Promoting Dental Health

Colin R Cowell
Aubrey Sheiham

King Edward's Hospital Fund for London

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by
Colin R Cowell

and

Aubrey Sheiham

King Edward's Hospital Fund for London

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Dedication

To Laurie Pavitt MP who encouraged us to write this book.

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CRC and AS

1981

Notes on authors

Colin Cowell is chief dental officer, Unilever (UK Central Resources) Ltd and honorary adviser in clinical studies to the department of community dental health, The London Hospital Medical College, Dental School.

Aubrey Sheiham is senior lecturer in community dental health, The London Hospital Medical College, Dental School.

Preface

The origin of this book is the background material produced for the consultative document, *A Challenge for Change in the Dental Services*, submitted by Mr Laurie Pavitt MP, chairman of the Parliamentary Labour Party Health Group, to the Secretary of State for Social Services in 1976. The papers were offered to the King's Fund for publication, but the Fund, an independent charitable foundation with no political affiliations, was unable to publish them as they stood. It was decided, however, that a book on dental health services would be a good addition to the Fund's own list of titles on various aspects of planning, organisation and management of health services and the care of patients. Accordingly, we were invited to write it.

We have attempted to present a concise and accurate account which covers the causes and prevalence of dental diseases; methods of preventing disease and promoting dental health; international comparison of provision of dental care; the planning, organisation, management and staffing of services, and the evaluation of service effectiveness. Our account, views and conclusions are supported throughout by reference to evidence from reputable research studies.

Publication of a book does not necessarily imply agreement with the opinions of the author. The Fund's aims in publishing this book are to present an informative account of the current state of knowledge and the method of providing services, and to contribute to the debate on the future of dental care within the organisation of the health services in this country. We hope we have achieved those aims.

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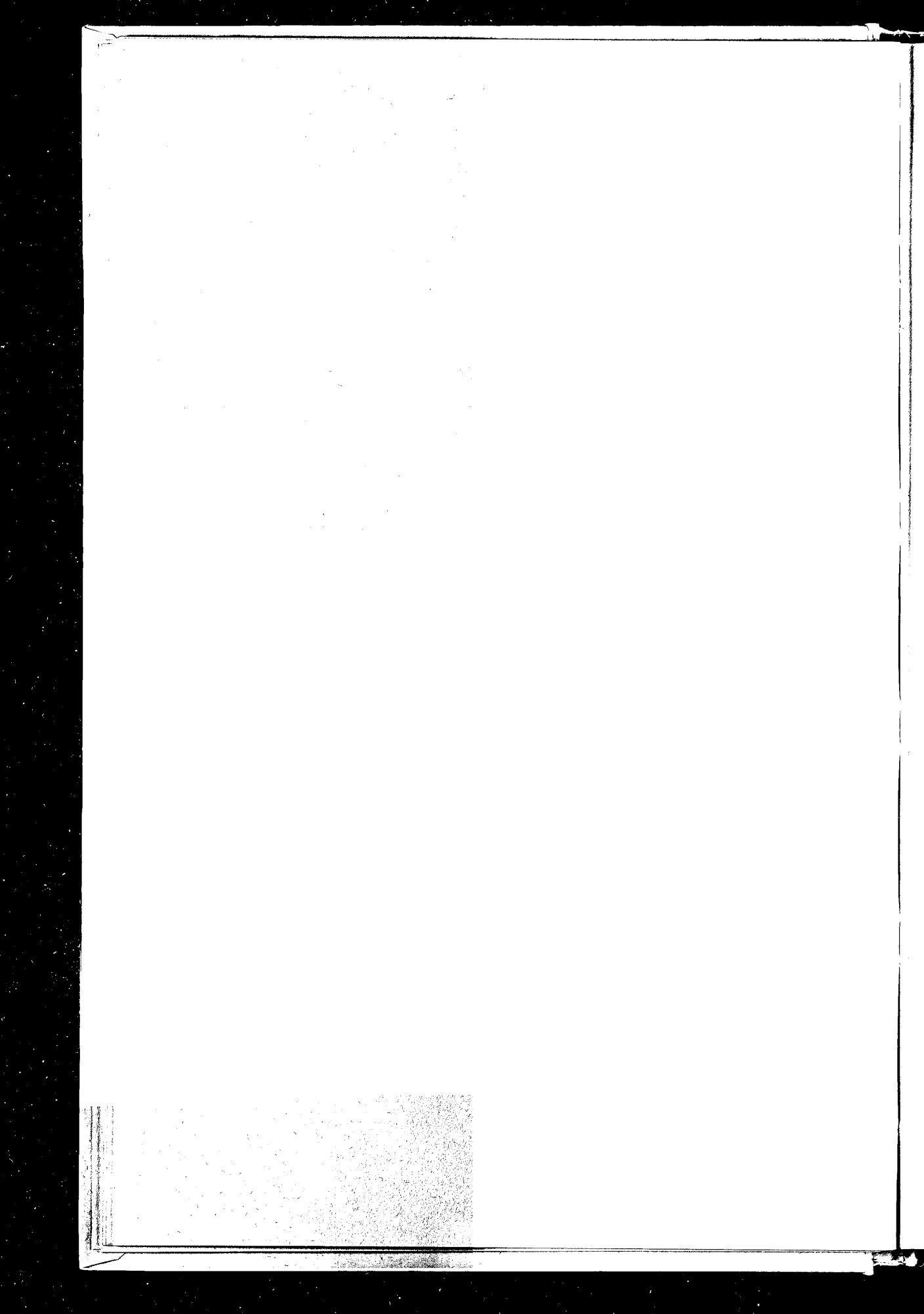

