

# CHAPTER 1: PROBLEM STATEMENT, AIMS, RESEARCH DESIGN AND STRUCTURE

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## 1.1 Problem statement

Since the “discovery” of fluoride and conclusive evidence provided by Dean and Elvove (1935) on the caries reducing potential of natural fluoride in drinking water, in excess of 100 studies have been conducted in more than 40 countries indicating similar results with the artificial fluoridation of drinking water (Murray, Rugg-Gunn and Jenkins, 1991a). Three recent reviews have confirmed water fluoridation as the most cost-effective and safe primary preventive measure against dental caries (Forum on Fluoridation, 2002; Medical Research Council, 2002; NHS Centre for Review and Dissemination, 2000).

Despite all this evidence in favour of water fluoridation and a Commission of Inquiry into water fluoridation recommending the fluoridation of public water supplies to the optimal fluoride concentration (Republic of South Africa, 1966), no artificially fluoridated water scheme exists in South Africa. A National Fluoridation Committee (NFC) was appointed by the Minister of Health in 1996 to finalise regulations for water fluoridation. These regulations were promulgated on 8 September 2000 (Republic of South Africa, 2000). Water providers are compelled by the regulations to fluoridate public water supplies, but may apply for exemption under special circumstances such as optimal natural fluoride levels already being present. These regulations were repealed with the repealing of the Health Act of 1977 and have been amended and will follow the normal legal process for approval (Smit, 2007).

Both the United Kingdom (UK) Medical Research Council (MRC) (Medical Research Council, 2002) and University of York reports (NHS Centre for Review and Dissemination, 2000) have concluded that there is a need to extensively research the economic impact of water fluoridation where the cost

of the programme should be weighed against its benefits, especially in times of a trend of a reduction in dental caries and exposure to other fluoride products.

Dental caries was included in a South African National Children's Oral Health Survey (NCOHS) (Department of Health, 2003b) to determine reliable baseline data and monitor trends in oral health status in all provinces of South Africa. The report on this survey concluded that caries in the primary dentition was more severe than in the permanent dentition. Caries severity for 12-year-olds ranged between very low to low according to the World Health Organization (WHO) classification (Barmes, 1977). High levels of untreated caries were however recorded. The report recommended that the implementation of water fluoridation be evaluated for South Africa taking into account caries levels in areas where water is supplied by water providers, cost of water fluoridation, levels of fluorosis and trends in dental caries prevalence and severity (Department of Health, 2003b).

The cost and consequences of water fluoridation in any assessment model are dependent on the perspective of the analysis by society, the public health sector, a third-party payer or a particular segment of the population (White, Antczak-Bouckoms and Weinstein, 1989). Guidelines to calculate the cost of water fluoridation based on 44 communities in Florida, United States of America (USA) (Ringelberg, Allen and Brown, 1992) were used to develop a computerised simulation model to evaluate the cost of water fluoridation for Gauteng (Van Wyk, Kroon and Holtshousen, 2001).

The White Paper for the Transformation of Health Services in South Africa presents implementation strategies to meet the basic needs of the population. It recognises dental practitioners, oral hygienists, dental therapists, technicians and dental assistants as members of the oral health workforce delivering these services. Adoption of the Primary Health Care (PHC) approach and reducing the incidence of common oral diseases through a minimum package of care, water fluoridation, and reduction of the

consumption of refined sugar have been identified as the main principles to address oral health (Republic of South Africa, 1997b).

A package of PHC services was agreed to at a meeting of the Provincial Restructuring Committee in Bloemfontein on 13 April 2000 (Pick et al., 2001) and have been published in separate documents (Department of Health, 2001a; Department of Health, 2001b). For oral health it consists of:

- Oral examination and charting of dental status;
- Intra-oral radiographs;
- Scaling and polishing of teeth;
- Promotive and preventive oral health services;
- Basic curative services including emergency relief of pain and sepsis (including dental extractions);
- Simple restorations (1-3 tooth surfaces);
- Treat traumatic injuries to teeth; and
- Treat post-extraction bleeding.

Irrespective of the implementation of water fluoridation and/or a minimum package of oral care, it will impact on human resources required in future. Three studies have been conducted in South Africa over the past number of years investigating human resources required.

Booyens (1994) applied the WHO/Fédération Dentaire Internationale (FDI) needs model (World Health Organization/Fédération Dentaire Internationale, 1989) to the 1988/89 National Oral Health Survey (NOHS) data (Department of Health, 1994) to provide quantitative and qualitative information regarding oral health human resources needs for South Africa. This study concluded that more oral hygienists should be trained to address the need for more primary preventive dental services.

Van Wyk (1996) developed a model to determine the future human resources needs for optimal oral health care for the total population of South Africa where the actual demand for services was used as a point of departure. This

study concluded that the levels of human resources required for 2011 would be difficult to attain and a programme of optimal fluoridation was suggested as an absolute necessity to address oral health to the population of South Africa.

Kissoon-Singh (2001) also used the WHO/FDI needs based model (World Health Organization/Fédération Dentaire Internationale, 1989) and the basic oral health care package (Department of Health, 2001a) to plan human resources for oral health care for KwaZulu-Natal. This study concluded that there was a gross shortage of oral health personnel to meet the oral health needs of this province.

The majority of reports on human resources in South Africa have highlighted the inequitable distribution between urban and rural on the one side and the private and public sectors on the other.

The recently published National Human Resources Plan for Health (NHRP) identifies human resources planning and development as a key priority area and provides a framework to guide all stakeholders to provide an adequate workforce in partnership with government (Department of Health, 2006a).

The NHRP proposes annual productions for the various members of the oral health team (Department of Health, 2006a). In doing so it recognises that targets may appear high, but consideration has to be given to mobility of health professionals to and from the private sector, migration overseas and other attrition factors. The recommendations contained in the NHRP have been criticised by the Chief Executive Officer (CEO) of the South African Dental Association (SADA) (Campbell, 2006).

The challenge to any planner of health and oral health programmes and services is to establish a health system which is available, accessible, affordable and acceptable to all citizens and meets the needs and demands in the most cost-effective way to lead to improved health for all.

## 1.2 Aims and objectives of the study

The aim of this study was to perform an economic assessment of the implementation of water fluoridation and the delivery of the minimum package of oral care and the impact this will have on human resources planning for oral health in South Africa.

The objectives of the study were:

- To determine per capita cost, cost-effectiveness and cost-benefit of the implementation of water fluoridation for seventeen major metropolitan cities, towns and water boards in all nine provinces of South Africa by way of a model taking into account operating cost, opportunity cost and capital depreciation;
- To determine the per capita cost of delivering the minimum package of oral care to 4- to 15-year-old children based on the treatment needs as determined in the 1999-2002 NCOHS and National Reference Price List (NRPL) and Uniform Patient Fee Schedule (UPFS) fees;
- To calculate human resources needed for the implementation of the minimum package of oral care to 4- to 15-year-old children based on the WHO/FDI model (World Health Organization/Fédération Dentaire Internationale, 1989) and a “Service Targets Method” model (Bui Dang Ha Doan, 1981; Hall, 1978). Both models considered different scenarios for caries reduction achieved through water fluoridation.

## 1.3 Research design

This study was conducted in three parts based on the three objectives of the study:

- **Part 1:** Cost evaluation for the implementation of water fluoridation in the metropolitan areas and larger towns of South Africa;
- **Part 2:** Costing the delivery of the minimum package of oral care (Department of Health, 2001a; Department of Health, 2001b);
- **Part 3:** Calculate the oral health human resources needs for the implementation of the minimum package of oral care.

The following databases and information documents were used in this study:

- 2006 South African mid-year population estimates (Statistics South Africa, 2006);
- 1999-2002 NCOHS (Department of Health, 2003b);
- Council for Medical Schemes' 2006 NRPL (Council for Medical Schemes, 2006);
- 2006 UPFS (Gauteng Provincial Government, 2005); and
- Minimum package of oral care (Department of Health, 2001a; Department of Health, 2001b).

## **1.4 Structure of thesis**

Chapter 2 presents a literature review on water fluoridation (including a historical perspective, water fluoridation in South Africa and economic assessment), human resources planning (including approaches, the WHO/FDI model, a South African perspective and human resources distribution and trends) and South African policy documents on health and oral health service delivery.

Chapter 3 describes a model, results and discussion of the per capita cost, cost-effectiveness and cost-benefit of the implementation of water fluoridation for seventeen major metropolitan cities, towns and water boards in all nine provinces of South Africa.

Chapter 4 describes a model, results and discussion of the per capita cost of delivering the minimum package of oral care to 4- to 15-year-old children taking into account different scenarios for caries reduction achieved through water fluoridation.

Chapter 5 describes two models, results and discussion to calculate the oral health human resources required for the implementation of the minimum package of oral care to 4- to 15-year-old children taking into account different scenarios for caries reduction achieved through water fluoridation.

Chapter 6 describes the conclusions and recommendations from this study linked to water fluoridation and delivering the minimum package of oral care.

## **1.5 Summary**

This chapter provided the background, aims and objectives and a brief overview of the three phases of this study.

Chapter 2 will present a literature review of water fluoridation, human resources planning and South African policy documents on health and oral health service delivery.

## CHAPTER 2: LITERATURE REVIEW

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### 2.1 Overview of water fluoridation

#### 2.1.1 Historical perspective

##### a) The early years

The classic epidemiological study involving research conducted independently by Dr Frederick McKay (a dentist from Colorado Springs, USA), Mr H.V. Churchill (chief chemist from the ALCOA Company) and Dr H. Trendley Dean (a dentist from the United States Public Health Service) is well documented and is described in detail in all major textbooks dealing with preventive dentistry, fluoride and dental public health. Without repeating this entire study into the “discovery” of fluoride in community water supplies and its relationship between dental caries and dental fluorosis, key findings of this study, spanning from 1900 to 1942, are summarised in Table 1.

**Table 1: Summary of early studies into the relationship between fluoride in community water supplies, dental caries and dental fluorosis**

| Year        | Description                                                                                                                                                                                                              |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Early 1900s | Dr Frederick McKay describes the “Colorado Stain” in his patients seen in his Colorado Springs, Colorado practice (Murray, Rugg-Gunn and Jenkins, 1991b)                                                                 |
| 1916        | McKay enlists the collaboration of Dr G.V. Black who describes this phenomenon as “mottled enamel” (Black and McKay, 1916)                                                                                               |
| 1918        | McKay concludes that a “mysterious element” in the community water supply is responsible for mottled enamel (McKay, 1918)                                                                                                |
| 1928        | McKay observes a reduced caries experience in patients with mottled enamel (McKay, 1928)                                                                                                                                 |
| 1931        | Mr H.V. Churchill identifies high fluoride levels in water samples sent to him by McKay for analysis (Churchill, 1931)                                                                                                   |
| 1931        | Dr H. Trendley Dean is appointed as the first dentist of the newly established National Institute of Health’s Dental Hygiene Unit which became the National Institute of Dental Research in 1948 (Burt and Eklund, 2005) |
| 1933        | Dean publishes his first report of the distribution of mottled enamel in the United States (Dean, 1933)                                                                                                                  |
| 1934        | Dean describes his seven-point, ordinal scale index of fluorosis (Dean, 1934)                                                                                                                                            |
| 1935        | Dean starts using the term “fluorosis” to replace mottled enamel (Dean and Elvove, 1935)                                                                                                                                 |



**Table 1: (continued)**

|           |                                                                                                                                                                                                                                                                                                                                     |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1936      | Dean concludes the minimal threshold of fluoride in water should be 1 ppm (Dean, 1936) and that fluorosis in communities where fluoride levels were below this threshold were of no public health significance (Dean and Elvove, 1936)                                                                                              |
| 1938      | Dean's first report on the inverse relationship between dental caries and dental fluorosis (Dean, 1938)                                                                                                                                                                                                                             |
| 1939      | Dean and McKay provide conclusive and direct proof that fluoride in public water supplies is the primary cause of dental fluorosis (Dean and McKay, 1939)                                                                                                                                                                           |
| 1941/1942 | Dean reports on his "21 cities study" indicating that dental caries experience decreases sharply as fluoride concentration increases towards 1 ppm (Dean, Arnold and Elvove, 1942; Dean et al., 1941) which led to the adoption of 1.0-1.2 ppm as the appropriate concentration of fluoride in drinking water in temperate climates |

**b) North American studies**

This initial phase linked to natural fluoride in drinking water, was followed by the first controlled fluoridation trials in the United States and Canada commencing in 1945 and 1946 in Grand Rapids, Michigan (Muskegon as control), Newburgh, New York (Kingston as control), Evanston, Illinois (Oak Park as control) and Brantford, Ontario (Sarnia as control) (Burt and Eklund, 2005). All of these studies, some reporting results of up to fifteen years after the commencement of controlled fluoridation, clearly indicated a sharply reduced caries experience in each of the study populations (Arnold et al., 1962; Ast and Fitzgerald, 1962; Blayney and Hill, 1967; Hutton, Linscott and Williams, 1956). These studies, all of which were of a sequential cross-sectional design, also reported fluorosis levels of between 7-16% as described by Dean in earlier studies at a fluoride concentration of 1 parts per million (ppm).

**c) The Dutch Tiel-Culemborg study**

The first truly longitudinal study into the controlled fluoridation of public water supplies was conducted in The Netherlands in the towns of Tiel (fluoridated) and Culemborg (control). This study also described the caries inhibitory effect of fluoride in drinking water being of more benefit to smooth surfaces compared to pits and fissures and confirmed the benefits of lifelong exposure to water fluoridation on oral health. Evidence from this study suggests that

adequate ingestion of fluoride during enamel formation is important to prevent pit and fissure caries, but is of less importance where smooth surface caries is concerned (Backer Dirks, Houwink and Kwant, 1961; Backer Dirks, 1967; Kwant et al., 1972; Kwant et al., 1974).

