,3 minutes/ person/ year

Fissure Sealants

Calculations were only done for the 0-14 year age cohort.

Fissure sealants were calculated by: Time (minutes) X Frequency / Number of years in the cohort

0-14 year cohort:

Minutes/ person/ year = $\frac{5 \text{ minutes X } 0.7}{15 \text{ years}}$ = 0.2 minute/ person/ year

Special Group Care

This part does not involve a specified type of treatment, but covers the *extra time* needed to provide domiciliary or institutional care (WHO/ FDI 1989). Special group care was included in this study, for all age cohorts, due to the high level of disability (vide 3.3.8:64) and the debilitating effects of HIV/ AIDS (vide 3.3.6:62) in KwaZulu-Natal.

Special group care can involve any aspect of oral health care, and should be provided to the target groups that require such care. Time estimates used were 150 minutes for five percent for all age cohorts.

Calculations for Special Group Care were done by using the formula:

$$\text{Minutes/ person/ year} = \frac{\text{Time (minutes) X Percentage Population}}{\text{Number of years in a cohort}}$$

0-14, 15-29, 65-80 year cohorts:

$$\text{Minutes/ person/ year} = \frac{150 \text{ minutes}}{15 \text{ years}} \text{ X } \frac{5.0}{100} = \underline{0.5 \text{ minute/ person/ year}}$$

30-64 year cohort:

$$\text{Minutes/ person/ year} = = \frac{150 \text{ minutes}}{34 \text{ years}} \text{ X } \frac{5.0}{100} = \underline{0.2 \text{ minute/ person/ year}}$$

TABLE 5.1 - Summary of calculations for the complete basic oral health care package for 2000

Cohort	Type of care	Total time in minutes (Column 3)	Divide column 3 by number of years in cohort	Minutes per year (Column 5)
0-14	Preventive Care	75	15	5.0
	Sp. Group Care	7.5	15	0.5
	Scaling	26	15	1.7
	Extractions	1.5	15	0.1
	Surgical Care	3.0	15	0.2
	Simple fillings	22.5	15	1.5
	Fissure Sealants	3.5	15	0.2
	Total			**9.2**
15-29	Preventive Care	75.0	15	5.0
	Sp. Group Care	7.5	15	0.5
	Scaling	62.0	15	4.1
	Extractions	4.5	15	0.3
	Surgical Care	7.5	15	0.5
	Simple fillings	73.5	15	4.9
	Total			**15.3**
30-64	Preventive Care	15.0	34	0.4
	Sp. Group Care	7.5	34	0.2
	Scaling	180.0	34	5.1
	Extractions	36.0	34	1.0
	Surgical Care	7.5	34	0.2
	Simple fillings	282.0	34	8.1
	Total			**15.0**
65-80	Preventive Care	15.0	15	1.0
	Sp. Group Care	7.5	15	0.5
	Scaling	164.0	15	10.9
	Extractions	45.0	15	3.0
	Surgical Care	7.5	15	0.5
	Simple fillings	199.5	15	13.3
	Total			**29.2**

5.2.2 COMPUTER CALCULATIONS FOR EACH PROCEDURE

Calculations were subsequently done for each age cohort on the WHO/ FDI (1989) computer model, as seen in Tables 5.2 a-d. Minor differences between calculations obtained from the computer model and manual may be due to the rounding off of results in the computer model.

TABLE 5.2a – Time estimates for the total package to the 0-14 year age cohort for 2000, expressed in minutes per person per year

Type of Care	Percentage population	Frequency	Time (minutes)	Time/ cohort (minutes)	Time/ year (minutes)
Preventive Care: Group		1.0	15.0	15.0	--
Individual		4.0	15.0	60.0	--
Subtotal					5.0
Special Group Care	5.0		150.0	7.5	0.5
Scaling (2.6)	55.0	2.0	5.0	26.0	1.7
Extractions		0.2	7.5	1.5	0.1
Surgical Care	5.0		60.0	3.0	0.2
Fissure Sealants		0.7	5.0	3.5	0.2
New fillings		1.5	15.0	22.5	1.5
TOTAL					**9.2**

(Calculations according to WHO/ FDI computer model 1989:44)

TABLE 5.2b – Time estimates for the total package to the 15-29 year age cohort for 2000, expressed in minutes per person per year

Type of Care	Percentage population	Frequency	Time (minutes)	Time/ cohort (minutes)	Time/ year (minutes)
Preventive Care: Group		0.0	15.0	0.0	--
Individual		5.0	15.0	75.0	--
Subtotal					5.0
Special Group Care	5.0		150.0	7.5	0.5
Scaling (3.1)	55.0	4.0	5.0	62.0	4.1
Extractions		0.6	7.5	4.5	0.3
Surgical Care	5.0		150.0	7.5	0.5
New fillings		4.9	15.0	73.5	4.9
TOTAL					**15.3**

(Calculations according to WHO/ FDI computer model 1989:44)

TABLE 5.2c – Time estimates for the total package to the 30-64 year age cohort for 2000, expressed in minutes per person per year

Type of Care	Percentage population	Frequency	Time (minutes)	Time/ cohort (minutes)	Time/ year (minutes)
Preventive Care: Group		0	15.0	0	--
Individuals		1.0	15.0	15.0	--
Subtotal					0.4
Special Group Care	5.0		150.0	4.5	0.2
Scaling (3.6)	55	5.0	10.0	180.0	5.1
Extractions		4.8	7.5	36.0	1.0
Surgical Care	5.0		150.0	7.5	0.2
New fillings		18.8	15.0	282.0	8.1
TOTAL					**15.0**

(Calculations according to WHO/ FDI computer model 1989:44)

TABLE 5.2d – Time estimates for the total package to the 65-80 year age cohort for 2000, expressed in minutes per person per year

Type of Care	Percentage population	Frequency	Time (minutes)	Time/ cohort (minutes)	Time/ year (minutes)
Preventive care: group		0	15.0	0	--
Individual		1.0	15.0	15.0	--
Subtotal					1.0
Special group care	5.0		150.00	4.5	0.5
Scaling (4.1)	55.0	4.0	10.0	164.0	10.9
Extractions		6.0	7.5	45.0	3.0
Surgical care	5.0		150	7.5	0.5
New fillings		13.3	15.0	199.5	13.3
TOTAL					**29.2**

(Calculations according to WHO/ FDI computer model 1989:44)

5.2.3 CALCULATION OF DEMAND FOR CARE

All calculations, done up to this stage, give time estimates of the *need* for oral health care. However, in order to obtain more realistic projections, the *demand* for care also has to be taken into consideration.