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Research knowledge as a basis for future action

Dental research in Britain has developed as part of the larger area of medical research and, as such, has inherited the traditional approach based on the meticulous observation of the individual patient by the clinician. Evidence of the achievements gained by this Baconian method can be found in textbooks which contain the eponymous titles of many diseases. When intuitive skills are added to the ability for careful observation, the results can lead to dramatic advances in medical knowledge such as the treatment of diabetes or the control of infection by penicillin. Although comparatively rare, such brilliant advances can be expected if a sufficient number of trained minds are confronted with existing problems. If dental research is to share in these advances, it should provide an environment which will attract at least some of the research workers of high potential. However, the future progress of research cannot be based on this expectation entirely and it is necessary to look to the slower advances to be made on a broader front.

Predominant among dental problems which need to be solved are two chronic diseases: dental caries and chronic periodontal disease. The exceptionally high prevalence of these two diseases ensures that few individuals escape their effects. They are, together, responsible for an enormous amount of pain and suffering which leads to the loss of millions of teeth each year.

Research has, over the years, uncovered a great deal of information

about these two diseases which should be translated into practical measures for their prevention. The difficulties encountered in translating research knowledge into action are formidable, especially when there are no direct commercial application and no dramatic effect which will be immediately obvious. An attempt will be made to examine these factors in relation to dental health, to give explanations and to suggest possible solutions.

The growth of research activity has been one of the most remarkable phenomena of the last three decades, with the result that it is difficult to encompass the whole field of knowledge. This is particularly so in dental research, which relies upon knowledge culled from many varied disciplines.

The inevitable result has been increasing specialisation in dental research which, in turn, has accompanied a tendency for the research worker and the practitioner to drift apart. The dentist who combines dental practice with some research activity is uncommon in Britain, whereas in Scandinavia, particularly Sweden, the combination is not so rare. This may have some bearing upon the important contribution made to dental research by Scandinavia in the post-war years, especially in clinically related areas.

In any international comparison of dental research effort, it is difficult to match the vast input of resources made by the United States, especially from government funding via the national institutes of health.

Research is dependent upon the allocation of resources and its strategy is usually determined by the bodies which control these resources. The size of the problem can be visualised by consulting a copy of the Grants Register, which lists the awards for research by country and by discipline.[159] There are twelve different sections listed for the United Kingdom, with the section covering the medical and health sciences having more than 80 headings. This alone gives no idea of the value of resources which are made available via the universities. The share of resources controlled by bodies such as the University Grants Committee, Medical Research Council, Department of Health and Social Security and the Science Research Council probably dominate the research scene in the United King-

dom. The Royal Colleges of Surgeons, which provided a home for dentistry before the establishment of university departments, still make a major contribution to research opinion and the college in England maintains its own research unit.