**d) The New Zealand Hastings study**

This was a retrospective study reporting on baseline examinations conducted in 1954, 1964 (10 years after the introduction of fluoridation) and 1970 after 16 years of fluoridation. This study indicated a caries reduction of 49% between 1954 and 1970 and also demonstrated the selective caries inhibitory effect of fluoride on different tooth surfaces (Ludwig, 1965; Ludwig, 1971).

**e) United Kingdom studies**

The earliest studies in the UK confirmed Dean's findings. Caries in South Shields was reported to be 50% lower than in North Shields (Weaver, 1944). Similar findings were reported from studies in the North-East of England (Weaver, 1950) and other parts in Britain where fluoride levels varied from 0.9 to 5.8 ppm (Forrest, 1956).

A study conducted in East Anglia confirmed the benefits of continuous exposure to fluoride compared to those exposed to fluoride in drinking water for different periods of time (James, 1961).

A British Government mission to the USA to study fluoridation in operation recommended that water fluoridation should be implemented in selected communities first before general implementation. Watford, Kilmarnock and a part of Anglesey were chosen. Fluoride was added to the drinking water in 1955-1956. After 5 years a report confirmed that fluoridation of water supplies was highly effective in reducing dental caries (Murray et al., 1991b).

**f) The World Health Organization and water fluoridation**

The WHO has always taken a keen interest in this public health topic and in 1958 produced their first report endorsing the findings that water containing approximately 1 ppm was a practical and effective health measure to reduce dental caries (World Health Organization, 1958).

A report on fluoridation was submitted to the World Health Assembly which resulted in the adoption of the following resolution on 22 July 1969:

“The World Health Organization recommends member states to examine the possibility of introducing and where applicable to introduce fluoridation of those community water supplies where the fluoride intake from water and other sources for the given population is below optimal levels, as a proven public health measure, and where fluoridation of community water supplies is not practicable to study other methods of using fluoride for the protection of dental health” (World Health Organization, 1969).

This resolution was reaffirmed in the Report of the WHO Director General in 1975 (Murray et al., 1991b).

The 2003 World Oral Health Report confirmed the evidence that long-term exposure to an optimal level of fluoride results in diminishing levels of caries in both children and adults. This report did however recognise the various sources of fluoride and requests public health administrators to maximise caries reduction and at the same time minimise dental fluorosis. This report estimated that 210 million people benefit from fluoridated water (Petersen, 2003).

**g) Current status of community fluoridation throughout the world**

It came as no surprise that the favourable results of initial studies led to many other communities adding fluoride to their public water supplies. It was estimated that by 1981 approximately 210 million people worldwide were exposed to fluoridated water (Murray, 1986).

A summary of the world status of fluoridation shows (Burt and Eklund, 2005):

- According to the FDI 34 countries reaching 246 million people had fluoridated water;
- Fluoridation in Singapore reached 100% of its population in 2004;
- Ireland is the only nation with a mandatory fluoridation law;
- More than 50% of the population in Australia, Ireland, Malaysia, New Zealand and the USA are reached by water fluoridation;
- 10% of the population in Spain (mainly Seville and Córdoba) and the UK (Birmingham and Newcastle) received fluoridated water;
- Fluoridation projects in Eastern European and South and Central American countries are of uncertain status; and
- By the end of 1992, 135 million persons in the USA were served by fluoridated water with a further 10 million having naturally fluoridated water.

WHO in collaboration with the FDI and the International Association for Dental Research (IADR) hosted a global consultation on “Oral Health through Fluoride” from 17-19 November 2006. The aim and objectives of the Consultation were to (World Health Organization, 2006):

- Review and highlight successes in promoting oral health through the use of fluoride;
- Identify barriers for making fluoride available to all;
- Explore effective strategies for making fluoride available and affordable to all; and
- Develop an action plan for fluoride promotion and advocacy.

A declaration from this consultation reaffirmed the efficiency, cost-effectiveness and safety of the daily use of optimal fluoride and that access to fluoride for dental health forms part of the basic human right to health (Fédération Dentaire Internationale, 2006).

### 2.1.2 Caries prevention from water fluoridation

The extensive literature on the effectiveness of water fluoridation reports mostly on studies conducted in children (Burt and Fejerskov, 1996). A summary of studies of artificial fluoridation throughout the world showed that of the 113 studies conducted in 23 countries, 66 reported on the effect on deciduous teeth and 86 on permanent teeth (Murray et al., 1991a). More than half of these studies were conducted in the USA. Modal percentage caries reduction for deciduous teeth was 40 to 49% and 50 to 59% for permanent teeth. Reports from these studies as well as the four pioneering studies described earlier, has led to the statement “water fluoridation reduces dental caries by half” (Burt and Eklund, 2005).

A review of the effectiveness of water fluoridation in the USA between 1979 and 1989 found that caries reduction varied from 8 to 37% amongst adolescents (Newbrun, 1989). Since the early days of water fluoridation, caries has declined in both fluoridated and non-fluoridated communities, mainly due to:

- the diffusion of fluoridated water to areas through bottling and processing of foods and beverages; and
- the widespread use of fluoride toothpaste (Horowitz, 1996).

McKay was the first to report on the beneficial effect of water fluoridation on adults. He reported a 60% difference in mean decayed, missing and filled teeth (DMFT) scores between adults in naturally fluoridated Colorado Springs and the non-fluoridated town of Boulder (McKay, 1948). Increased retention of teeth in ageing populations can lead to an increase in the prevalence of root caries. Studies which indicated a reduction in root caries in fluoridated areas are therefore important to emphasise its benefits to adults and the elderly as well (Burt, Ismail and Eklund, 1986; Stamm, Banting and Imrey, 1990).

### 2.1.3 Recent international reports

#### a) University of York (2000)

The York review was the first systematic review to be undertaken on water fluoridation. The protocol and all stages were subject to external review (Treasure et al., 2002).

The aim was to assess available evidence on both the positive and negative effects of water fluoridation as a strategy to prevent dental caries. The world-wide-web and 25 electronic databases were searched, 214 studies met the inclusion criteria for one of the 5 objectives of this review (McDonagh et al., 2000).

#### **Objective 1: Effect of water fluoridation on dental caries**

The best evidence found suggested that fluoridation of drinking water does reduce caries incidence as measured by the proportion of children who are caries free and by the mean change in dmft/DMFT scores. The degree to which this applied was not clear from this review. Evidence from studies after withdrawal of water fluoridation suggested an increase in caries prevalence levels approaching that of low fluoride groups (Treasure et al., 2002).

#### **Objective 2: Beneficial effect of water fluoridation over and above other interventions**

This review found no difference in the mean dmft/DMFT or percentage caries free individuals in studies conducted before or after 1970, suggesting that water fluoridation may still be of benefit after the introduction of fluoride toothpaste during the 1970's (Treasure et al., 2002).

#### **Objective 3: Equity of water fluoridation**

No longitudinal studies were found to investigate this. Cross-sectional studies were limited to the UK. Where dmft/DMFT was used, it seemed as if water fluoridation did reduce the inequalities in dental health in social classes aged 5 and 12. The authors suggested that caution should be taken in interpreting

these results due to the few studies which investigated equity of water fluoridation (Treasure et al., 2002).

#### **Objective 4: Possible negative effects of water fluoridation**

Dental fluorosis is regarded as the most widely reported negative effect of water fluoridation. This report identified a significant dose-response relationship between water fluoridation and dental fluorosis with a prevalence of 48% at a level of 1 ppm, fluorosis of aesthetic concern at this level was 12.5%. At 0.1 ppm the corresponding figures were 15% (prevalence) and 6% (aesthetic concern). Altitude and temperature were not found to be significant factors affecting dental fluorosis (Treasure et al., 2002).

The majority of studies investigating bone fractures as a consequence of water fluoridation were divided into hip and other fractures. No clear association could be found between hip or other fractures and water fluoridation. The majority of studies reported a small variation around the no effect outcome (Treasure et al., 2002).

No clear association could be indicated between any form of cancer and water fluoridation (Treasure et al., 2002).

This report concluded that studies of a much higher quality needed to be conducted to be conclusive of any negative effects of water fluoridation (Treasure et al., 2002).

#### **Objective 5: Differences between natural and artificial water fluoridation**

Very few studies compared natural to artificial fluoridation, no major differences were apparent, however evidence was found to be inadequate (Treasure et al., 2002).

In summary this report concluded that little high quality research had been conducted into public water fluoridation, including any negative effects. It was suggested that future studies should include ethical, environmental, ecological, cost and legal issues of the implementation of water fluoridation.



None of these aspects were included in this review (McDonagh et al., 2000). It was concluded however that water fluoridation does prevent caries and is associated with dental fluorosis (Treasure et al., 2002).

**b) Ireland Forum on Fluoridation (2002)**

This forum was established by the Ireland Minister of Health in May 2000 with the overall objective to review fluoridation of public water supplies in Ireland to inform the public, legislators and health professionals about the benefits and risks of fluoridation for human health. This would be the first major review of fluoridation in Ireland since its introduction in 1964 (Forum on Fluoridation, 2002). It was prompted by an increased interest among the public and advocacy groups leading to a subsequent increase in media coverage (Clarkson, McLoughlin and O'Hickey, 2003). The report covered scientific, technical and ethical issues relating to fluoridation.

The overall conclusions of the final report were (Forum on Fluoridation, 2002):

- Fluoridation was very effective to improve oral health of children, adults and the elderly;
- The best evidence suggested that at the maximum permitted level of 1 ppm human health was not adversely affected; and
- Dental fluorosis is well recognised and evidence suggested that it was on the increase in Ireland.

Two of the eight recommendations referred to water fluoridation with the remaining six aimed at fluoride toothpaste, the oral health care industry, infant formula, fluoride research, education, information and public participation and public health and professional practice. All were aimed to achieve maximum protection against dental caries and minimising the occurrence of dental fluorosis (Forum on Fluoridation, 2002). Only those applicable to this study are highlighted:

- **Policy aspects of water fluoridation:** Fluoridation should continue, but the optimal level should be amended from 0.8 to 1.0 ppm to between 0.6



and 0.8 ppm. This level should be sufficient to maintain low caries levels and reduce the prevalence of dental fluorosis (Clarkson et al., 2003).

- **Technical aspects of water fluoridation:** Guidelines should be developed to support ongoing quality assurance and external audit of fluoridation plants should be put in place. Fluoride monitoring and reporting procedures should be updated.
- **Fluoride toothpaste:** The continued use of fluoride toothpaste was recommended due to the additive benefit from the combination of this and water fluoridation. Fluoride toothpaste should not be used up to the age of 2 and parents should supervise the brushing of their children's teeth between ages 2 and 7 with only a pea-sized amount of toothpaste used. Swallowing of fluoride toothpaste should be avoided during these ages.

**c) United Kingdom Medical Research Council (2002)**

Following on the York report commissioned by the Chief Medical Officer of the UK Department of Health, the MRC was requested to investigate what further research would be required to improve the evidence base of fluoride and health in light of the conclusions and recommendations of the York report, the results of which were published as a separate report. The following recommendations were made (Medical Research Council, 2002):

- **Risk assessment, management and perception:** Evaluate methods for gauging public opinion, especially relating to water fluoridation, increase understanding on how to engage the public when planning research, assess methods to communicate results to the public and improved involvement of public opinion in reaching policy decisions.
- **Total fluoride exposure and uptake:** Differences in bioavailability and absorption of fluoride from natural compared to artificially fluoridated sources, calculate lifetime intake of fluoride, trends in fluoride exposure as a result of the use of discretionary fluorides such as fluoride toothpaste by infants.
- **Dental caries:** Effect of fluoridation against a background of widespread use of other fluoride sources, effect of water fluoridation on differences in

social class, impact of fluoridation on caries in adults and root caries in the elderly, impact of fluoridation on quality of life and economic indices.

- **Dental fluorosis:** Determine levels of fluorosis in both fluoridated and non-fluoridated communities, the public's perception of dental fluorosis and what level is aesthetically acceptable, fluorosis to be included as an outcome measure in any prospective study into water fluoridation.
- **Potential negative health outcomes:** Does bio-availability of fluoride from artificial and natural sources affect health differently, the relation between hip fractures and long-term consumption of artificially fluoridated water, update analysis of UK data on water fluoridation and cancer rates.

#### 2.1.4 Water fluoridation in South Africa

##### a) The history of water fluoridation from 1935-1996

The history of water fluoridation for this period can be categorised into three phases (Moola, 1996).

During **Phase 1 (1935-1968)** the presence of fluorosis in children in high fluoride areas, delineation of areas of endemic fluorosis, levels of fluoride in different areas in South Africa and the observation of dental caries in these areas were reported (Ockerse, 1941; Ockerse, 1942; Ockerse, 1944; Ockerse and Meyer, 1941). This work led to an investigation by the Council for Scientific and Industrial Research (CSIR) into the desirability of water fluoridation, the report of which approved the suggestions to add fluoride to community water supplies as a preventive health measure to reduce dental caries (Staz, 1963).

Towards the end of this phase, in view of the divergence of opinions between those who supported and those with objections to fluoridation of public water supplies, a Commission of Inquiry was appointed by the State President to report on (Republic of South Africa, 1966):

- The maximum exposure to fluoride which was safe for the human body;

- Possible short and long-term beneficial and detrimental effects on the health of human beings of all ages; and
- Safe methods of utilising the possible advantages of the use of fluoride.

The Commission was overwhelmingly in favour of fluoridating the drinking water and the report recommended (Republic of South Africa, 1966):

- Local authorities should be encouraged, advised and assisted to fluoridate the water supplies of their communities as soon as possible;
- Fluoridation schemes should aim to achieve optimal concentration of fluoride in the drinking water for the prevalent climatic conditions;
- Where fluoride was naturally present in public water supplies, adjustment should not exceed the recommendations published in the report;
- Where natural fluoride concentrations exceeded the recommended levels, defluoridation should be considered;
- Consumers should be informed of the best means of obtaining the beneficial effects of fluoride;
- Where supplementation of fluoride in drinking water was practiced, the average concentration should be kept within the upper and lower limits as recommended in the report;
- Regulations should be developed and published to ensure the monitoring and safe and uniform standards were maintained in fluoridation plants;
- Local authorities should be legally authorised to decide whether or not the public water supplies over which they have jurisdiction should be fluoridated.