Demand is the *health services that the consumer is willing to buy, or ask for* (vide 2.4.4:35). However demand is affected by the availability of human and financial resources, as well as the awareness and attitudes to oral health care by the consumer (Department of Health 1994:141). Demand for oral health care in the public sector is mainly due to symptomatic reasons, and very few patients attend for routine dental examinations (vide 3.7.3:84).

However all demand is not met, and this is known as 'unmet demand' (vide 2.4.4:35). The demand for care that is actually used is the 'met' or 'effective' demand, and can be translated into utilization of services. Calculation of demand is dependent on current utilization rates and behaviour patterns of the consumer (vide 2.4.4:35). However, technological changes, such as water fluoridation, may also affect demand for care.

Therefore in this study, in order to determine demand for care, levels and patterns of utilization of the population of South Africa were studied (vide 3.7.3:84). In South Africa (Department of Health 1994:140), the patterns of utilization vary between race groups as shown in Table 5.3.

TABLE 5.3 - Patterns of utilization with regard to type of dental service mostly used

	Blacks (%)	Indians (%)	Whites (%)	Coloureds (%)
Private Dentists	28,7	57,7	88,2	70,0
Public Clinic	44,0	28,2	7,2	22,7
None	27,3	14,1	4,2	6,7

(Department of Health 1994)

It was found that most of the Coloured, Indian and White respondents in South Africa used private facilities. However in the Black population, only 28,7% used private dentists.

It must be remembered that 87% of the population of KwaZulu-Natal use public health services (vide 3.2.2:54), and only five percent of the African population has access to medical aid (vide 3.3.1:58).

Utilization patterns for KZN were then calculated (Table 5.4) by weighting results obtained in Table 5.3, with percentage population of this province.

TABLE 5.4-Utilization patterns of KZN, weighted according to percentage population

	Blacks	Indians	Whites	Coloureds	Total
Public Service	35,9	2,6	0,4	0,3	39,2
None	22,3	1,3	0,3	0,1	24,0

Therefore in this study, demand would be weighted at 40% for all age cohorts. In determining the optimal number of oral health personnel required for the year 2000, the effects of water fluoridation would not be included at this stage.

Calculation of need and demand for age cohorts of KwaZulu-Natal:
Minutes of need were calculated from Table 5.1 (110), and percentage demand of 40% was determined, as per section 5.2.3 (115). These results were fed into the computer programme, together with percentage population of each age cohort. Minutes of demand were determined by the computer programme. These findings are summarized in Table 5.5.

TABLE 5.5 - Summary of need and demand for the different age cohorts in KZN

Age Cohorts	Minutes of Need	% Demand	Minutes of Demand	% Population
0-14	9.2	40	3.7	35.8
15-29	15.3	40	6.1	29.4
30-64	15.0	40	6.0	29.9
65-80	29.2	40	11.7	4.9

- These calculations resulted in a weighted average of 5.5 minutes per person per year.
- Calculations were done for number of hours per year worked per operator = 1 750.
- This resulted in a human resource: population ratio of 1:19 091.
- Number of human resources required were:

$$= \frac{\text{Total number of state-dependent population}}{\text{Human resource: population ratio}}$$

$$= \frac{7\,716\,900}{19\,091}$$

= 404 oral health personnel are required to provide the complete basic oral health care package to the state-dependent population for the year 2000.

Calculations were then performed for each category of personnel:

- Procedures to be performed by oral hygienists:
  preventive care
  scaling of teeth
- Procedures to be performed by dental operators:
  emergency care - extractions, surgical care
  restorative care - fillings, fissure sealants
- Special group care:
  This does not cover any specified type of treatment, but is *additional time allocated* for both dental operators and oral hygienists to provide extra care for special patients (vide 5.2.1:104).

The optimal numbers required to provide the complete package to the entire state dependent population for 2000 were 184 dental operators and 220 oral hygienists (Table 5.6). These figures will serve as baseline data for the rest of the planning process.

TABLE 5.6 – Optimal number of oral health personnel required for the complete package for 2000

Personnel	#Dental operator	$Dentist	$Dental therapist	Oral hygienist	*Dental assistant
Number required	184	31	153	220	276

Dental operator refers to dentists and dental therapists

* Calculated according to operator: assistant ratio of 1:1.5 proposed by policy document (Department of Health 1999)

$ Calculated by dentist: therapist ratio of 1:5 (Department of Health 1999)

The optimal numbers were compared to existing numbers of oral health personnel in the province (Table 5.7). It can be concluded that there is an acute shortage of oral health human resources in KwaZulu-Natal. These results revealed that the *optimal number* of oral health personnel required to provide the complete basic oral health care package were unrealistic. Therefore, in the following section, modifying factors for KwaZulu-Natal will be appraised before formulating the human resource plan.

TABLE 5.7 - Comparison of existing and optimal numbers of oral health personnel required for the complete package for 2000

Personnel	* Existing Number	#Optimal Number
Dentists	65	31
Dental therapists	14	153
Oral hygienists	15	220
Dental assistants	94	276

***(Department of Health KwaZulu-Natal 1999) #(Calculations by WHO/ FDI computer model: 1989)**

5.3 MODIFYING FACTORS

Human resource planning cannot be done in a static state, but should consider the rapidly changing situation in this province. Therefore factors that modify the human resource plan were then appraised.

5.3.1 POPULATION PROFILE

KwaZulu-Natal has a significant state-dependent population (87%), many of whom live in deprived socio-economic conditions (vide 3.3.1:58). The large rural component (56,9%) has limited geographical access to health services. Low educational levels contribute to decreased oral health awareness in a large sector of the population.

KwaZulu-Natal has the highest prevalence of HIV/AIDS in South Africa (Whiteside and Sunter 2000:73). Projections show that population numbers do not increase significantly due to the effects of this disease (vide 3.2.2:54). However it will result in many sick people and numerous AIDS orphans (vide 3.3.6:62). This province also has the highest number of handicapped people in the country (vide 3.3.8:64), and crime and violence statistics are significant (3.3.7:63).

5.3.2 PUBLIC SECTOR FUNDING

The increasing incidence of notifiable diseases (vide 3.3.5:62) and HIV/AIDS has resulted in a depleted public health service budget. Human and financial resources are very scarce, and priority is given, by the public sector, to these life-threatening diseases. Consequently, budgetary allocations for oral health care are minimal.

5.3.3 POLICY DOCUMENTS

The White Paper for the Transformation of the Health System in South Africa (Department of Health 1997) recommends the prioritization of

service delivery to target groups, with a shift toward prevention and promotion within the district health system.