No action was taken by the then government of the day to implement water fluoridation.

**Phase 2 (1978-1989)** was characterised by a number of reports and symposia (Moola, 1996). A publication on the views of the profession and the Department of Health (Taljaard, 1978) triggered public debate from those opposed to water fluoridation. This prompted a National Symposium on Water Fluoridation which ended inconclusively with no clear mandate to government

to implement water fluoridation (Department of Health, 1979). During this phase considerable research was conducted into the levels of fluoride in drinking water as well as research supported by the MRC on alternative sources of fluoride (Dreyer and Grobler, 1984; Grobler and Dreyer, 1988; Grobler et al., 1994; Grobler, Van Wyk Kotze and Cleymaet, 1991; Janse van Rensburg et al., 1991; Louw and Van Wyk, 1984; Zietsman, 1991).

**Phase 3 (1990-1996)** occurred during major political change in South Africa (Moola, 1996). Water fluoridation was discussed at the National Medical and Dental Association (NAMDA) and the MRC organised another symposium (Medical Research Council, 1991; National Medical and Dental Association, 1990). The National Health Plan of the African National Congress (ANC) included water fluoridation as a PHC measure (African National Congress, 1994a). In 1995 the Oral Health Committee, appointed by the Ministry of Health, recommended that government implement water fluoridation as part of its Reconstruction and Development Programme (African National Congress, 1994b). Subsequent to this the Oral Health Committee set up a Subcommittee on Water Fluoridation to oversee the implementation of water fluoridation. This committee was renamed the National Fluoridation Committee (NFC) shortly after.

Towards the end of this phase, a number of journal articles reported on the effectiveness of water fluoridation in South Africa (Du Plessis, 1995; Du Plessis et al., 1996; Du Plessis et al., 1995). Children from the black and white population groups on the Free State Goldfields (0.54 ppm fluoride) showed respective caries reductions of 85% and 31% when compared to children in the coastal areas (<0.01 ppm fluoride). From this study it was concluded that an acceptable level of fluoride in public water supplies on the Free State Goldfields should not exceed 0.7 ppm. As part of a severe drought in the coastal city of Port Elizabeth (<0.1 ppm fluoride), water from the Orange/Fish/Sundays River schemes was transferred to this city. This water has a natural fluoride concentration of on average 0.62 ppm. A study investigated caries prevalence in children receiving the high fluoride water compared to the low fluoride water 16 months after this change was made.

No statistically significant difference could be indicated for the primary dentition. In the permanent dentition, 12- and 15-year-old children consuming the higher fluoride concentration water respectively had 14% and 7.8% less caries compared to the lower fluoride group.

**b) The history of water fluoridation from 1996**

One of the main objectives of the NFC of the Department of Health was to draft regulations for the fluoridation of water supplies. On 8 September 2000 the Minister of Health approved these regulations as part of Health Act No. 63 of 1977. These regulations were published in the Government Gazette (Republic of South Africa, 2000) and compelled every water supplier to initiate fluoridation unless exempted thereof, in writing by the Director General: Health.

An advisory committee to the NFC, called the Joint Fluoridation Implementation Committee (JFIC), was formed in 2002 consisting of members from the South African Association of Water Utilities (SAAWU), South African Local Government Association (SALGA), Department of Health and the Department of Water Affairs and Forestry. The JFIC was chaired by the CEO of the Water Research Commission. The JFIC drafted criteria for the identification of “front runner sites” for the safe implementation of water fluoridation (Smit, 2007). Cape Town, Port Elizabeth, East London and Durban, (coastal areas) were identified as potential front runner sites (Department of Health, 2003a).

A new Health Act (Act No. 61 of 2003) for South Africa (Republic of South Africa, 2003) necessitated an amendment to the regulations on fluoridating water supplies, since the previous regulations were repealed with the repealing of the Health Act of 1977. SAAWU and SALGA also demanded a change to the regulations as certain legal and technical aspects in the original regulations had to be amended. They furthermore complained that the regulations were an unfunded mandate and that that they did not have the funds to implement water fluoridation. The regulations have now been

amended and will follow the normal legal process of consultation through the invitation of comments, including via the Government Gazette. The NFC will consider inputs received, where after the regulations will be submitted to the Minister of Health for promulgation (Smit, 2007).

**c) Attitudes to water fluoridation in South Africa**

A National Fluoridation Survey was conducted in 1998 prior to the publication of the Regulations on Fluoridating Water Supplies. The findings were presented in three parts (Chikte and Brand, 1999; Chikte and Brand, 2000; Chikte et al., 2000).

This survey found that 25.6% of the population surveyed had heard or read about fluoridation, 65.6% had not, with 8.9% unsure. In terms of racial classification 62.6% of the white population group had heard about fluoridation, whilst 72.2% of the black population group had not. The highest percentage of respondents who had heard about fluoridation resided in the Western Cape (46.3%), the highest no response (82.8%) was found in North West province.

The electronic media were the most dominant source of information (40%), followed by the print media (27%). More than a third of respondents (36%) could identify the purpose of water fluoridation correctly, 28% believed it to purify water, 29% were unsure.

The majority of respondents (61.9%) agreed that fluoride should be added to water, 9% disagreed with the remaining 29.1% unsure. The main reasons for a support vote was given as prevention of tooth decay (30%) and affecting health positively (30.6%), whilst the main reasons for a negative response was that water should stay as it is (26.1%), it will create bigger problems as it remains in the water (15.6%) and it affects health negatively (12.3%). The majority of respondents who were uncertain of adding fluoride to water could not provide a reason (90%).

As was expected a strong relationship was found between educational level and knowledge of and attitude towards fluoride with 59% of respondents in the highest educational group having heard or read about fluoridation. Similar trends were found related to income (70%) and occupation (68% of professional/executive).

When compared to previous similar studies (Chikte, 1997; Gilbert and Chikte, 1993), this study concluded that support for water fluoridation has increased. Educational programmes on water fluoridation should be aimed at lower educational and income groups with the electronic media as the vehicle of choice. A small resistant, yet influential, group existed which opposed fluoridation. Especially in South Africa, water fluoridation is needed to address inequalities in oral health and based on these results health authorities and policy makers should proceed with its implementation.

### **2.1.5 The economics of water fluoridation**

Costing water fluoridation and its benefits is a complex process looked upon differently by city councils, proponents of fluoridation, dental practitioners and even those opposed to fluoridation (Burt and Eklund, 2005). In general per capita cost of fluoridation is affected by the size of the community, number of fluoride injection points, amount and type of equipment required, amount and type of fluoride chemical as well as its transport and storage, training and expertise of personnel required to run the plant.

Although the actual cost of water fluoridation cannot and should not be ignored, estimates of saving in treatment cost may be more important than per capita cost. Health economists at the conclusion of a 1989 workshop in Michigan concluded that water fluoridation was one of a few public health measures where it actually saved more money than it cost to operate (Anonymous, 1989).



Benefits from fluoridation can be expressed in several ways (Davies, 1974):

- Saving in the cost of dental treatment based on the reduction in number of restorations and extractions;
- Saving in the oral health worker's working time or salary as a result of the reduction in treatment required; and
- Less pain and discomfort and a reduction in loss of time from school and industry. This is difficult to express in monetary terms.

Cost- effectiveness and cost-benefit analysis in relation to dental procedures are defined as follows (Horowitz and Heifetz, 1979):

- Cost-effectiveness analysis (CEA) is expressed as the cost per person per year to save 1 DMFT; and
- Cost-benefit analysis (CBA) is expressed as the cost of implementing the procedure divided by the savings in the cost of treatment.

CEA and CBA frequently overlap and are sometimes difficult to distinguish. Where CBA is used to make broad decisions about competing programmes, CEA assists in choosing among alternative programmes to achieve the same outcome, for example as defined by Horowitz and Heifetz (1979) to save 1 DMFT. While costs can usually be accurately assessed with CBA, it has the disadvantage that the benefit to an individual's freedom from pain, discomfort or inconvenience cannot be reliably established in monetary terms. CEA is therefore the less complicated technique (Fédération Dentaire Internationale, 1981).

Saving in the costs of dental treatment, working time and CBA for the fluoridation studies conducted in Hastings (New Zealand), Newburgh (USA), Watford (United Kingdom), Tiel (Netherlands) and Basel (Switzerland) are shown in Table 2. It should be noted that cost-benefit ratios vary because of differences in cost of dental treatment between countries, in all cases however the value of the benefits substantially exceeded the cost of implementation (Davies, 1974).



**Table 2: Savings in cost of dental treatment, working time and cost-benefit analysis for water fluoridation studies in five countries (Davies, 1974)**

| Study (country)                 | Savings in cost of dental treatment per child                  | Savings in working time                         | Cost-benefit analysis                                                              |
|---------------------------------|----------------------------------------------------------------|-------------------------------------------------|------------------------------------------------------------------------------------|
| Hastings (1965) (New Zealand)   | NZ\$1.79 (2.5-13.5-year-olds)<br>NZ\$ 5.72 (13.5-15-year-olds) | 0.65 whole-time dental nurse per 1,000 children | NZ\$4.4 saved for every NZ\$ spent on water fluoridation                           |
| Newburgh (1966/70) (USA)        | US\$4.81-8.17 (5-year-olds)<br>US\$1.99-9.40 (6-year-olds)     | 16.7 minutes per child per year                 | US\$4.1 saved for every US\$ spent on water fluoridation                           |
| Watford (1962) (United Kingdom) | £1.62 (age 3) to £4.32 (ages 6-7)                              | Not available                                   | £2.5 saved for every £ spent on water fluoridation                                 |
| Tiel (1972) (Netherlands)       | 26 Dutch Guilder (age 7) to 229 Dutch Guilder (age 15)         | Not available                                   | 10 Dutch Guilder saved for every Dutch Guilder spent on water fluoridation (age 7) |
| Basel (1967) (Switzerland)      | 90.75 Swiss Francs over 5 years                                | 70% in dentist man-hours over 5 years           | 4.4 Swiss Francs saved for every Swiss Franc spent on water fluoridation           |

A decrease in caries prevalence is reported from both fluoridated and non-fluoridated communities. Especially where limited resources is an issue, the continued adjustment of water fluoride levels in public water sources should be investigated in terms of the economic outcomes of the investment (White et al., 1989).

Cost estimates of water fluoridation should include the following (White et al., 1989):

- To initiate a new fluoridation program, costs for a referendum and associated campaigns should be included, although this is a once off activity only;
- The number of employee hours required to adjust the level of fluoride, maintain equipment and to monitor fluoride levels linked to the hourly wage rate or salary for these employees;
- Choice of chemical, cost per unit, amount of chemical needed per year and the cost of transporting these chemicals;
- Equipment needed, expected annual maintenance costs, expected length of time this equipment can be used and the replacement cost;

- Opportunity cost of purchasing equipment (and not other things) as well as depreciation costs as the equipment loses value over time;
- Overhead costs such as electricity, rent, insurance, shared space costs, etc.;
- Cost of testing equipment to measure compliance, expected length of time this equipment can be used and the replacement cost;
- Amount of natural fluoride in water affects both cost and consequences of the fluoridation programme;
- Temperature of the region affects water consumption which will impact on cost as more or less chemical will be needed;
- Number of injection sites required for fluoridation; and
- Cost of installation and consulting engineers' fees.

In a study of 44 fluoridated Florida communities it was estimated that per capita costs ranged from US \$0.31 (communities more than 50,000 residents) to US \$2.12 (communities less than 10,000 residents) and was still regarded as the most cost-effective in terms of cost per saved tooth surface (Ringelberg et al., 1992). An economic analysis in the United States estimated that the prevention of dental caries, largely attributed to fluoridation and fluoride-containing products, led to a saving of \$39 billion in dental care expenditures from 1979 to 1989 (Brown, Beazoglou and Heffley, 1994).

A more recent study in the USA to determine if the reduction in cost of restorative care due to averted disease still exceeded the program cost of water fluoridation in a time where caries reductions were observed in both fluoridated and non-fluoridated communities, came to the conclusion that water fluoridation was still cost saving with the exception of communities with less than 5,000 residents (Griffin, Jones and Tomar, 2001).

A similar study conducted in New Zealand (Wright et al., 2001) still regarded water fluoridation as cost-saving for communities for 1,000 residents or above and was also higher for lower socio-economic communities and a high

proportion of children. This study also indicated that the break-even point for five fluoride injection points, was a community of 10,000 residents.

A UK study expressed the benefits of water fluoridation projects in the context of population sizes of 60,000, 120,000 and 600, 000 (Birch, 1990). For these communities the ratio of cost to benefit implies that the fluoridation programme would reduce dental caries at an average cost of £4.80 per dmft per person per year avoided for a population of 60,000, £3.07 for a population of 120,000 and £1.60 for a population of 600,000 in high caries areas. In low caries areas the discounted costs were £19.46, £12.44 and £6.49 respectively for population sizes of 60,000, 120,000 and 600,000. This study concludes that with all things being equal, caries reduction as a result of water fluoridation would cost four times as much in a low caries area compared to a high caries area, suggesting that considerable economies of scale exist in terms of the reduction in cost per unit of benefit as population size increases.

Although population sizes as low as 1,000 have traditionally been considered as unfavourable for the introduction of water fluoridation, technological advances are resulting in new and more cost-effective options in its delivery. An Australian study reported on the feasibility, costs of installation and operation of fluoridation units over two years in two remote Indigenous communities in the Northern Territory of Australia (Ehsani and Bailie, 2007). These communities had populations of 2,000 and 1,300 respectively at the time of the study. Several technical, operational and policy issues were identified which need to be addressed. Capital cost for each of the two fluoridation plants was estimated to be US\$130,000, with annual operational and maintenance cost of about US\$11,800. The authors concluded that this investment should lead to a substantial and significant improvement in oral health of remote Indigenous Australian communities in the medium to long run.