5.3.4 CARE PROFILES AND PROCEDURES

There are large differences between the number of oral health human resources in the public and private sectors. Even though dentist: population ratios appear to be satisfactory in this province (vide 3.5.3:79), oral health services are inaccessible to the large state-dependent population due to financial constraints.

In the public service, extractions are the main type of service provided. Oral health prevention and promotion is negligible. Special care for the large handicapped population is minimal, and the management of the maxillo-facial injuries due to trauma is neglected.

Many non-governmental organizations work independently of each other, resulting in a duplication of services in some areas, with a deficiency of service provision in others (vide 3.5.4:80). This province has a large number of community health workers, many of whom work in peri-urban and rural areas (vide 3.5.5:81). Primary health care services have obtained extensive coverage within KwaZulu-Natal, and are carried out at schools, crèches, and mother and child clinics (vide 3.7.4:85).

5.3.5 ORAL HEALTH STATUS

The DMFT of the population of this province appears to be stable (Table 3.8:66), and many of the World Health Organization goals for the year 2000 (Table 2.3:16) have been reached. With the introduction of fluoridated water and fluoride toothpastes, these levels should decrease further in the long term (Renson et al. 1995:238; Chikte et al. 1996:697).

However, when the Significant Caries Index for 12 year old Black children in South Africa of 4,30 is considered, it is clear that certain sectors of the population have higher caries levels than others (vide 2.2.2:16). This index has not been determined for KZN. However, in this study, it is hoped that screening programmes will reveal these high-risk groups.

The HIV/AIDS epidemic is associated with oral manifestations, many of which can be alleviated by oral health care (vide 3.4.6:75). Therefore greater time has to be allocated for special group care for such high-risk individuals.

5.3.6 DEMAND FOR ORAL HEALTH CARE

- Factors increasing demand for oral health care (Hall 1978:59) are:
  - Oral health promotion efforts performed in the short-term would increase the awareness of the population in oral health care, and health services available (Schou and Blinkhorn 1993).
  - As accessibility, availability and acceptability of oral health services improve in the short-term, more people will attend for dental procedures, other than for symptomatic relief of pain. This would redress the large backlog in oral health care.

- Factor decreasing demand for oral health services:
  - Water fluoridation, which would result in a decrease in the dental caries levels mainly in children (Murray 1986; Renson et al. 1985; Du Plessis et al. 1995). This would reduce the need for preventive care in large sectors of the population, thereby decreasing the oral health personnel requirement.

This can be accomplished by employing all dentists doing compulsory community service to underserved areas only. This will greatly increase the human resource pool in rural areas.

Incentives should be provided to existing oral health personnel, within the public sector, to work in rural areas (Mejia 1978:272). They could include post-graduate study bursaries, additional remuneration packages, and an efficient and effective working environment. Therefore existing dental facilities and infrastructure should be upgraded, if necessary, to support personnel.

5.5.2 SERVICE PROVISION BY ORAL HYGIENISTS

From Table 5.10, it can be seen that, after re-allocation to regions, there will be a very small number of oral hygienists in each region within the public sector. Therefore oral hygienists should be utilized to provide preventive care to target groups.

Preventive Care

- Oral health prevention, promotion and education programmes should be focused on target groups as recommended by the policy documents (vide 2.2.2:13). They include:
  - pre-school children at mother and child clinics,
  - school children as part of school-health programmes,
  - pregnant women at ante-natal clinics,
  - elderly and handicapped individuals at institutions, and
  - AIDS patients and AIDS orphans at hospitals and institutions.

- Courses in Oral Health Care – oral hygienists should provide courses in oral health care to the various cadres of people who provide health

education to the community. They include school-teachers, school-health nurses, primary health care nurses and community health workers.

- Incorporation of oral health care into district health programmes – oral hygienists should have collaborative discussions with the authorities at district level, on how to incorporate oral health prevention, promotion and education into the existing comprehensive health programmes of the region. They should also devise special programmes for the districts in which they are located.

Annual Examination

The screening of school children for dental caries has been found to stimulate dental attendance in children in all social classes (Donaldson and Kinirons 2001:143).

Examination time is included in the time allowances for each category of procedure, and includes visits for check-ups and for specific care (WHO/ FDI 1989:26). All the target groups will have access to an annual examination, as prescribed by the basic oral health care package. If any further dental treatment is required, patients should be referred to dental clinics at district hospitals for the other procedures recommended by the basic package.

5.5.3 SERVICE PROVISION BY DENTAL OPERATORS

Emergency care for the relief of pain and sepsis

Pain in the oral cavity is the foremost reason that patients attend the dental clinic (Scully 1989:323). It is often found that, the best way to treat pain, is by removing the cause (Scully 1988:128), e.g. incision and drainage of an acute dental abscess provides immediate pain relief.

Emergency care for the relief of pain and sepsis will be provided on demand to the entire state-dependent population, and will include:

- extractions, and incision and drainage for the removal of pus,
- prescription of essential drugs (antibiotics and analgesics),
- temporary fillings for the relief of acute pain,
- surgical treatment of maxillo-facial injuries,
- diagnosis and management of the oral manifestations of Aids,
- and infection control measures.

Restorative Care and Bite-Wing Radiographs

According to the Department of Health (1994), only 32% of the six-year age group is caries-free. This is low compared to the World Health Organization goal for 2000 of 50% (FDI 1982:74). However, the mean DMFT of the twelve-year age group in KZN is 1,2. This is relatively low compared to other countries (Table 5.9:126). The DMFT of KZN varies from 0,4 in Ulundi to 2,5 in Ladysmith (Table 3.13:69), which shows that rural areas have significantly lower levels of dental caries. Therefore the Significant Caries Index needs to be done for each population when district-specific plans are being formulated (vide 2.2.2:16).

The 0-14 year cohort was chosen as the target group for restorative care in the short-term plan. Children will be screened at schools and clinics by oral hygienists, school health nurses and teachers. Referral should be done to dental operators at the nearest health facility within the district. Restorative care will focus on simple one to three surface fillings for the management of the dental caries in the 0-14 year age cohort.

Bite-wing radiographs are also recommended by the basic oral health package. Most regions within this province have access to x-ray equipment (vide 3.6:82), and radiographs are currently being taken at the

training institution and provincial clinics (vide 3.7.1:83). However due to the shortage of financial resources, and the high cost involved in the provision of this procedure, bite-wing radiographs will not be included in the calculations. The existing x-ray equipment can be used in the management of dental emergencies.

5.5.4 WATER FLUORIDATION

As discussed in the literature review (vide 2.2.1:12), it can be concluded that water fluoridation is one of the cheapest and most cost-effective methods of caries prevention. According to the Department of Health (1998), the cost of adjusting the fluoride concentration in drinking water is less than one rand per person per year. It is 18 times cheaper than toothpaste, and 61 times cheaper than filling a tooth.

Renson, et al. (1985:238) has reported a reduction or stabilization of mean DMFT in many countries due to water fluoridation, as demonstrated in Table 5.9. This will result in a reduction in the need, and therefore demand, for dental care in the long term.

Table 5.9 - Mean reduction in DMFT of 12 year old children in countries following water fluoridation

Country	Year	DMFT	Year	DMFT	% Coverage by 1982
Hong Kong	1968	2.0	1980	1.8	98
Australia	1975	4.8	1983	2.8	65
Colombia	1965	7.1	1980	4.8	37
Brazil	1975	7.2	1980	7.2	23
Singapore	1970	3.0	1979	2.8	100

(Renson et al. 1985:238)

The article, by McDonagh, Whiting, Wilson, Sutton, Chestnut, Cooper, Misso, Bradley, Treasure and Kleijnen (2000:855), reviewed the safety and efficacy of fluoridation on drinking water. It measured the change in

prevalence of dental caries from baseline to final examination, in fluoridated compared to control areas. Adverse effects were also measured.

Results showed that in fluoridated areas, there was a significant increase in the proportion of children without caries in 19 out of 30 analyses. The range (median) of the mean difference in the percentage of children without caries was 5,0% - 64% (14,6%). In addition, 15 of 16 analyses found a significantly greater mean change in decayed, missing and filled primary/ permanent teeth in the fluoridated areas than in the non-fluoridated ones. The mean change in decayed, missing and filled primary/ permanent teeth was 2,25 teeth.

McDonagh et al. (2000:855) also revealed a dose-dependent increase in dental fluorosis. At a water fluoride concentration of 1,0 p.p.m, the prevalence of fluorosis was 48%, and fluorosis of esthetic concern was 12,5%. Therefore during the implementation of water fluoridation, existing water fluoride levels and dental fluorosis should be carefully monitored.

Murray (1986:44) summarized the findings of many water fluoridation studies. He found that a 50 to 60% reduction in dental caries levels in the permanent dentition was seen, if exposure occurred from birth to two years. However all studies showed a reduction of less than 50% when water fluoridation was started at four years or older. The post-eruptive benefits of fluoride are mainly on smooth tooth surfaces, whereas the pre-eruptive effects are on pit and fissures and smooth surfaces.

Water fluoridation has been legislated nationally (Republic of South Africa 2000), and should be implemented at provincial level as soon as possible. Therefore negotiations should be conducted between the Departments of Health, Water Affairs and Forestry, and Umgeni Water as a matter of priority.

5.6 LONG TERM PLANS

5.6.1 INTRODUCTION

From Table 5.7 (118), it is evident that the full basic oral health care package cannot be provided to the entire state-dependent population. Therefore procedures were selected for the long-term plans, concentrating on target groups, to ensure that the population receives the best available oral health care within limited resources.

Two sets of calculations were done for the long-term plan:

- The first set of calculations was done to determine the number of oral health personnel required, using current *DMFT levels* as calculated in Table 4.1.
- Subsequently, due to the anticipated effects of water fluoridation, a second set of calculations using decreased DMFT levels, were done. The DMFT of the 0-14 year cohort was decreased by 30%, and the other three cohorts by 10%.

5.6.2 PROCEDURES RECOMMENDED FOR DENTAL OPERATORS

Emergency care for the relief of pain and sepsis

Policy documents recommend that at least a *minimal* level of oral health care should be provided to the state-dependent population. This will include all procedures recommended in the short-term plan (vide 5.5.3:124), including extractions and surgical care.

Calculations done for emergency care were the same as for those done for optimal levels (vide 5.2.1:104) since this care would be available to all age cohorts. (Table 5.11 a-d:135).

Restorative Care and Bite-Wing Radiographs

Simple one to three surface fillings will be provided to all age cohorts in the long term plan. Replacement fillings are not included in the calculations because the amount of restorative care performed in the public sector has been very low.

Due to the high cost of x-rays, bite-wing radiographs would not be included in the calculations. X-ray equipment is available in all regions of KwaZulu-Natal (vide 3.6:82) and should be used in the management of dental emergencies.

$$\text{Minutes/ person/ year} = \frac{\text{Time (minutes) X Frequency}}{\text{Number of years in the cohort}}$$

0-14 year cohort:

$$\frac{\text{15 minutes X 1,5}}{\text{15 years}} = \text{1,5 minutes/ person/ year}$$

15-29 year cohort:

$$\frac{\text{15 minutes X 4,9}}{\text{15 years}} = \text{4,9 minutes/ person/ year}$$

30-64 year cohort:

$$\frac{\text{15 minutes X 18,8}}{\text{34 years}} = \text{8,1 minutes/ person/ year}$$

65-80 year cohort:

$$\frac{\text{15 minutes X 13,3}}{\text{15 years}} = \text{13,3 minutes/ person/ year}$$

Fissure sealants

Kidd and Joyston-Bechal (1997:169) state that fissure sealing *all* posterior teeth may be regarded as "overtreatment". It should be done on high caries-risk patients. These include children with special needs e.g. handicapped, poor oral hygiene, high level of caries in the primary dentition and caries-susceptible e.g. deep pits and fissures.

Primary data of the recent national survey (Department of Health 2000) reveals the greatest need of 34.9% and 31.6% are in the six and twelve year age groups respectively. The average number of teeth requiring sealing is 1.2 and 2.1 respectively. Therefore in this study, sealants would be provided for high-risk children for the 0-14 year age cohort on a referral basis only.

Fissure sealants were calculated by: $\frac{\text{Time (minutes) X Frequency}}{\text{Number of years in the cohort}}$

Minutes/ person/ year = $\frac{\text{5 minutes X 0,7}}{\text{15 years}}$ = 0,2 minute/ person/ year

5.6.3 PROCEDURES RECOMMENDED FOR ORAL HYGIENISTS

Preventive care

By 2010, the primary health care teams of this province should have been established (vide 3.7.5:86). It is hoped that oral health promotion and education will be completely integrated into the general health programmes at district level at this stage. Target groups would include all those recommended in the short-term plan.

Currently 67,6% of the population of KwaZulu-Natal has access to piped water (vide 3.3.4:61). Approximately five million consumers are from urban areas, and one million are from rural areas (Umgeni Water 2000:3). The national goal for 2005 (Table 2.1:15) is to ensure that 40% of the population with piped water systems receives fluoridated water.