Based on previous studies (Davies, 1973; Doessel, 1985; Ringelberg et al., 1992), an economic model for the implementation of water fluoridation for Gauteng, South Africa was developed (Smalberger, 1998). This model took into account:

- **Factors which modify input variables:**

- Natural fluoride content
- Rainfall
- Pollution
- Labour action
- Remuneration
- Exchange rates
- Inflation
- Population size and growth
- Health profile

- **Input variables:**

- Opportunity costs
- Cost of water
- Chemical cost
- Capital cost
- Financing

- **Process variables:**

- Labour cost
- Expertise
- Maintenance
- Financing

- **Output variables:**

- Per capita cost
- Saving per person
- Cost-effectiveness

The output variables for Gauteng as found in this study were (Smalberger, 1998):

- Per capita cost: R0.11 – R2.40
- Saving per person: Estimated 55% caries reduction: R25.86 – R61.36  
Estimated 35% caries reduction: R16.41 – R38.15  
Estimated 25% caries reduction: R11.70 – R26.60

In another South African study a computerised simulation model, based on the studies by White et al. (1989) and Ringelberg et al. (1992), was developed to report on cost-effectiveness and cost-benefit (Horowitz and Heifetz, 1979) of water fluoridation for Gauteng (Van Wyk et al., 2001). The results of this study for adjusting the fluoride level to 0.7 ppm are summarised in Table 3.

**Table 3: Cost evaluation of the implementation of water fluoridation in Gauteng (Van Wyk et al., 2001)**

| <b>Total annual cost</b>                                                                                    |                                                                                    |                |
|-------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|----------------|
| A. Chemical cost per year                                                                                   | Sodium silicofluoride                                                              | R2,744,727.72  |
| B. Labour cost                                                                                              | 6 operators/1 hour per day                                                         | R38,824.40     |
| C. Capital cost                                                                                             |                                                                                    | R14,000,000.00 |
| D. Maintenance cost                                                                                         | 2.4% of capital cost                                                               | R366,000.00    |
| E. Opportunity cost                                                                                         | 13.5% of capital cost                                                              | R1,890,000.00  |
| F. Capital depreciation                                                                                     | Buildings: over 15 years<br>Mechanical/electrical/Instrumentation:<br>over 8 years | R1,578,839.04  |
| G. Operating cost                                                                                           | A + B + D                                                                          | R3,119,552.12  |
| H. Total cost                                                                                               | E + F + G                                                                          | R6,588,391.16  |
| <b>Cost-effectiveness and cost-benefit analysis</b>                                                         |                                                                                    |                |
| Total population for Gauteng                                                                                |                                                                                    | 9,000,000      |
| Cost per person per year for total population                                                               |                                                                                    | R0.73          |
| Cost per person per year younger than 15 years                                                              |                                                                                    | R2.93          |
| Cost-effectiveness analysis (cost per person per year to save 1 DMFT)                                       | Estimated 50% caries reduction                                                     | R3.95          |
|                                                                                                             | Estimated 30% caries reduction                                                     | R6.58          |
|                                                                                                             | Estimated 10% caries reduction                                                     | R19.73         |
| Cost-benefit analysis (cost of implementation of water fluoridation divided by saving in cost of treatment) | Estimated 50% caries reduction                                                     | 0.04           |
|                                                                                                             | Estimated 30% caries reduction                                                     | 0.07           |
|                                                                                                             | Estimated 10% caries reduction                                                     | 0.22           |

Results of this study indicated that even at caries reductions of 10% and 30%, it would still be cost-effective and of benefit to implement water fluoridation for Gauteng. It recommended that water fluoridation should not be considered if the cost-benefit ratio approached, equalled or exceeded one (Van Wyk et al., 2001).

## 2.2 Human resources planning

### 2.2.1 Brief overview

Demands for health care is increasing rapidly in virtually all countries due to population growth, rising social expectations, socio-economic development, advances in health technology and a shift in patterns of disease from acute to chronic illnesses. Human resources is one of the critical elements needed for the provision of health care to all citizens of any country and consume a significant portion of the total health expenditure. A lack of human resources is therefore one of the most obvious constraints in any health service.

Human resources planning can be defined as “the process of estimating the number of persons and the kind of knowledge, skills and attitudes they need to achieve predetermined health targets and ultimately health status objectives” (Mejía and Fülöp, 1978).

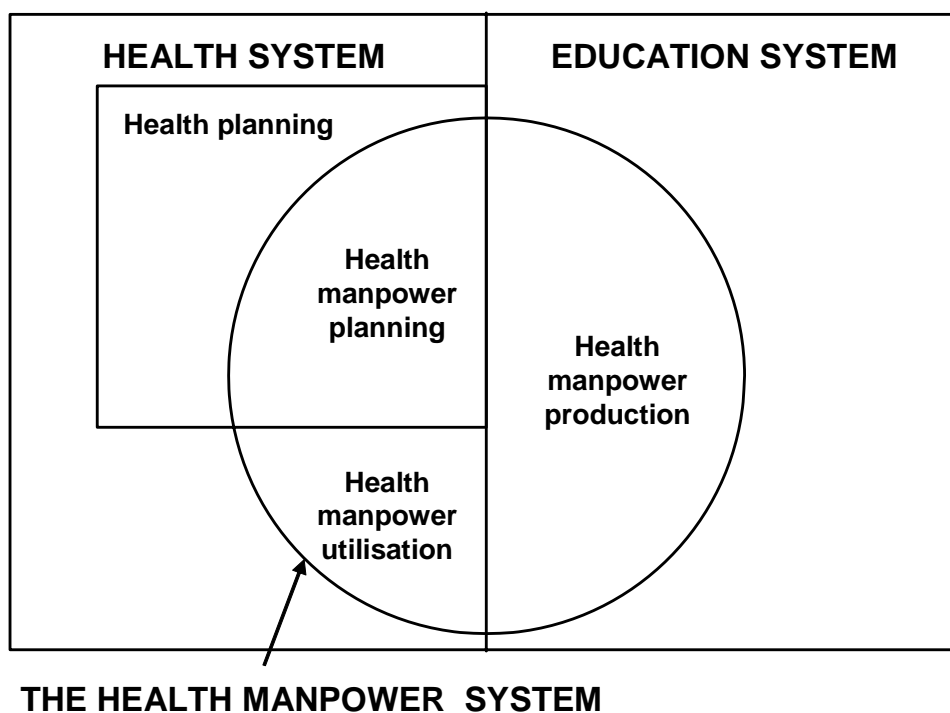
Human resources cannot be improvised and the three components of the development process (planning, production and management), must be brought into closer and more functional relationships with each other and with developments in the health services themselves (Mejía and Fülöp, 1978).

These three components involve the following (Van Wyk, 1996):

- **Planning:** The end result should be to develop and implement a human resources plan that will fulfil the needs and demands of the health services. This process is dynamic and feedback mechanisms are required to be able to make changes to it.

- **Production:** Involves the training and education of the workforce. It is controlled by both the health and educational sectors which necessitates coordination to ensure that the needs and demands of the public are met.
- **Management:** Involves employment, utilisation and motivation of all categories of health workers and determines the productivity of the health system and ability to retain its workforce.

The interaction between these three components is illustrated in Figure 1 (Mejía and Fülöp, 1978).



**Figure 1: The health manpower system (Mejía and Fülöp, 1978)**

Any human resources model should take into account the influences of a number of other systems (Mejía, 1978):

- The political system: through formal legislative and executive procedures and informal political influence of individuals and organisations;
- The education system: the manner in which human resources for health are produced and utilised;
- Professional bodies: exerts influence by control over licensing, curricula, career structures, income by way of fee structures and standards of practice;

- Health service agencies: regard themselves as qualified to determine population needs and demands; and
- Health services consumers.

### 2.2.2 Approaches to human resources planning

Human resources planning is influenced by a number of factors (Hall, 1978):

- Demographic: Size, distribution, density, growth rate, age structure, gender ratio with population size and distribution being regarded as the most important;
- Economic: Driven by supply and demand based on disposable income and demand for services;
- Social and cultural: These may influence the degree to which the public is aware of the availability of health services and the value placed on obtaining it;
- Health status of the population;
- Accessibility to health services;
- Resource availability; and
- Health care technology.

When applied to human resources planning, need and demand can be defined as follows (Hall, 1978):

- Need: An estimation based on professional judgement and current medical technology of the number of workers or amount of services necessary to provide an optimum standard of health care.
- Demand: The sum of the amounts of the various types of health services that the population of a given area will seek and has the means to purchase at the prevailing prices within a given time period.

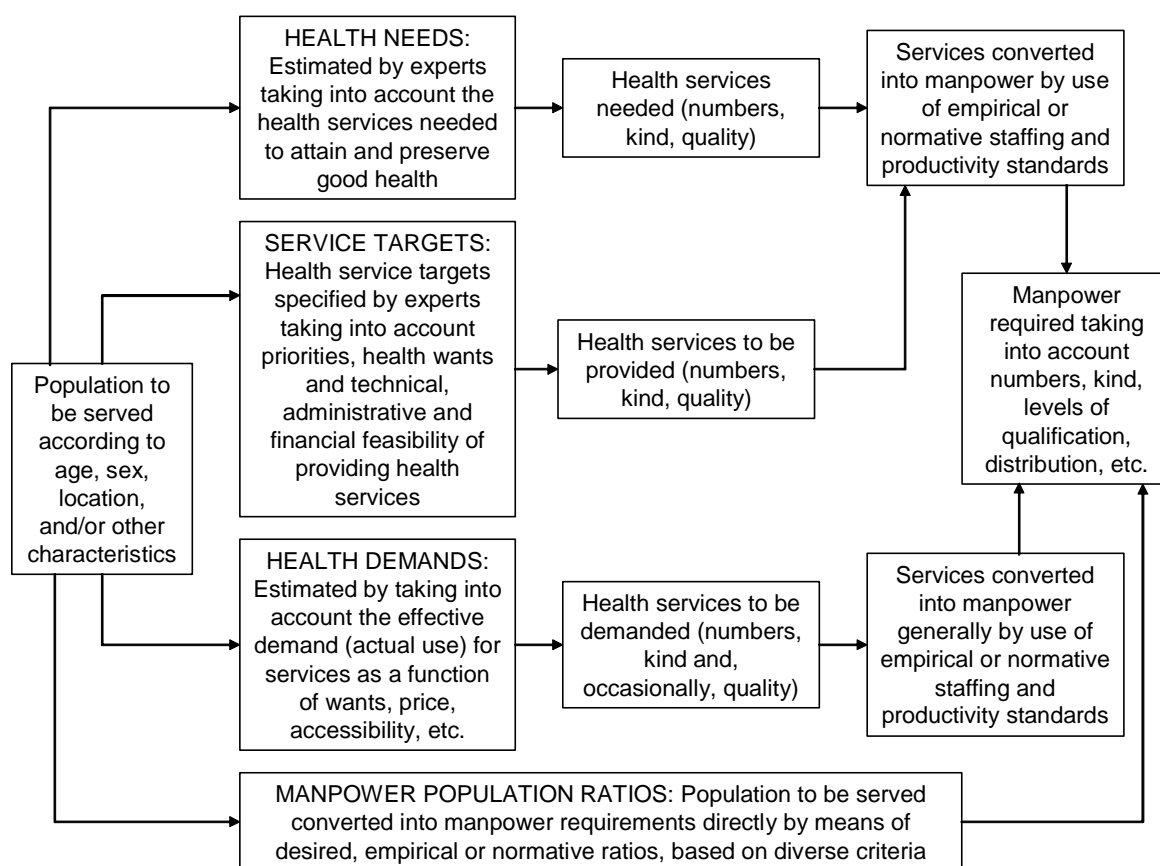
Based on these definitions of need and demand, four methods for estimating human resources have been described (Hall, 1978):

- Human resources to population ratio approach;
- Health needs approach;



- Health demands approach; and
- Service targets approach.

The health needs, service targets and health demands approaches convert people into the health services that they desire which are then converted into human resources. The human resources to population approach converts people directly into human resources (Hall, 1978). The main differences between these approaches are presented in Figure 2.



**Figure 2: Schematic representation of the four approaches to human resources planning (Hall, 1978)**

**a) Human resource to population ratio approach**

This method is very simple, low cost and easy to interpret and requires (Hall, 1978):

- Projected population;
- Number of human resources present; and

- A desired human resources to population ratio.

**b) Health needs approach**

This approach is normative and based on the perception that health professionals are best equipped to determine the health needs of a population. This approach requires (Hall, 1978):

- Disease-specific mortality and morbidity rates;
- Norms and standards which affect the number, kind, frequency and quality of services to be provided;
- Staffing norms to convert the various services required into the amount of time needed for each category of health worker to provide the service;
- Total personnel hours needed in a target year for the projected population; and
- The average number of hours worked annually per person.

**c) Health demands approach**

This approach is based on projections of health services that users are willing to pay or ask for, regardless of their need for these services (Bui Dang Ha Doan, 1981). This is determined by factors such as disposable income, costs of services, access to services, level of education and membership of medical aid schemes. This approach is more predictive than normative and this approach requires (Hall, 1978):

- Observation and quantification of present demand;
- Projection of demand for an entire year; and
- Change of demand for services into demand for personnel.

**d) Service targets approach**

This approach involves the setting of targets for the production and delivery of specific health services and then converting these into human resources requirements by means of staffing and productivity standards. Is normative and many regard it as micro-analytical since it considers each of the various

components of the health sector separately with a primary focus on provision of services. It attempts to strike a balance between needs and wants of the population, available technology and what can be delivered. This approach requires (Hall, 1978):

- Targets for production and delivery of services;
- A description of the planned services;
- Calculation of the sum of services required;
- Types and mix of human resources needed to deliver the service; and
- Consideration of productivity.

The main advantages, disadvantages and indications of each of these methods is summarised in Table 4 (Hall, 1978; Kisson-Singh, 2001).