However it is hoped that the entire population that is currently supplied by Umgeni Water will receive fluoridated water by 2010. This will translate to 67,6% of the total population receiving fluoridated water, and will result in a need for specific prevention procedures for about 33% of the population. This will also decrease the oral health personnel requirement.

- **Annual Examination**

An annual examination would be available for all target groups listed under preventive care. Patients should be referred to the dental clinics in that district for further care.

- **Scaling of teeth**

The recent national survey (Department of Health 2000) shows that a significant percentage of the population (55%) has calculus and bleeding on probing (Table 3.14:72). The draft South African Oral Health Policy (Department of Health 2001:13) indicates that there is good evidence to recommend scaling for initial therapy in patients with active periodontitis when combined with maintenance therapy. However, this document also states that there is no evidence to show that there are benefits of root planning in periodontal therapy.

Due to the high level of HIV/ AIDS, scaling of teeth would be provided in the long term plan for the 0-14 and 15-29 year cohorts, due to these

groups being considered as *high risk* (vide 3.3.6:62). Oral manifestations of AIDS, such as gingival and periodontal lesions, can be managed effectively by scaling of teeth, and oral hygiene instructions (Naidoo and Chikte 1999:624).

Scaling time per person per year would be calculated as described in Section 5.2.1(106):

0-14 year cohort:

$$\text{Time/ person/ year} = \frac{2{,}6 \times 5 \times 2{,}0}{15} = 1{,}7 \text{ mins/person/year}$$

15-29 year cohort:

$$\text{Time/ person/ year} = \frac{3{,}1 \times 5 \times 4{,}0}{15} = 4{,}1 \text{ mins/person/year}$$

5.6.4 SPECIAL GROUP CARE

Target groups would include the elderly, handicapped, AIDS patients and orphans, and calculations were done as described in section 5.2.1. By 2010, the AIDS epidemic would have peaked, resulting in a large number of people with full-blown AIDS, and many AIDS orphans (vide 3.3.6:63).

Therefore time estimates for special group care will be increased to 150 minutes for 10% of the 0-14 and 15-29 year age cohorts. The 30-64 year cohort would remain at 150 minutes for 5% of the population, due to this group being economically active. The 65-80 year cohort would also increase to 150 minutes for 10% due to their increasing numbers.

0-14 year cohort:

$$\text{Minutes/ person/ year} = \frac{150 \text{ minutes}}{15 \text{ years}} \times \frac{10,0}{100} = 1,0 \text{ min/ person/ year}$$

15-29 year cohort:

$$\text{Minutes/ person/ year} = \frac{150 \text{ minutes}}{15 \text{ years}} \times \frac{10,0}{100} = 1,0 \text{ min/ person/ year}$$

30-64 year cohort:

$$\text{Minutes/ person/ year} = \frac{150 \text{ minutes}}{34 \text{ years}} \times \frac{5,0}{100} = 0,2 \text{ min/ person/ year}$$

65-80 year cohort:

$$\text{Minutes/ person/ year} = \frac{150 \text{ minutes}}{15 \text{ years}} \times \frac{10,0}{100} = 1,0 \text{ min/ person/ year}$$

TABLE 5.10 - Summary of calculations for selected procedures in the basic oral health care package for 2010

Cohort	Type of care	Total time in minutes (Column 3)	Divide column 3 by number of years in cohort	Minutes per year (Column 5)
0-14	Preventive Care	75.0	15	5.0
	Sp. Group Care	15.0	15	1.0
	Scaling	26.0	15	1.7
	Extractions	1.5	15	0.1
	Surgical Care	3.0	15	0.2
	Simple fillings	22.5	15	1.5
	Fissure Sealants	3.5	15	0.2
	Total			**9.7**
15-29	Sp. Group Care	15.0	15	1.0
	Scaling	62.0	15	4.1
	Extractions	4.5	15	0.3
	Surgical Care	7.5	15	0.5
	Simple fillings	73.5	15	4.9
	Total			**10.8**
30-64	Sp. Group Care	7.5	34	0.2
	Extractions	36.0	34	1.0
	Surgical Care	7.5	34	0.2
	New fillings	282.0	34	8.1
	Total			**9.5**
65-80	Sp. Group Care	15.0	15	1.0
	Extractions	45.0	15	3.0
	Surgical Care	7.5	15	0.5
	New fillings	199.5	15	13.3
	Total			**17.8**

(Calculations according to WHO/ FDI 1989)

5.6.5 CALCULATION OF ORAL HEALTH PERSONNEL REQUIREMENT USING CURRENT DMFT LEVELS

Calculations were also done using the computer model to determine the total number of oral health personnel required in the long term using *current DMFT levels* (Tables 5.11 a-d).

TABLE 5.11a – Time estimates for the provision of selected procedures for the long-term plan for the 0-14 year age cohort, expressed in minutes per person per year

Type of Care	Percentage population	Frequency	Time (minutes)	Time/ cohort (minutes)	Time/ year (minutes)
Preventive Care: Group		1.0	15.0	15.0	--
Individual		4.0	15.0	60.0	--
Subtotal					5.0
Special Group Care	10.0		150.0	15.0	1.0
Scaling	55.0	2.0	5.0	26.0	1.7
Extractions		0.2	7.5	1.5	0.1
Surgical Care	5.0		60.0	3.0	0.2
Fissure Sealants	10.0	0.7	5.0	3.5	0.2
New Fillings		1.5	15.0	22.5	1.5
TOTAL					**9.7**

(Calculations according to WHO/ FDI 1989)

TABLE 5.11b – Time estimates for the provision of selected procedures for the long term plan for the 15-29 year age cohort, expressed in minutes per person per year

Type of Care	Percentage population	Frequency	Time (minutes)	Time/ cohort (minutes)	Time/ year (minutes)
Special Group Care	10.0		150.0	15.0	1.0
Scaling	30	4.0	5.0	62.0	4.1
Extractions		0.6	7.5	4.5	0.3
Surgical Care	5.0		150.0	7.5	0.5
New Fillings	40	4.9	15.0	73.5	4.9
TOTAL					**10.8**

(Calculations according to WHO/ FDI 1989)

TABLE 5.11c – Time estimates for the provision of selected procedures for the long term plan for the 30-64 year age cohort, expressed in minutes per person per year

Type of Care	Percentage population	Frequency	Time (minutes)	Time/ cohort (minutes)	Time/ year (minutes)
Special Group Care	5.0		150.0	7.5	0.2
Extraction		4.8	7.5	36.0	1.0
Surgical Care	5.0		150.0	7.5	0.2
New Fillings		18.8	15.0	282.0	8.1
TOTAL					**9.5**

(Calculations according to WHO/ FDI 1989)

TABLE 5.11d – Time estimates for the provision of selected procedures for the long term plan for the 65-80 year age cohort, expressed in minutes per person per year

Type of Care	Percentage population	Frequency	Time (minutes)	Time/ cohort (minutes)	Time/ year (minutes)
Special Group Care	10		150.00	15.0	1.0
Extraction	40	6.0	7.5	45.0	3.0
Surgical Care	5.0		150	7.5	0.5
New Fillings		13.3	15.0	199.5	13.3
TOTAL					**17.8**

(Calculations according to WHO/ FDI 1989)

Calculation of need and demand for age cohorts of KwaZulu-Natal

Minutes of need were calculated from Table 5.10(134), and percentage demand was determined as per section 5.2.3(115). These results were fed into the computer programme, together with percentage population of each cohort. Minutes of demand were determined by the computer programme. These findings are summarized in Table 5.12.