**Table 4: Summary of advantages, disadvantages and indications of the four approaches to human resources planning (Hall, 1978; Kisson-Singh, 2001)**

|                                        | Advantages                                                                                                                                                                                                                                                                                                                                                                                                                                    | Disadvantages                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Indications                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Human resources to population approach | <ul style="list-style-type: none"> <li>- Easy to use and interpret to others</li> <li>- Requires modest data</li> <li>- If current health situation is adequate, it can be used to justify the <i>status quo</i></li> <li>- Useful to provide baseline projections for different kinds of human resources required</li> <li>- Can be a useful short to medium term planning instrument if used together with a more precise method</li> </ul> | <ul style="list-style-type: none"> <li>- Easy to select unrealistic ratios</li> <li>- Generally used with single occupational categories only</li> <li>- Relatively difficult to estimate cost</li> <li>- Will inevitably show a human resources shortage</li> <li>- Overlooks the relevance of demand</li> <li>- Does not address productivity, distribution, utilisation and relevance of services</li> <li>- Fails to recognise accessibility of services to the population</li> <li>- Adequate ratios do not automatically provide good health</li> </ul> | <ul style="list-style-type: none"> <li>- Countries with fairly satisfactory health status and adequate health systems</li> <li>- A stable health sector</li> <li>- Limited planning resources</li> <li>- Either an active or passive approach to health services</li> <li>- Either public or private sector dominance</li> <li>- Applicable where fairly similar international models have been used</li> </ul> |

**Table 4: (continued)**

|                         | <b>Advantages</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Disadvantages</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Indications</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Health needs approach   | <ul style="list-style-type: none"> <li>- Easy to understand, based on scientific knowledge, logical and workable</li> <li>- Ethical to consumers since it is based on services to entire population</li> <li>- Emphasis is on production of services, not human resources</li> <li>- Encourages evaluation of health technology</li> <li>- Encourages allocation of resources where needed most</li> <li>- Useful in design of educational programmes</li> <li>- Promotes concern about quality of care</li> <li>- Facilitates cost estimation</li> <li>- Facilitates health team planning</li> </ul> | <ul style="list-style-type: none"> <li>- Costly and requires extensive and detailed data</li> <li>- Does not consider cultural, economical and other barriers that will prevent need being converted to demand</li> <li>- May encourage detailed planning</li> <li>- Setting of standards complicated by a possible lack of consensus</li> <li>- Gives little attention to alternatives</li> <li>- Likely to result in requirements in excess of country's ability to provide them</li> <li>- Based on physician's model for health services delivery which are mainly curative</li> </ul>                                                                                                                                               | <ul style="list-style-type: none"> <li>- Countries with sophisticated data systems, survey capabilities and planning expertise</li> <li>- An adequate health services delivery system is required</li> <li>- Active government policy required</li> <li>- Dominant public sector with control over human resources and services</li> <li>- Elevated awareness of public health matters</li> <li>- Applicable where prevention, promotion and specific health programmes are in place</li> </ul> |
| Health demands approach | <ul style="list-style-type: none"> <li>- Facilitates understanding of demand</li> <li>- Allows for separate consideration of different components</li> <li>- Produces economically realistic projections</li> <li>- Results in a good estimate of minimum growth in demand likely to occur</li> <li>- Some variants of this approach are simple</li> <li>- Provides useful information for comparing economic returns with those in other fields</li> <li>- Identifies and quantifies market forces which affect consumers and suppliers</li> <li>- Applicable in a fee-for-service system</li> </ul> | <ul style="list-style-type: none"> <li>- Some variants require sophisticated data and can be complicated and costly</li> <li>- May neglect political and societal reasons for health services distribution and delivery</li> <li>- Does not take into account quality of services or their relevance</li> <li>- May neglect ways to improve productivity</li> <li>- May be difficult to explain rationale and results to authorities and public</li> <li>- Often arduous to collect reliable data from the private sector</li> <li>- May enhance or continue inequalities in access to care</li> <li>- Changes within the health services could alter projections of demand</li> <li>- Cannot assess changes in health status</li> </ul> | <ul style="list-style-type: none"> <li>- Dominant private sector</li> <li>- Passive government attitude towards service delivery</li> <li>- Where health care system provided equally for all sectors</li> <li>- Promotes allocation of human resources to entire health team</li> <li>- Relatively minor imbalances in delivery of services to different segments of the population</li> </ul>                                                                                                 |

**Table 4: (continued)**

|                          | <b>Advantages</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Disadvantages</b>                                                                                                                                                                                                                                                                                                              | <b>Indications</b>                                                                                                                                                                                                                                   |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Service targets approach | <ul style="list-style-type: none"> <li>- Various components of demand are separated with most suitable method chosen for each</li> <li>- Facilitates study of productivity, utilisation, staffing ratios</li> <li>- Emphasis on production of services, not human resources</li> <li>- Simple to explain and easy to interpret</li> <li>- Cost estimation is simpler</li> <li>- Readily usable with other planning methods</li> <li>- Facilitates planning for the total health team</li> <li>- Facilitates demand model revision when data is updated</li> <li>- Requires modest data and planning capabilities</li> </ul> | <ul style="list-style-type: none"> <li>- Standards set more on what people perceive is needed rather than reality</li> <li>- Assumes the utilisation of services</li> <li>- Restricted where poor government regulation and control over health services exists</li> <li>- May encourage excessively detailed planning</li> </ul> | <ul style="list-style-type: none"> <li>- Dominant public sector with control over human resources and service</li> <li>- Active government role required</li> <li>- More useful in prevention, but can also be used for curative services</li> </ul> |

### **2.2.3 World Health Organization/Fédération Dentaire Internationale planning model**

In 1970 the WHO took a leading role in planning health services and more specifically human resources when a Scientific Group on the Development of Studies on Health Manpower was established with the request to review development and methods of health manpower studies and to recommend future lines of research to WHO. One of the recommendations of the Scientific Group was that WHO should promote health manpower planning in member states (World Health Organization, 1971).

A WHO Expert Committee report identified five steps of planning a public dental health services which served as basis for future WHO planning models (World Health Organization, 1976). These steps are:

- Situation analysis;
- Problem identification and formulation of objectives;
- Formulation and analysis of alternative strategies;

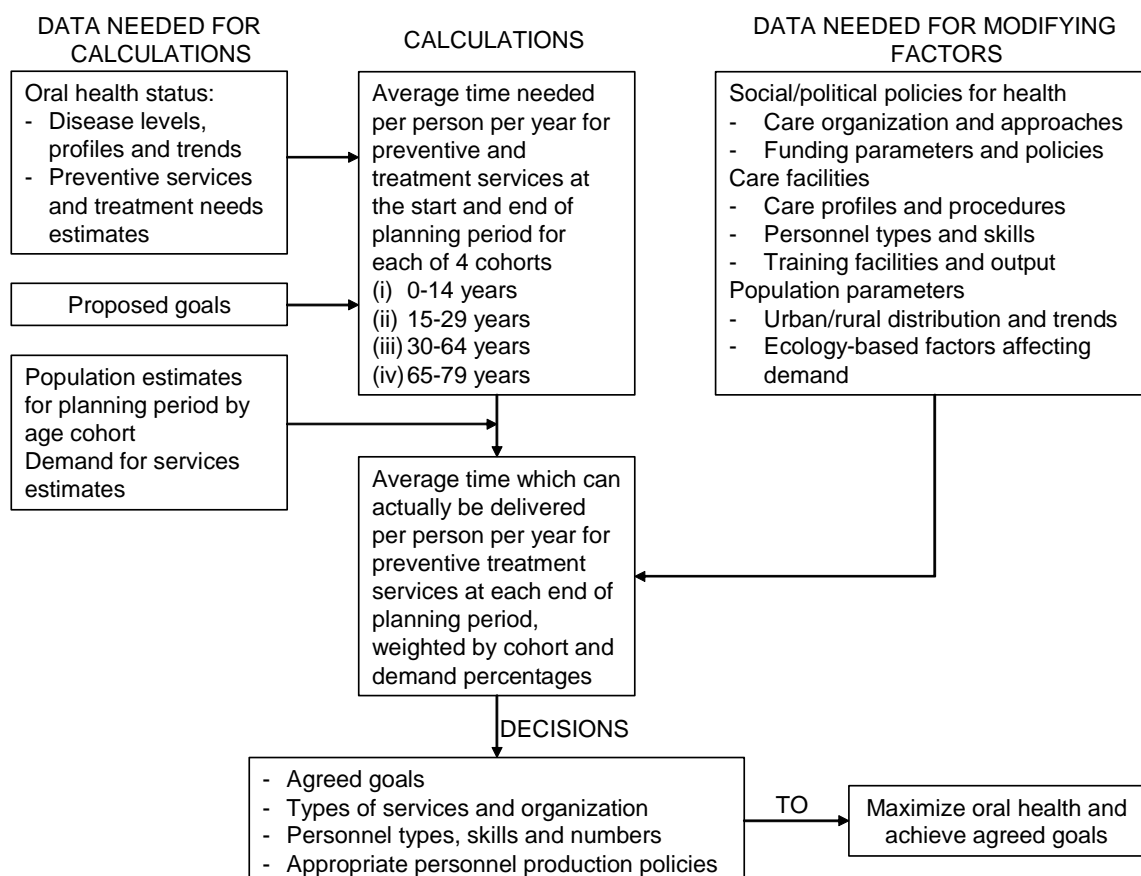
- Strategy selection; and
- Programme formulation.

Following on this the WHO publication “Planning Oral Health Services” was aimed at the more practical aspects of planning taking into account resources, including human resources. It recognises manpower production goals as an integral part of the planning process where the human resources are divided into professionals (dentists, stomatologists), operating auxiliaries (dental therapists, dental hygienists), non-operating auxiliaries (dental assistants, dental technicians) and other supporting staff (health auxiliaries, teachers, parents). It also recognised the setting of goals based on existing resources and identified five options of care from “Type 1”, where a minimal service is rendered every five years, to “Type 5”, where services are based on a six monthly recall (World Health Organization, 1980).

The acceptance of the concepts and approaches of “Health for All by 2000” through PHC led to a joint WHO/FDI publication describing a human resources model based on the needs and demands of a population and placing a much bigger emphasis on prevention and control of disease, maintenance of health and high quality restorative care. Figure 3 illustrates a planning flow chart of this model (World Health Organization/Fédération Dentaire Internationale, 1989).

This model translates need into full-time equivalents (FTE) of oral health human resources required to provide a calculated level of care. The model makes provision for modifying factors. Recommendations for time estimates are based on the prevailing conditions in a country. Variables in the model can be altered to suit the situation of that country. Limitations of this model include (Kissoon-Singh, 2001) :

- Calculations are made for the general population and do not take into account different communities such as urban, peri-urban and rural;
- The model may over-projects human resources; and
- Model doesn't take into account the capacity of training institutions.



**Figure 3: Flow chart of the WHO/FDI human resources planning model (World Health Organization/Fédération Dentaire Internationale, 1989)**

## 2.2.4 A South African perspective on human resources planning

### a) Historic overview

The historical development of the provision of health services in South Africa since 1652 can be divided into three phases (Van Wyk, 1996):

- **Phase 1: 1652 to 1918:** The first 150 years of this phase was characterised by the establishment of a health service under the influence of the Dutch settlers. The last 100 years commenced with the British occupation of the Cape Colony and was characterised by the expansion, consolidation and control over health services, including registration of health providers.
- **Phase 2: 1918 to the second half of the seventies:** This phase commenced with the unification of the four colonies of South Africa and was characterised by technological advances in health care, the



establishment of a curative approach in health services and public and private sectors of delivering health care to the community. This phase was also characterised by government accepting responsibility for the delivery of health services.

- **Phase 3: Second half of the seventies to 1993:** This phase coincided with the “health for all” era and concluded with the run-up to the first democratic election in South Africa in 1994. During this phase government accepted responsibility for the delivery of certain oral health services. Similar to other countries it was soon realised that resources were not available to deliver all services to the entire population, leading to the development of more cost-effective approaches such as training of auxiliary oral health workers. During this phase the PHC approach and more emphasis on prevention was also adopted with the aim of reducing curative services.

A detailed description of all three phases can be found in Van Wyk (1996). Landmark developments in the delivery of health services and human resources development in South Africa during phases 2 and 3 are summarised in Table 5 (Van Wyk, 1996).

**Table 5: Summary of landmark human resources developments in South Africa from 1910 to 1993 (Van Wyk, 1996)**

| Year        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1919        | Proclamation of “Act on Population Health” (Law 36 of 1919) follows on the influenza epidemic of 1918 and leads to the establishment of a separate Ministry and Department of Health in addition to provincial health administrations                                                                                                                                                                                                                                                                                                                                                                           |
| 1928        | “Act on Doctors, Dentists and Pharmacists” provides for the establishment of a Medical and Dental Board which replaced the four provincial medical boards                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 1942 - 1944 | The National Health Services Commission (Gluckmann Commission) follows on the Great Depression and its findings can be summarised into four main areas:<br>i) Lack of coordination between the seven parties involved in health services delivery<br>ii) A lack of services in general, especially in black rural and urban areas<br>iii) The curative nature and emphasis on profit in the private sector leading to a maldistribution of services<br>iv) Inappropriate emphasis on curative services and priorities<br>The main recommendation was for a national health service – this was never implemented |
| 1962        | Commission of Enquiry into the high cost of medical services and medicines makes 50 recommendations. Three of these are aimed at oral health: <ul style="list-style-type: none"> <li>• Training of auxiliary personnel to address the shortage of dentists</li> <li>• Fixed tariff structure for delivery of services in the private sector</li> <li>• Training of district health nurses in terms of oral health with the purpose to refer</li> </ul>                                                                                                                                                          |



**Table 5: (continued)**

| Year        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1967        | Commission of Enquiry into dental services and training of non-white dentists under chairmanship of Dr J.F. van de Sandt de Villiers. The recommendations formed the backbone of the development and delivery of oral health services over the next 30 years.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 1974        | National Oral Health Policy formulated under the leadership of the first Chief Dentist of the Republic of South Africa, Dr L.T. Taljaard. Approved by Cabinet in 1975 and served as the official oral health policy for the next 15 years. Classifies all services as education, preventive, curative or supplementary and identifies target groups.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 1980, 1986  | Brown Commission of Enquiry into health services emphasises excessive fragmentation of services, lack of central policy, inappropriate allocation of resources, insufficient communication, lack of emphasis on preventive and PHC services, overemphasis on expensive secondary and tertiary services, over regulation of services in the private sector, shortage of certain services (including dentistry), shortage of health workers of the non-white population groups, shortage of statistics on the health services. A separate oral health working group chaired by Prof L.T. Taljaard made recommendations on dentistry to the commission.                                                                                                                                                                                                                                                                                                                                                                                         |
| 1982        | Interdepartmental committee into dental services and training (Venter Committee) made recommendations regarding the future training of dentists, dental therapists and oral hygienists for the white, black, coloured and asian population groups with specific emphasis on employment in the public sector. The human resources to population ratio approach was used in the calculations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 1984        | Committee of Enquiry into facilities for medical and dental training. Builds on the recommendations of the Venter Committee with specific recommendations for each of the dental schools. It also recommends a review of oral health human resources every five years.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 1986        | National Health Plan. Results from the recommendations of the Brown Commission. Places a big emphasis on appropriate resources on each of the six levels of health care delivery.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 1986        | Report of an ad hoc committee of Federal Council of the Dental Association of South Africa emphasises appropriate intake of students of all population groups, defining the future role of the dental therapist, expansion of services for the oral hygienist, creation of oral health educators, expansion of public oral health services.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 1988 - 1991 | Committee of Dental Deans 2020 Seminars. Three seminars were held culminating in a report after the 1991 seminar which recommended: <ul style="list-style-type: none"> <li>• Emphasis on the 15-year-old age group in terms of prevention, pain relief and 1- to 2-surface restorations</li> <li>• Oral health workforce consisting of oral health educator, dental assistant, oral hygienist, dental therapist, dentist, dental specialist, dental technician – minimum training requirements were formulated for each</li> <li>• Reduction of dentists, increase in dental auxiliaries and closer monitoring within the public and private sectors</li> <li>• Job descriptions for each category of oral health worker</li> <li>• Consideration of a “denturist” for the provision of dentures (to practice independently)</li> <li>• Training of community health workers for extractions and procedures to relieve pain and sepsis</li> <li>• Compulsory community service provided adequate facilities and posts are created</li> </ul> |

Most commissions and committees during phases 2 and 3 commented on the fragmentation of services as well as lack of adequate preventive services. The majority of reports concluded that oral hygienists are mostly employed in the private sector and that dental therapists and dentists placed a too large emphasis on curative services (Van Wyk, 1996).

In summary, the history of health services and human resources planning in South Africa can be considered against the three components of the human resources development process. Although production of oral health human resources commenced in 1927 with the establishment of a dental school at the University of the Witwatersrand, little planning for oral health related human resources was done until the 1970s (Van Wyk, 1996).

It is clear from the available literature that despite several committees and commissions reporting on oral health, very few have been taken seriously and only a limited number of recommendations have been implemented.

#### **b) Human resources studies, reports and publications since 1994**

After a 1992 referendum effectively brought about an end to “apartheid”, citizens of all races took part in the first democratic elections in 1994. Since then several postgraduate studies and reports into human resources for the new South Africa have been published. These are briefly summarised below.

- **Booyens (1994)**

The purpose of this study was to determine human resources needed for delivering primary preventive services by using needs as determined by the 1988-89 NOHS, slightly modified by demand from the same survey (Department of Health, 1994). A modified version of the WHO/FDI human resources model was used for the calculations (World Health Organization/Fédération Dentaire Internationale, 1989).

Since oral health status varies between the different population groups, separate calculations were done based on the WHO variables for an

industrialised country with stable caries for the white population group, a developing country with increasing caries for the black, asian and coloured population groups (Scenario I) and an industrialised country with stable caries for all population groups (Scenario II), both assuming a 1,750 hour working year per operator. Results are summarised in Table 6 (Booyens, 1994; Booyens, 1996).

This study concluded that the need for oral health personnel was not in line with the human resources available at the time of the study based on registration with the South African Medical and Dental Council (SAMDC).

**Table 6: Human resources required for the delivery of oral health services in South Africa based on the WHO/FDI model (Booyens, 1996)**

| Population group                                                                                                        | Scenario I *       | Scenario II **                      |
|-------------------------------------------------------------------------------------------------------------------------|--------------------|-------------------------------------|
| White                                                                                                                   | 1,860              | 1,860                               |
| Black                                                                                                                   | 4,094              | 4,594                               |
| Asian                                                                                                                   | 196                | 225                                 |
| Coloureds                                                                                                               | 550                | 583                                 |
| <b>Total</b>                                                                                                            | <b>6,700</b>       | <b>7,262</b>                        |
| * Highly industrialised country, stable caries (white) / developing country, increasing caries (black, asian, coloured) |                    |                                     |
| ** Highly industrialised country, stable caries (all population groups)                                                 |                    |                                     |
| <b>Suggested percentage distribution of oral health personnel needed for South Africa</b>                               |                    |                                     |
|                                                                                                                         | <b>Suggested %</b> | <b>Registered with SAMDC (1992)</b> |
| Specialists                                                                                                             | 6 – 8%             | 6%                                  |
| Dentists                                                                                                                | 21 – 24%           | 77%                                 |
| Dental Therapists                                                                                                       | 22 – 27%           | 3%                                  |
| Oral Hygienists                                                                                                         | 42 – 49%           | 14%                                 |

- **Van Wyk (1996)**

The purpose of this study was to determine human resources needed based on the principles of supply and demand taking into consideration modifying factors, treatment needs and trends. Demand data was obtained from the 1988-89 NOHS (Department of Health, 1994).

Based on this study, 5,594 oral health personnel would be needed in 2011 to address demand for oral health services. Based on personnel and attrition rates, between 2,482 and 2,923 oral health personnel have to

be trained between 2000 and 2011, an average of between 207 and 244 per year, to address the demands as reflected in the 1988/89 NOHS (Van Wyk, 1996).

The need for oral health personnel by 2011 as found in this study is summarised in Table 7 (Van Wyk, 1996).

**Table 7: The need for oral health personnel in South Africa by 2011 (Van Wyk, 1996)**

|                                           | Needed by 2011 | Training per year (2000-2011) |
|-------------------------------------------|----------------|-------------------------------|
| Dentists                                  | 3,337          | 29 – 66                       |
| Dental therapists                         | 2,515          | 160 – 170                     |
| Oral hygienists                           | 1,040 – 1,267  | 16 – 30                       |
| Dental technicians                        | 1,001          | 15                            |
| Dental assistants/oral health educators * | 4,982          | 294                           |

\* Public sector only

- **Dental Association of South Africa (DASA), Federal Council (1996)**

This report by the Health Services and Dental Education Committees of the DASA expressed a concern that by 2010 there would be an over-supply of dentists (Rossouw, 1996). Based on the needs-based study by Booyens (1994), the report justified not to increase the number of dentists trained. Based on demand as determined in the 1988/89 NOHS (Department of Health, 1994), the report stated that utilisation of dental services by the white population group had reached levels as described for industrialised countries such as Canada, Ireland, Norway and the USA. It also concluded that since 75% of the population of South Africa is state dependent, access to the public dental services should be improved and that these services could adequately be rendered by dental therapists. According to dentists surveyed during the 1988/89 NOHS, 88% were of the opinion that there were enough white dentists already, 54% felt that there were not enough black dentists. This report estimated that the greatest demand for dental services will come from the state dependent section of the black population group (Rossouw, 1996).

In terms of human resources to population ratio, two studies were quoted in this report indicating that only 4 of the 156 main metropolitan areas/cities in the nine provinces had not yet reached a dentist to population ratio of 1:3,600 (Rossouw and Van Rensburg, 1995; Van Wyk, Kroon and Cleaton-Jones, 1994). Some of these cities/areas had reached a dentist to population ratio where similar ratios in industrialised countries had led to the closing of dental schools. On the other hand several rural areas have extremely unsatisfactory ratios (1:10,000+). These results indicated a persistent maldistribution of dentists (Rossouw, 1996).

This report concluded that dental schools should reduce the number of dentists trained, increase the number of auxiliaries trained and that the use of models should continue to monitor human resources for oral health. It further recommended that DASA facilitate efforts to establish a consensus view regarding the over-supply and distribution of dentists and contribute to efforts to establish agreement between all role players regarding future supply of dentists (Rossouw, 1996).

- **Committee of Dental Deans (1996 – 1997)**

In a guest editorial the Committee of Dental Deans cautioned against action following on the study by Van Wyk (1996) and the DASA Federal Council report (Rossouw, 1996) until this contentious issue has been further debated and totally clarified (Anonymous, 1996).

This resulted in a report where the annual growth in oral health care workers (dentists/specialists, dental therapists and oral hygienists) over a period of fifteen years up to the end of 1996 was calculated as 160 per year, comprising of 104 dentists, 42 oral hygienists and 14 dental therapists. At the same time the total clinically available oral health care workforce for 2010 was projected at 5,828 consisting of 4,000 dentists, 556 dental therapists, 972 oral hygienists and 300 specialists. In order to achieve this the expansion of present academic oral health centres to deliver a larger output of dental therapists and oral hygienists was recommended (Dreyer, Rossouw and Chikte, 1997).

- **Compulsory Community Service reports (1999-2005)**

In terms of the Medical, Dental and Supplementary Health Service Professions Amendment Act, 1997 (Act 89 of 1997) (Republic of South Africa, 1997a), every person registering for a profession shall perform remunerated community service in terms of the regulations of the Act, and shall, on completion of such service, be entitled to practice the profession in question.

An audit was undertaken prior to the introduction of Compulsory Community Service (CCS) for dentists by way of a self administered questionnaire to seek information on physical, human and financial resources and their distribution within each of the nine provinces. Site visits were undertaken to validate information supplied (Gugushe, 1999).

Of the 368 dentists employed within the public sector in 1999 (excluding academic oral health centres), 267 were full time, 63 part time and 38 had patients referred to their practices by agreement with the province. A total of 213 auxiliaries (100 dental therapists and 113 oral hygienists) were employed of which close to 90% full time. Approximately 70% of public dental clinics were urban based, with 38.9% in urban districts and 30% in peri-urban districts. The most frequently utilized clinical procedure was dental extractions (Gugushe, 1999).

The outcome of this study indicated a variation by province in the organizational structure and management of oral health services. This report identified several problems and constraints and recommended that a national operational team be appointed for the national planning, organisation, implementation and control of CCS for dentists. Availability of adequate financial support from the national department of health was identified as a prerequisite for the successful implementation of CCS for dentists (Gugushe, 1999).

Following on this audit CCS for dentists was introduced in July 2000. A cross-sectional descriptive study was conducted at the end of the first

year of CCS. Response rate was only 35%, with 45% of respondents of the opinion that the allocation process was not handled efficiently. Only 52% were provided with accommodation and 26% described the condition of the clinics as poor. Almost a quarter did not have a full set of instruments, 10% did not have an autoclave or high-speed hand piece and 50% reported that equipment broke down often without immediate repairs being done. Although 75% felt their clinical competence was enhanced, more than three-quarters reported that they had lost some form of clinical competence during the year of CCS (Naidoo and Chikte, 2002).

A “Dentist Satisfaction Survey” was administered to the 2003 cohort of graduates from the Medical University of Southern Africa (MEDUNSA) shortly before graduation and upon completion of their year of CCS. Comparison of the two surveys revealed a general downward trend in the level of job satisfaction upon completion of CCS. In this study 62% of CCS dentists were dissatisfied that they were unable to practice dentistry to its full potential with too much emphasis on extractions. CCS dentists also commented on the lack of respect from medical colleagues who appeared ignorant on the extent to which dentists are trained (Harris and Zwane, 2005).

- **Kissoon-Singh (2001)**

In a similar study to Booyens (1994), this study reported on a human resources plan for oral health care for the province of KwaZulu-Natal based on the primary oral health care package (Department of Health, 2001a) and the results of the 1988/89 NOHS (Department of Health, 1994) and 1999-2002 NCOHS (Department of Health, 2003b). The joint WHO/FDI human resources model was used for the calculations (World Health Organization/Fédération Dentaire Internationale, 1989). Human resources requirements calculated for 2000 and 2010 for selected procedures of the minimum package of oral care are indicated in Table 8 (Kissoon-Singh, 2001).



**Table 8: Human resources requirements for KwaZulu-Natal (2000 and 2010) for selected procedures of the basic oral health care package (Kissoon-Singh, 2001)**

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

This study concluded that a gross shortage and inequitable distribution of oral health personnel existed within the public service of KwaZulu-Natal with only 6% of dentists in this province working in this sector and 78% of the population dependent on this service for oral care. Due to this shortage not even the minimum package of oral care could be implemented. Training of the correct number and an appropriate mix of oral health personnel, intersectoral collaboration, continuing education courses, equitable distribution of resources, CCS, cooperation within the department of health, community health workers and water fluoridation were just some of the recommendations of this study to alleviate the problems of oral health care delivery (Kissoon-Singh, 2001).

- **Pick Report (2001)**

This report served as a first attempt to provide a national strategy on human resources for health and resulted as an outcome of a 1999 workshop of the Provincial Health Restructuring Committee and the Heads of Human Resources for Health in the nine provinces and is based on the underpinning philosophy of PHC. It proposed a strategy to better utilise existing resources, focused strongly on the needs of the underserved and attempted to produce greater synergy between knowledge, skills, attitudes and behaviour of health workers and population health care needs (Pick et al., 2001).



Computer simulation models developed by the WHO and historical information from registers of the statutory councils were used to project supply of a number of health workers (including oral health) over a 30 year period to the year 2029 using different demographic assumptions (Pick et al., 2001).