TABLE 5.12 - Summary of need and demand for the different age cohorts for the long term plan

Age Cohorts	Minutes of Need	% Demand	Minutes of Demand	% Population
0-14	9.7	40	3.9	35.8
15-29	10.8	40	4.3	29.4
30-64	9.5	40	3.8	29.9
65-80	17.8	40	7.1	4.9

(Calculations according to WHO/ FDI 1989)

- These calculations resulted in a weighted average of 4,1 minutes per person per year.
- Calculations were done for number of hours per year worked per operator = 1 750.
- This resulted in a human resource: population ratio of 1:25 610.
- Number of human resources required were:

$$= \frac{\text{Total number of state-dependent population}}{\text{Human resource: population ratio}}$$

$$= \frac{7\,912\,650}{25\,610}$$

= 309 *oral health personnel are required to provide selected procedures of the basic oral health care package for the year 2010.*

Calculations were then performed for each category of personnel as described in section 5.2.3 (118).

TABLE 5.13 – Number of oral health personnel required for the long term plan

Category	#Dental operator	$Dentist	$Dental therapist	Oral hygienist	*Dental assistant
Number required	196	33	163	113	294

Dental operator refers to dentists and dental therapists

* Calculated according to operator: assistant ratio of 1:1.5 proposed by policy document (Department of Health 1999)

$ Calculated by dentist: therapist ratio of 1:5 (Department of Health 1999)

During the initial stages of implementation of the long term plan, if there are inadequate financial and human resources, the number of oral health personnel can be almost halved by providing simple fillings to the 0-14 and 15-29 year cohorts only (Table 5.14). The other cohorts can be provided for as, and when, resources become available.

TABLE 5.14 – Number of oral health personnel required for the long term plan, with provision of simple fillings to the first two cohorts only

Personnel	#Dental operator	$Dentist	$Dental therapist	Oral hygienist	*Dental assistant
Number required	106	18	88	113	159

5.6.6 CALCULATION OF ORAL HEALTH PERSONNEL REQUIREMENT USING DECREASED DMFT LEVELS DUE TO WATER FLUORIDATION

Calculations were done using the decreased DMFT levels anticipated due to the implementation of water fluoridation (Table 5.15).

TABLE 5.15 - Dental caries projections showing reduced levels of DMFT due to water fluoridation for age cohorts used in this study

Age cohorts	0-14 (30% reduction)	15-29 (10% reduction)	30-64 (10% reduction)	65+ (10% reduction)
DMFT	1.2	4.8	12.2	17.6
MT	0.2	0.8	5.6	11.6
FT	0.1	0.2	2.3	5.0
NFT	0.7	2.7	6.7	4.9
NFS	1.1	4.9	16.8	12.3
Extractions	0.2	0.6	4.8	6.0

(Calculations according to WHO/ FDI computer model 1989:44)

However, in the computer programme, the effects of water fluoridation on DMFT levels only affected the time estimates for Restorative Care: fillings. Therefore Table 5.16 will only show this aspect of the new calculations.

TABLE 5.16 – Time estimates for restorative care for the long term plan, taking into account reduced DMFT due to the effect of fluoridation, expressed in minutes per person per year

Cohort	Frequency	Time	Time per cohort	Time per year
0-14	1.1	15.0	16.5	1.1
15-29	4.9	15.0	73.5	4.9
30-64	16.8	15.0	252.0	7.2
65-90	12.3	15.0	184.5	12.3

(Calculations according to WHO/ FDI 1989)

Calculation of need and demand for age cohorts of KwaZulu-Natal

Need and demand was calculated as in section 5.6.5 (135) and is summarized in Table 5.17.

TABLE 5.17 - Summary of need and demand for the different age cohorts taking into account the effects of water fluoridation

Age Cohorts	Minutes of Need	% Demand	Minutes of Demand	% Population
0-14	9.3	40	3.9	35.8
15-29	10.8	40	4.3	29.4
30-64	8.6	40	3.4	29.9
65-80	16.8	40	6.7	4.9

- These calculations resulted in a weighted average of 3.9 minutes per person per year.
- Calculations were done for number of hours per year worked per operator = 1 750.
- This resulted in a human resource: population ratio of 1:26 923.
- Number of human resources required were:

$$= \frac{\text{Total number of state-dependent population}}{\text{Human resource: population ratio}}$$

$$= \frac{7\ 912\ 650}{26\ 923}$$

= *294 oral health personnel are required to provide selected procedures of the basic oral health care package for the year 2010 taking into the effects of water fluoridation.*

Calculations were then performed for each category of personnel as described in section 5.6.5, and represented in Table 5.18.

TABLE 5.18 – Number of oral health personnel required for the long term plan taking into account the effects of water fluoridation

Personnel	#Dental operator	$Dentist	$Dental therapist	Oral hygienist	*Dental assistant
Number required	181	30	151	113	272

From Table 5.18, it can be seen that water fluoridation decreases the number of oral health personnel required. Therefore the immediate implementation of water fluoridation should become a priority for the provincial Departments of Health, and Water Affairs and Forestry.

5.7 SUMMARY

The optimal number of personnel required to provide the complete package was calculated, and compared to existing numbers and distribution in KZN. The human resource plan was formulated for the short and long terms.

Due to the shortage of human resources, the short term plan aimed to provide at least a minimal level of oral health care to the state-dependent population, by equitably redistributing all existing personnel to each region of this province. Selected dental procedures would be provided to target groups, and water fluoridation was identified as a priority.

In the long term plan, due to changing epidemiologic priorities in the province, target groups were also used to provide selected procedures to sectors of the population who needed them most. The human resource plan was therefore formulated to ensure the optimal utilization of human resources in the provision of oral health care to the state-dependent population of KwaZulu-Natal.