In terms of training and education it regarded the following as major challenges (Pick et al., 2001):

1. Revision of admission criteria and training programmes to develop skills relevant to the delivery of PHC;
2. Attraction and retention of previously disadvantaged persons, firstly as students and then as staff; and
3. Provision of continuing professional development with a minimal disruption in service delivery.

According to this report the supply of dentists exceeded population growth (assuming an annual 2% population growth rate and a 25% net loss of graduates to other countries). It also emphasised the unequal distribution between the public and private sectors and mentioned the introduction of CCS to dentists as a possible solution.

The report suggested (Pick et al., 2001):

1. The creation of a single dental auxiliary to replace the oral hygienist and dental therapist;
2. A downward revision of the annual intake of dental students;
3. Dental assistants in underserved areas should receive a 1 year training by dentists to perform simple procedures such as the Atraumatic Restorative Technique (ART);
4. The scope of the dental therapist should be expanded to include placement and removal of sutures and removable orthodontic appliances and care of wounds (It should be noted that this recommendation contradicts recommendation 1); and
5. A projected requirement for 2029 of 6,413 dentists and 435 oral hygienists.

- **A National Human Resources Plan for Health (2006)**

Chapter 7 of the National Health Act of 2003 (Act 61 of 2003) (Republic of South Africa, 2003) mandates the Minister of Health to take steps to develop and manage human resources in the national health system. Building on the Pick report (Pick et al., 2001), the NHRP identified human resources planning and development as a key priority area and provided a framework to guide all stakeholders to provide an adequate workforce in partnership with government (Department of Health, 2006a).

A set of 11 core guiding principles underpin the NHRP (Department of Health, 2006a):

1. Stewardship for health care lies with the National Department of Health;
2. South Africans must enjoy a reliable supply of skilled and competent health professionals for self-sufficiency;
3. Planning and development of human resources linked to the needs and demands of the health system must be strengthened;
4. The optimal balance, equitable distribution and use of skilled health professionals to promote access to health services must be developed;
5. Health workers must have the capacity and skills to render accessible, appropriate and high quality care at all levels;
6. Work environments should be conducive to good management practice in order to maximise the potential for the health work force to deliver quality health services;
7. South Africa's role in international health issues contributing to leadership, scientific advances and global health professions is critical;
8. South Africa's contribution in the short to medium term to the global health market must be managed in such a way that it contributes to the skills development of health professionals;
9. Mobilisation of funding to ensure successful implementation of the plan;
10. The Department of Health must ensure that it has the technical expertise necessary to lead health workforce planning; and

11. There must be adequate remuneration of health professionals and good work conditions to enable them to regard the public health sector as employer of choice.

The NHRP proposed the following annual productions for the various members of the oral health team (Department of Health, 2006a):

**Dental practitioners:** Reduce to 120 by 2008. It is the opinion that maintaining current levels will be adequate for both the public and private sectors with aggressively recruiting dentists back to the public sector.

**Dental Therapists:** Increase to 600 by 2009. Dental Therapists are regarded as critical to the provision of PHC services related to oral health. Training must occur at every dental school. Career mobility must be improved in the public sector.

**Dental Technicians:** Current levels to be maintained.

**Oral Hygienists:** Increase to 150 by 2009.

**Dental Assistants:** 300 by 2008.

The NHRP recognised that targets may appear high, but consideration had to be given to mobility of health professionals to and from the private sector, migration overseas and other attrition factors.

By way of an editorial in the South African Dental Journal (SADJ), the CEO commented as follows on the NHRP (Campbell, 2006): "..., but alas, those who know little to nothing about dentistry have yet again elected to ride rough-shod over the advice advanced by dental educators and the profession itself." This editorial continued to compare the suggested reduction in number of dentists to be trained to similar experiences in The Netherlands and the UK which eventually led to massive shortages in both countries, ironically two countries favoured by South African qualified dentists as a possible option for employment upon graduation. The editorial did however welcome the suggestion for an increase in number of oral hygienists to 150 per year, but questioned where the figure originated from. It furthermore expressed great concern on the suggested number of dental therapists to be trained, especially since current facilities

were only equipped to train 300 dentists/dental therapists per year. It referred to a SADA position paper on dental therapists (South African Dental Association, 2000) which recommended an immediate moratorium on the training of dental therapists until all key stakeholders had debated future training and urged the Health Professions Council of South Africa (HPCSA) to rescind a previous decision to allow dental therapists to practice independently which was not in the best interest of the public sector, especially since the intention was that dental therapists be employed by this sector.

## **2.2.5 Human resources distribution and trends in South Africa**

### **a) Number of dentists to be trained**

The majority of reports on human resources in South Africa have highlighted the inequitable distribution between urban and rural on the one side and the private and public sectors on the other. Recommendations were put forward by the Commission of Enquiry into the Dental Services and the Training of Non-White Dentists as a result of which three new dental schools were opened and existing facilities expanded. The Commission predicted that 1,708 dentists would be registered in South Africa by 1980 (Republic of South Africa, 1967). Another study indicated that this figure had already been reached in 1973 and that South Africa would be faced with an overproduction of dentists by 1983 (Germishuys, 1979).

Reports and opinions on training of dentists in South Africa continued during the 1980s. In 1984 it was suggested that no new dental schools be established, but that existing faculties be expanded and opened to all ethnic groups (Dreyer, Lemmer and Dreyer, 1984). An ad hoc committee of the DASA warned that an overproduction of white dentists might become a reality and that intake of white students had to be reduced (Dreyer et al., 1986).

During the 1990s there was a shift in emphasis on dentists as the main dental service providers to an oral health care workforce consisting of health

educators, assistants, oral hygienists, dental therapists, dentists, specialists and technicians. A 50% decrease in the number of dentists trained was suggested with a corresponding increase of 250 auxiliaries per annum over the next 5 to 10 years (Dreyer et al., 1992).

**b) Dentist to population ratios**

A comparison of the geographical spread of dentists in South Africa between 1972 and 1982 confirmed a decrease in dentist to population ratio from 1:12,133 in 1972 to 1:9,868 in 1992 (Smith and Cleaton-Jones, 1985). A follow-up study indicated that this had further decreased to 1:7,991 in 1992 (Van Wyk et al., 1994). Both these studies highlighted the maldistribution of dentists in South Africa.

The number of dentists increased by 135.6% from 1,599 in 1972 to 3,767 in 1992. When dental therapists were included (112 in 1992), the operator to population ratio decreased further to 1:7,991. This represented 1.25 dentists/operators per 10,000 of the population (Van Wyk et al., 1994).

Any health system attempts to achieve the objective of equitable distribution of resources. Table 9 summarises the dental operators to population ratios for magisterial districts with the lowest (all urban) and the highest (all rural) ratios. It clearly illustrates the extent of maldistribution of dental operators in South Africa (Van Wyk et al., 1994).

**Table 9: Magisterial districts with the lowest and highest operator to population ratios in South Africa (Van Wyk et al., 1994)**

| Lowest operator : population ratio |           |                             | Highest operator : population ratio |           |                             |
|------------------------------------|-----------|-----------------------------|-------------------------------------|-----------|-----------------------------|
| Magisterial district               | Operators | Operator : population ratio | Magisterial district                | Operators | Operator : population ratio |
| Cape Town                          | 169       | 1:1,069                     | Seshego                             | 2         | 1:151,338                   |
| Pretoria                           | 486       | 1:1,374                     | Nongoma                             | 1         | 1:169,153                   |
| Bellville                          | 151       | 1:1,788                     | Witsieshoek                         | 2         | 1:171,443                   |
| Durban                             | 252       | 1:1,880                     | Morokeng                            | 1         | 1:446,155                   |
| Hermanus                           | 11        | 1:1,965                     | Ntuzuma                             | 1         | 1:458,529                   |

It was estimated that 78% of all oral health personnel are employed in the private sector with the remaining 13% in the public sector required to serve 65 to 80% of the total population (Rossouw, 1995).

Based on information from the 1988/89 NOHS (Department of Health, 1994), 57% of dentists practice within the five major metropolitan areas of South Africa with male dentists dominating the profession (92.8%). Of the dentists responding to the questionnaire, 68.5% qualified after 1970 and 38% after 1980. Only 12.8% of dentists employed an oral hygienist on a full-time and 11% on a part-time basis. There was a perception amongst dentists that there was no need to employ oral hygienists (62%), with 11% of dentists indicating they did not do so because of unavailability. Conservative dentistry was the most frequently practiced service (91.6%) followed by scaling and polishing (74.2%). Topical fluoride application and placement of fissure sealants were ranked low (Rudolph, Brand and Gilbert, 1995).

A Health Systems Trust report estimated the distribution of public sector dentists per 100,000 of the public sector dependent population decreased from 1.7 in 2000 to 1.58 in 2003. Some provinces had 4 times as many dentists in the public sector compared to others. The 2003 ratios for the Eastern Cape and KwaZulu-Natal were 0.7 and 0.99 respectively, compared to 2.79 and 3.35 for Gauteng and the Western Cape. Despite the introduction of CCS for dentists in 2000, the number of dentists in the public sector had steadily declined. Based on a 2% population growth per annum, a 25% net loss of graduates to other countries and using WHO simulation models, this report estimated that the dentist to population ratio would decrease from 1:9,400 in 1999 to 1,7800 by 2029 (Padarath, Ntuli and Berthiaume, 2004).

**c) South African qualified dentists in the United Kingdom**

Shortly after the emergence of the new democratic South Africa, several concerns were expressed on the political arena about the so called “brain drain” of professionals to other countries. A Central Statistics Service (CSS) report published in the lay press estimated that 3,000 people left South Africa

during the first quarter of 1996, 1.3% of these belonged to the medical and dental professions (Beeld, 1996). This was followed by an attempt by the Minister of Health to stop qualified health professionals from working and living in the UK (Rapport, 1996). It was estimated that between 1989 and 1997 nearly 250,000 people left South Africa for Australia, New Zealand, Canada, the UK and the USA. Of the total health workforce in the UK, 6% were South African qualified (Padarath et al., 2004).

Information on South African qualified dentists living abroad is essential for human resources planning. The 1967 Commission of Enquiry into Dental Services estimated that 9% of dentists registered with the then SAMDC were practising in the UK (Republic of South Africa, 1967). Little information is available on this for the seventies and eighties, but a 1992 editorial referred to a “massive brain drain” of final year dental students to the UK (Wiltshire, 1992). The same editor one year later reported an increase in total number of dentists due to a massive influx from India and Eastern Europe (Wiltshire, 1993). Following on this editorial, it was reported that 726 South African qualified dentists were registered with the General Dental Council (GDC) in London (Holtshousen, 1993). Another study reported that 80% of dentists who qualified in South Africa during the period 1962 to 1991 were still registered with the SAMDC with the majority of the remaining 20% practicing in the UK (Germishuys, 1994).

A study into the number of South African qualified dentists registered with the GDC reported that this figure had increased from 726 in January 1992 to 1,160 in December 1995, an increase of 59.8% over a 4 year period. Of these dentists 49.3% still had addresses in South Africa listed with the GDC. When expressed as a percentage of the number qualified during the same period, the number of South African dentists registered with the GDC increased from 4.6% for the period 1940 to 1949 to 32.4% for the period 1990 to 1995. Of the dentists qualifying in South Africa between 1990 and 1995, 76.3% registered with the GDC during this same period. Less than 50% of these were actually working or living in the UK (Holtshousen and Van Wyk, 1997).



Reasons why professional people were leaving South Africa since 1990, especially dentists in the UK, were the high levels of crime, followed by economical considerations, either their own or the general economy of the country and uncertainty about economical, political, professional and the educational future of their children (Van Wyk, Holtshousen and Geldenhuys, 1999). The reasons given were no different to findings of other reports dealing with the same subject.

**d) Gender and race distribution of dentists and specialists**

Two recent studies reported on the pre-democracy (1985 to 1994) and post-apartheid (1995 to 2004) gender and race distribution of dental graduates and first year dental students (2000 to 2005) as well as dental specialist training in South Africa (Laloo et al., 2005; Laloo, Naidoo and Myburgh, 2006). A total of 3,353 dentists graduated from the five dental training institutions between 1985 and 2004 of which 64% were male. Based on racial group, 59% were white, 17% black, 17% asian and 8% coloured. The breakdown for each of the two periods under study as well as first year students for the period 2000 to 2005 and dental specialists (1985 to 2004) is found in Table 10. The number of female and black students entering and graduating from the dentistry programme had increased since 1994, but this needed to continue for black students to reflect the national population distribution. This also applied to specialist training.

**Table 10: Number and percentage of South African dental graduates, first year students and dental specialists by gender and racial group (Laloo et al., 2005; Laloo et al., 2006)**

|          | Dental graduates          |                            |             | First year students | Dental specialists |
|----------|---------------------------|----------------------------|-------------|---------------------|--------------------|
|          | Pre-democracy (1985-1994) | Post-apartheid (1995-2004) | Total       |                     |                    |
| Male     | 1,043 (79%)               | 1,104 (54%)                | 2,147 (64%) | 674 (43%)           | 266 (86%)          |
| Female   | 271 (21%)                 | 926 (46%)                  | 1,197 (36%) | 895 (57%)           | 43 (14%)           |
| Asian    | 121 (9%)                  | 451 (22%)                  | 572 (17%)   | 456 (29%)           | 44 (14%)           |
| Black    | 77 (6%)                   | 476 (24%)                  | 553 (17%)   | 424 (27%)           | 18 (6%)            |
| Coloured | 93 (7%)                   | 163 (8%)                   | 256 (8%)    | 147 (9%)            | 19 (6%)            |
| White    | 1,018 (78%)               | 932 (46%)                  | 1,950 (58%) | 542 (35%)           | 228 (74%)          |



**e) Dental therapists**

The first dental therapists qualified in 1977 and although this had increased to 294, only 158 were registered with the SAMDC in 1993 (Van Wyk, 1996). Of these 117 were employed by the public services. This represented a loss of 60.2% of trained dental therapists. Poor salaries and limited career opportunities were listed as the main reasons (Prinsloo, 1994).