CHAPTER 6 - DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

CHAPTER 6 - DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

6.1 DISCUSSION

Human resources take up between sixty and seventy-five percent of the health sector recurrent budget (Green 1994:291). Therefore planning for oral health personnel should be comprehensive and thorough in order to make optimal use of all available resources.

Planning for oral health personnel should be done many years in advance since production takes a long time, and is expensive to the state (Mejia & Fulop 1978:13). It must also be remembered that oral health care has received low priority by the South African government and the consuming public. Therefore, budgets and other resources are minimal; and plans should be formulated which make optimum use of these limited resources.

The situation analysis revealed that KwaZulu-Natal had the highest population of all the provinces of South Africa, with eighty seven percent being state-dependent. This province is beset by high levels of poverty, disease, disability and trauma. KZN has the highest prevalence of HIV/AIDS in South Africa.

Historical circumstances have resulted in gross inequities in the health care system of this province (vide 2.3.1:19). There is also a significant rural component that lives in areas with scattered terrain and inadequate transport systems (vide 3.3.1:58). Access to health facilities is inadequate, and oral health awareness is low.

The dental caries status within this province appears to be stable (vide 3.4.2:66), and the WHO goal for 2000, and South African goal for 2010, of the twelve year age group has already been reached. The Significant Caries Index for KZN has not been determined (vide 2.2.2:16). However national and local surveys reveal a large backlog in oral health care that needs to be redressed (vide 3.4.2:65).

There are adequate numbers of oral health personnel in this province (vide 3.5.3:77). However, most of them work in the private sector, and serve only thirteen percent of the population. Non-governmental organizations provide oral health services to many underserved communities in this province (vide 3.5.4:80). This is often done in an uncoordinated manner, resulting in a duplication of services in some areas, and a lack of care in others. There is an established primary health care network performing health prevention and promotion to large sectors of the population of this province (3.7.4:85). Extensive coverage of deep rural areas is obtained by mobile services.

To overcome the problem of health services historically being focused towards the Medical Model (vide 2.3.4:23), the National Department of Health has based its health services on the primary health care approach functioning within the district health system. Policy documents recommend that a basic package of oral health services should be available for all state-dependent people. Goals for oral health have been proposed for 2005 and 2010. Target groups have been defined and priority areas identified for the provision of oral health care.

A combination of planning approaches was used in this study in order to achieve a more comprehensive overall plan for this province. The WHO/ FDI (1989) manual and computer model were utilized to calculate the number of human resources needed.

The human resource plan for KwaZulu-Natal was formulated for the short and long terms. Baseline data was obtained by calculating the optimal number of human resources required to provide the complete package to the state-dependent population for 2000 (vide 5.2:103). This was compared to the number and distribution of existing personnel (3.5.1:77), and revealed a shortage and inequitable distribution of oral health personnel in all regions.

The short-term plan was drawn up to provide, at least a minimal level of, oral health care to all state-dependent people. All existing oral health personnel would be equitably redistributed to each region of KZN, and an emergency oral health service would be available to this population. Due to the shortage of personnel, target groups were identified for selected procedures.

Significant sectors of the population of KZN receive water from Umgeni Water. The implementation of water fluoridation was identified as a priority, as international studies have shown decreases in dental caries levels after this initiative was carried out. This would translate to a decreased oral health personnel requirement.

The long term plan was formulated, taking into account the anticipated decrease in dental caries due to fluoridation (vide 2.2.1:12), and the new epidemiologic priorities caused by HIV/ AIDS (vide 3.4.6:75). The AIDS pandemic would have peaked by 2010, resulting in many AIDS patients and orphans (3.3.6:63). In addition, this province has the largest disabled population in South Africa (vide 3.3.8:64), an increasing aged cohort, and an escalating number of victims of crime and violence (3.3.7:63). Therefore additional time was included in the long term plan for special group care to address the specific needs of these populations.

Due to an anticipated shortage of human and financial resources, target groups were again identified for selected dental procedures. Oral health services would refocus on prevention and special group care. Restorative care would initially be provided to the first two age cohorts. If resources become available, provision can be made to the older age groups.

The number of oral health human resources required, as determined by this study, is shown in Table 6.1. During the initial stages of implementation of the long term plan, if there are inadequate financial and human resources, the number of oral health personnel can be almost halved by providing simple fillings to the 0-14 and 15-29 year cohorts only. The other cohorts can be provided for as resources become available.

TABLE 6.1 – Human resource requirements calculated for 2000 and 2010 for selected procedures of the basic oral health care package

Year	Human resources	Dental operators	Oral hygienists
2000 complete package (optimal number, baseline data for planning process)	404	184	220
2010 with current DMFT levels (selected procedures to target groups)	309	196	113
2010 with reduced DMFT due to fluoridation (selected procedures to target groups)	294	181	113
2010 with current DMFT levels (selected procedures to target groups, & simple fillings provided to the first two cohorts only)	219	106	113

Calculations were done for the *complete* package for 2000, and for *selected procedures* only for 2010. However, the required number of dental operators increased in the long term plan, mainly due to the additional time allocated for special group care and the increasing population numbers. However the effects of water fluoridation decreased the human resource requirements significantly.

LIMITATIONS OF THE STUDY:

6.1.1 The supply of human resources will change due to the:

- movement of personnel between the private and public sectors
- number of dentists allocated for community service varies each year
- number of human resources affected by HIV/AIDS has not been determined.

6.1.2 Population projections used in this study have taken into account the effect of AIDS. The effects of interventive measures on this disease have not been considered.

6.1.3 Demarcations for the regions of KwaZulu-Natal are currently being revised. Regional boundaries may change which could alter population distribution.

6.1.4 The district health system has not been implemented fully in this province.

6.1.5 Planning was done for the province of KwaZulu-Natal as a whole. The WHO/FDI (1978) oral health personnel planning model does not take into account the special needs of individual communities.

6.2 CONCLUSIONS

6.2.1 There is a gross shortage and inequitable distribution of oral health personnel within the *public* service of KwaZulu-Natal. About six percent of all the dentists in this province work within the public sector. They are expected to serve eighty seven percent of the population.

6.2.2 There are high morbidity and mortality rates in this province, which uses up a significant proportion of the total health budget of the province. It is therefore improbable for any major increase in the oral health budget in the near future.

6.2.3 Due to the shortage of human and financial resources, it will not be possible to implement the complete basic package for all state-dependent people.

6.2.4 Oral health services in KwaZulu-Natal have not been completely devolved to district level. Minimal health prevention and promotion is being done, with the focus being on curative care.

6.2.5 Dental facilities and infrastructure are scarce in several regions of this province. Therefore many people of low socio-economic status do not have access to basic oral health services, and often lack an awareness of oral health care.

6.2.6 The dental caries status of the population of KwaZulu-Natal appears to be stable. Water fluoridation and other preventive efforts will contribute further towards lowering these levels. This will decrease the number of personnel required to provide basic oral health services. Therefore dental personnel can re-focus their efforts towards other priority areas, such as the management of oral manifestations of AIDS and special group care.

6.3 RECOMMENDATIONS

Human resource planning for a province must be done within the national political framework, health policies and plans of a country. Therefore policy documents were consulted during the formulation of the human resource plan.

The health human resource development process of a country (vide 2.1:11) is composed of three inter-related components (Mejia 1978:17). They are human resource production (tertiary institutions), management (health services) and planning (health planners). Therefore recommendations for this study will be made under these three headings.

6.3.1 TERTIARY INSTITUTIONS

Training of the correct number and mix of oral health personnel:

- An alteration in the number of oral health personnel trained necessitates critical evaluation between training institutions and service organizations. Therefore discussions should be held between these bodies to ensure that the correct mix of appropriately skilled oral health personnel are trained. This is because training of such personnel is very expensive to the state, and therefore should not be conducted in a haphazard manner (Mejia & Fulop 1978:12). However, the effects of increasing the number of oral health personnel trained will not be seen during the duration of this study (2000 – 2010).

- According to Rossouw (1996:24), South Africa has reached "*optimal levels of supply*" of dentists. If present trends in training continue, "*the present numbers will carry us comfortably to meeting the needs of*

dentists until 2010". Therefore there should not be an increase in the overall number of dentists trained in South Africa.

- The role of dental therapists and oral hygienists in the provision of oral health care in South Africa should be re-evaluated and re-defined. Training of larger numbers of dental therapists and oral hygienists (vide 2.5.3:46) has been proposed, and the creation of a single category of dental auxiliary (vide 2.5.4:47) should be considered.

- The capacity of training institutions should by expanded to train all categories of oral health personnel. Students should be trained to function at each level of the district health system, focusing on the primary health care approach.

Intersectoral Collaboration:

- Courses in oral health care should be provided to teachers, nurses and community health workers by tertiary institutions. Discussions should be held with teacher and nursing colleges to incorporate oral health care into their training curricula.

Continuing education courses:

- Continuing education courses and workshops should be provided to update all oral health personnel in the diagnosis and management of HIV/AIDS, and infection control.

6.3.2 SERVICE ORGANIZATIONS

Equitable redistribution to all regions:

- Redistribute all existing oral health personnel equitably between regions so that, at least a minimal level of care is available. However supportive facilities and infrastructure should be available, and fully functional.

Recruit larger numbers of personnel into the public sector:

- Ensure that each region within the province has an adequate number of posts available for oral health personnel. This can be achieved by unfreezing existing posts, and by creating new ones where they are deficient.

- Provide incentives to attract all categories of oral health personnel into the public sector. Bursaries can be provided for under- and post-graduate training, where recipients are required to work in the public service for a defined period of time.

- Create supportive environments for oral health personnel in rural areas. Satisfactory living and working conditions should be provided in all regions of the province. Special allowances should also be paid to people working in underserved areas.

Utilization of the private sector:

- Innovative methods need to be devised to incorporate this large sector of personnel to deliver the basic package to the state-dependent population.

- Due to the shortage of personnel in the public service, many oral health facilities are equipped, but unused. Private sector personnel could therefore provide part-time services in public facilities.

- If facilities are not available in the public sector, private sector personnel could treat patients on a capitation basis in their own practices.

- Pro deo services by this sector for a few hours a month could be performed, with possible tax rebates or concessions.

Compulsory community service:

- Compulsory community service should be implemented for all categories of oral health personnel. This would greatly increase the number of personnel available in the public service.

Non-governmental organizations:

- Services are provided by the various organizations in an un-coordinated manner. The public service should synchronize these efforts to avoid duplication. The human resource component could be voluntary, with the state contributing towards materials and equipment.

Cooperation within the Department of Health:

- Primary health care programmes have achieved extensive coverage in this province (Table 3.28:86), at clinics and community health centers, and using mobile units. According to Gilbert, Chikte, Josie Perez, Brand and Rudolph (1994:501), increased access to oral health care can be achieved by the use of such units. Therefore oral health prevention and promotion should be integrated into these initiatives at district level. Oral hygienists should work with nurses in mother and child clinics and school health programmes. This will enable oral

health to be integrated into the existing comprehensive health care projects of the province.

Intersectoral Collaboration with the Department of Education:

- Oral health prevention and promotion can yield effective results at primary and secondary school levels (Reisine 1993:111) because schools have access to large numbers of children. Teachers and parents can therefore be utilized to implement these programmes, initially supervised by oral health personnel. However a study by Frasier, Jenny and Johnson (1979:204) revealed that, in order for these programmes to be most effective, parents and teachers should be involved from the inception of the project.

Use of Community Health Workers:

- This province has 717 community health workers employed by the public sector (vide 3.5.5:81). They could help to increase community participation in the formulation of specific oral health plans for the districts, and raise the oral health awareness among the local population.

Water Fluoridation:

- Water fluoridation will play a significant role in improving the oral health status of the population. Therefore, the provincial health department should facilitate intersectoral collaboration between itself, and the Department of Water Affairs and Forestry, and Umgeni Water as a priority. When implemented, this initiative will greatly decrease the dental caries levels, thereby decreasing the oral health personnel requirements.

6.3.3 HEALTH PLANNERS

Creation of a central database:

- Planners within the KwaZulu-Natal Department of Health should create a central database specially designed for oral health, which should be updated on a regular basis.

- Each district should undertake a comprehensive situation analysis due to diversity among communities (Department of Health 2001). Procedures, methodologies and materials should be developed that fit the requirements of each district. From this information, strategies and targets can be chosen for the special needs of each community. However, community participation is essential at this stage.

- **Coordinate the implementation of the basic oral health care package:**

- Planners should coordinate activities during the implementation of the package, which should be constantly monitored, re-evaluated and revised if necessary.

- In-service training, support and supervision should be made available to providers of oral health care during the implementation of the basic oral health care package.

6.4 SUMMARY

This chapter discussed the human resource plan for the provision of the basic oral health care package to the state-dependent population of KwaZulu-Natal. This plan would be implemented at provincial level, and would provide the framework for community-specific oral health services. Recommendations were made for the various components of human resource development i.e. tertiary institutions, health services and planners, to ensure an equitable distribution and efficient utilization of oral health personnel in meeting the special oral health needs of the population of KwaZulu-Natal.