Regulations were changed during 1993 to allow dental therapists to enter the private sector and open their own practices. It is difficult to estimate their geographical distribution, but it can be assumed that this will have changed from the original intention of being employed by the public sector in mainly rural areas to be similar to dentists with a preference for urban and metropolitan areas.

**f) Oral hygienists**

The first group of oral hygienists qualified at the end of 1973. At the end of 1991 a total of 682 were registered with the SAMDC at which stage 450 were employed by dentists in the private sector (Van Wyk, 1996). It is safe to assume that the majority will still be employed in the private sector in urban and metropolitan areas.

**g) Current registrations of oral health professionals with the HPCSA**

A summary of the number of oral hygienists, dental therapists and dentists registered with the HPCSA as on 30 March 2007 is presented in Table 11 (Health Professions Council of South Africa, 2007).

**Table 11: Oral health professionals registered with the HPCSA on 30 March 2007 (Health Professions Council of South Africa, 2007)**

|                          | Oral Hygienists    | Dental Therapists | Dentists             | Total                |
|--------------------------|--------------------|-------------------|----------------------|----------------------|
|                          | <b>961 (15.5%)</b> | <b>456 (7.3%)</b> | <b>4,792 (77.2%)</b> | <b>6,209</b>         |
| By gender                |                    |                   |                      |                      |
| Female                   | 949                | 198               | 1,322                | <b>2,469 (39.8%)</b> |
| Male                     | 12                 | 258               | 3,470                | <b>3,740 (60.2%)</b> |
| By racial classification |                    |                   |                      |                      |
| Asian                    | 55                 | 74                | 570                  | <b>699 (11.3%)</b>   |
| Black/African            | 117                | 190               | 444                  | <b>751 (12.1%)</b>   |
| Coloured                 | 45                 | 2                 | 87                   | <b>134 (2.2%)</b>    |
| White/European           | 518                | 26                | 1,650                | <b>2,194 (35.3%)</b> |
| Other/Unknown/Left blank | 226                | 164               | 2,041                | <b>2,431 (39.2%)</b> |
| By province              |                    |                   |                      |                      |
| Western Cape             | 301                | 3                 | 1,092                | <b>1,396 (22.5%)</b> |
| Northern Cape            | 10                 | 6                 | 69                   | <b>85 (1.4%)</b>     |
| Eastern Cape             | 39                 | 11                | 249                  | <b>299 (4.8%)</b>    |
| Free State               | 45                 | 24                | 173                  | <b>242 (3.9%)</b>    |
| KwaZulu-Natal            | 83                 | 149               | 649                  | <b>881 (14.2%)</b>   |
| Gauteng                  | 369                | 148               | 2,027                | <b>2,544 (41%)</b>   |
| North West               | 32                 | 31                | 158                  | <b>221 (3.6%)</b>    |
| Mpumalanga               | 45                 | 27                | 211                  | <b>283 (4.6%)</b>    |
| Limpopo                  | 37                 | 57                | 164                  | <b>258 (4.2%)</b>    |

This information clearly illustrates the domination of dentists who make up 77.2% of the total oral health workforce. The oral health profession also continues to be dominated by white males. The maldistribution of oral health professionals is also clear with 41% indicating Gauteng as their registered address. Information on how many of these oral health professionals practice their professions overseas, but who are still registered with the HPCSA, is impossible to obtain.

## **2.3 South African policy documents on health and oral health service delivery**

### **2.3.1 Transformation of health services**

The White Paper for the Transformation of the Health System in South Africa (Republic of South Africa, 1997b) presented a set of policy objectives and principles upon which the national health system of South Africa would be based. It also presented implementation strategies to meet the basic needs

of the population and was guided by the principles of PHC and decentralising the management of health services with emphasis on a district health system.

The chapter on oral health recognised dental practitioners, oral hygienists, dental therapists, technicians and assistants as members of the workforce delivering these services. Two main principles were identified to address oral health and will be discussed briefly (Republic of South Africa, 1997b).

a) **Adoption of the Primary Health Care approach in the development of oral health services**

- **Prioritisation of service delivery:** Mothers, children, pregnant women, physically and mentally disabled and the elderly were identified as priority groups for preventive and other services. These priority groups should be provided with at least a minimum package of services. An equitable distribution of services should be reached in the shortest possible time.
- **Focus on prevention:** Cost-effective and innovative preventive strategies should be employed which include purchasing services from the private sector. Based on oral disease profiles most treatments could be delivered by oral hygienists and dental therapists, staffing levels at clinics should keep this in mind.
- **Integration of oral health care:** Oral health services should be integrated with other health services at all levels of care. A basic package of oral health services should be provided at all PHC facilities. When PHC facilities were planned, oral health facilities should be included.
- **Training of oral health personnel:** It was recommended that training should be reviewed to prepare professionals for different environments and to work amongst different sections of the population. Deployment and utilisation of oral health personnel should meet everyone's needs and be based on the new focus of oral health service delivery.

**b) Reducing the incidence of common oral diseases**

It was suggested that this be achieved through health promotion, prevention of oral diseases and the provision of basic curative and rehabilitative oral health services. Implementation strategies to achieve this included:

- **Minimum package of oral care:** Should consist of an annual examination, bitewing radiographs, cleaning of teeth, simple 1- to 3-surface restorations, fissure sealants and emergency relief of pain and infection control.
- **Water fluoridation:** It was suggested that water fluoridation be implemented immediately in the major metropolitan areas with the remaining areas being phased in systematically. Alternative methods of fluoridation such as use of fluoridated toothpaste and mouth rinses should be introduced in schools and among priority groups. Legislation to enable fluoridation of milk and salt should be pursued and dietary supplements should be included as part of the integrated nutrition programme.
- **Reduction of the consumption of refined sugar:** A call was made for a nutrition programme to reduce levels of sugar in infant and baby foods, medicines, fruit juices, vitamin preparations and common foods and to ensure the availability of accurate information of sugars and their levels on food labels.

**2.3.2 National Oral Health Policy**

The South African National Oral Health Strategy (Department of Health, 2005) was approved by the Minister of Health and the provincial representatives for health in February 2004 with the aim to improve the oral health of the South African population by promoting oral health and to prevent, appropriately treat, monitor and evaluate oral diseases.

**a) Oral health functions**

Specific oral health functions on the different levels of government were identified (Department of Health, 2005):

- **National level**

Formulation, implementation and review of the national oral health strategy process;

Formulation, implementation, monitoring and evaluation of a national water fluoridation programme and alternative fluoride measures in collaboration with the NFC; and

National norms and standards.

- **Provincial level**

Formulation, implementation and review of provincial oral health operational strategies;

Prevention of oral diseases and oral health promotion as priority including water fluoridation, alternative fluoride programmes, identify and develop collaborative approaches to disease based on common risk factors, raise awareness of oral disease risk and integrate oral health into programmes and policies;

Co-ordinate the oral health care system in the province;

Plan, support and evaluate district oral health services;

Collect data from districts for own and national use; and

Implement national norms and standards for oral health delivery.

- **District level**

Provision of appropriate disease prevention and health promotion measures based on the minimum package of care and cost-effective and evidence-based strategies;

Devise an appropriate oral health plan for each health setting;

Collect appropriate data; and

Establish an adequate referral system for advanced and specialised oral health services.

**b) National goals**

National goals set for 2010 included:

- An increase of PHC facilities delivering oral care services through district hospitals, community health centres and clinics, mobile or portable dental units;
- An increase the percentage of children who were caries free at age 6 to 50%;
- Reduce the mean DMFT at age 12 to 1.0;
- 60% of the population on piped water systems to receive optimally fluoridated water; and
- 100% of clinics offer the primary oral health care package.

**c) Resources**

The South African National Oral Health Strategy suggested that oral health human resources should form part of the integrated health human resources plan. In terms of financial resources the national directorate for oral health has its own budget and oral health at provincial levels should have cost centres for budgeting purposes. Provinces would be responsible for capital expenditure and equipping oral health facilities. It was furthermore suggested that patients will be charged for services rendered according to the UPFS. Oral health programme managers should be consulted in the planning of clinics and upgrading programmes (Department of Health, 2005).

**d) Links between national and provincial health authorities**

To facilitate better communication between the national and provincial health authorities, it was suggested that (Department of Health, 2005):

- The national Directorate of Oral Health met with provincial oral health programme managers at national office at least three times per year;
- The national Directorate of Oral Health visited provinces to assist and guide provincial oral health services;

- The national Department of Health would be responsible to annually assess the implementation and outcomes of this strategy and make recommendations accordingly; and
- The national Department of Health was also responsible for collating information provided by provincial health authorities and to disseminate summary data reports.

**e) Guidelines for oral health personnel**

A previous version of the oral health policy recommended ratios for delivery of oral health services. These are summarised in Table 12 (Department of Health, 1999)

**Table 12: Recommended ratios for oral health personnel in the public sector (Department of Health, 1999)**

| Human resource                    | Ratio       |
|-----------------------------------|-------------|
| Specialist : Population           | 1:1,000,000 |
| Dentist : Population              | 1:60,000    |
| Oral Hygienist : Population       | 1:50,000    |
| Dental Therapist : Population     | 1:12,000    |
| Dentist : Dental Therapist        | 1:5         |
| Dentist : Oral Hygienist          | 1:1.2       |
| Dental Therapist : Oral Hygienist | 5:1         |
| Clinical : Dental Assistant       | 1:1.5       |
| Dentist : Dental Technician       | 6:1         |

**2.3.3 Primary oral health care package**

A package of PHC services was agreed to at a meeting of the Provincial Restructuring Committee in Bloemfontein on 13 April 2000 (Pick et al., 2001). It was fully recognised that the better-endowed provinces might be in a position to provide more services than stated with others only able to deliver some elements of the PHC package. The basic elements of the PHC package and associated norms and standards were published in separate documents (Department of Health, 2001a; Department of Health, 2001b).

A minimum package of oral care was first mentioned in the White Paper for the Transformation of Health Services in South Africa (Republic of South



Africa, 1997b). A summary of procedures included in this minimum package of oral care as well as its translation to personnel requirements appears in Table 13 (Department of Health, 2001a; Pick et al., 2001).

**Table 13: The minimum package of oral care (Department of Health, 2001a; Pick et al., 2001)**

| Components of work                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Skills and knowledge requirements                                                                                                                                                                                                                                                                                                                                                                                                                   | Personnel requirements for skills                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Oral examination and charting of dental status</li> <li>• Intra-oral radiographs</li> <li>• Scaling and polishing of teeth</li> <li>• Promotive and preventive oral health services</li> <li>• Basic curative services including emergency relief of pain and sepsis (including dental extractions)</li> <li>• Simple restorations (1-3 tooth surfaces)</li> <li>• Treat traumatic injuries to teeth</li> <li>• Treat post-extraction bleeding</li> </ul> | <ul style="list-style-type: none"> <li>• Communication skills (verbal and non-verbal e.g. oral health education, charting of dental status)</li> <li>• Clinical skills e.g. oral examination, history taking, taking of intra-oral radiographs</li> <li>• Practical skills e.g. medicine prescription, dental extractions and simple restorations, treat traumatic injuries and post-extraction bleeding, scaling and polishing of teeth</li> </ul> | <p><b>Communication skills:</b></p> <ul style="list-style-type: none"> <li>• Dentist at District Hospital, Community Health Clinic</li> <li>• Dental Therapist</li> <li>• Oral Hygienist</li> <li>• Dental Assistant</li> </ul> <p><b>Clinical Skills:</b></p> <ul style="list-style-type: none"> <li>• Dentist</li> <li>• Dental Therapist</li> <li>• Oral Hygienist</li> </ul> <p><b>Practical Skills:</b><br/><b>(extractions/restorations/traumatic injuries/post-extraction bleeding)</b></p> <ul style="list-style-type: none"> <li>• Dentist</li> <li>• Dental Therapist</li> </ul> <p><b>(scaling and polishing of teeth)</b></p> <ul style="list-style-type: none"> <li>• Dental Therapist</li> <li>• Oral Hygienist</li> </ul> |

A recently published editorial suggests that from a public health perspective large inequalities in dental disease and a large variation in the amount of restorative care provided to children are two problems which impact on improving the oral health of young children in the UK (Tickle, 2006). Effective population-based interventions such as water fluoridation are recognised strategies to address inequalities. Far less is known on how to address the latter problem, this results in a wide variation of the amount of restorative care provided. This editorial continues by quoting two independently conducted studies which both reported that 80% of diseased primary teeth exfoliate without causing pain. This suggests that a less interventionist approach may be more appropriate. The provision of dental care to children should strike a balance between effective treatment and minimising any harm to the patient.

Until more evidence is available as to which approach is most effective, it should be accepted that the provision of the minimum package of oral care to South African children is appropriate.

## 2.4 Summary

This chapter provided a brief overview of the three main elements of this study.

For water fluoridation a historical perspective (including South Africa) was presented as well as an overview of caries prevention, recent international reports and the economics of this well recognised community-based preventive measure.

For human resources planning the different approaches described by Hall (1978) and the WHO/FDI planning model (World Health Organization/Fédération Dentaire Internationale, 1989) was presented. As part of a South African perspective on human resources planning several previous studies, reports and publications were summarised including the recently published NHRP (Department of Health, 2006a). Human resources distribution and trends in South Africa were also discussed.

The final part of this chapter was dedicated to South African policy documents on health and oral health service delivery. These include the White Paper for the Transformation of Health Services (Republic of South Africa, 1997b) which adopted the PHC approach as part of health services, National Oral Health Strategy (Department of Health, 2005) and the primary oral health care package.

Chapter 3 will present a model, outcomes and discussion of the economic variables of the implementation of water fluoridation for seventeen major metropolitan cities, towns and water providers from all nine South African provinces taking into account operating cost, opportunity cost and capital depreciation.