The difficulties of maintaining a coherent strategy for research is apparent from this background and has been the subject of a report, sponsored by the government, which attempted to place the award of resources on a rational basis.[63] Dental research represents a microcosm of the general problem. Over-direction of research is anathema to the freedom of thought and action required by most research workers, and yet the other extreme of *laissez-faire* is unlikely to produce the most effective progress.

Although dental research has become multidisciplinary, it has remained firmly based within the framework formed by the classical scientific disciplines. There has thus been a tendency to allow the results of research to plead their own case: a naive approach, since the practical application of research knowledge depends upon political, social and economic factors. The failure to realise this fact has contributed to the delay in implementing the results of research. The supplementation of fluoride-deficient water supplies is an example of a research-supported public health measure which has made little headway in Britain, in spite of its success in America where sociopolitical problems are more clearly understood.[33,123,125] The time-scale of the progress of fluoride research and the prevention of dental caries can be seen in Table 1.

It is vital to conduct informed debate upon any research results which are to be applied as a public health measure. In the last 50 years many acute infectious diseases have been controlled and our knowledge of nutrition has increased. The casualties inflicted upon this route to better health care are, quite rightly, remembered. Thalidomide must have contributed to a public distrust of scientific research. It is therefore natural for the public and the media to look for clear-cut results where innovative health measures are concerned. Unfortunately, dental research, in common with all biological research, is concerned with probabilities and central tendencies. The search for anything more than a working hypothesis, which resists refutation, is likely to continue interminably. A point is reached,

therefore, where the accumulated evidence is accepted because the probability that it is due to chance is very small, and because it has not been refuted by opposing evidence.

The supplementation of fluoride in drinking water has reached this point. The vast amount of information in its favour, nevertheless, is extremely vulnerable because the most alarming emotive criticisms, which attract great publicity, can be made. Painstaking research is required to investigate any criticism before it can be rejected with authority. It is the nature of things that the rejection seldom attracts the interest aroused by the original criticism. The objections to fluoridation were examined by a committee appointed by the Royal College of Physicians and all of them rejected.[129] In spite of this, a committee of the House of Commons found that further evidence was required before the supplementation of drinking water with fluoride could be recommended.[65] It is possible that no public health measure has been so carefully investigated over such a long period (see Table 1).

Table 1 A chronological table on fluoridation

1908	Observation of brown (mottled) teeth in Colorado (USA).
1928	Mottled teeth associated with the water supply and lower caries (decay).
1931	Agent revealed by spectrographic analysis to be fluoride.
1933	Observation in Maldon (UK) of an association between mottling of teeth, fluoride and low caries.
1939	Established that mottling occurred only with levels of fluoride over 1.0 part per million.
1942	Realisation that caries prevention was at its optimal level with fluoride levels too low to cause appreciable mottling.
1945–6	Artificial fluoridation studies initiated to bring water levels to optimal level in North America. (Test cities: Grand Rapids, Newburgh, Evanston. Control cities: Muskegon, Kingston, Oak Park)

1956	Results of these studies showed similar effects. The children who had developed teeth in this period living in the test cities had half the caries experience over all of their opposite numbers living in the control cities.
1966	Growth of an opposition lobby to fluoridation based principally on the interference of personal freedom involved and the possible dangers from long-term fluoridation.
1969	In the USA 3827 communities and in Canada 459 had fluoridated water.
1969	The report of an 11-year study in the UK published on behalf of the Ministry of Health decided that fluoridation is a highly effective way of reducing dental decay and is completely safe.
1969–70	Evidence from two areas where fluoridation was stopped after a period (Kilmarnock, Scotland, and Antigo, Wisconsin, USA) showed both a fall in caries for the fluoridation period and a rise towards previous levels when fluoridation was dropped.
1970	World Health Organization published a book on fluorides and human health which affirmed the safety of fluoridation.
1976	Report of the Royal College of Physicians (UK) denied that controlled fluoridation can cause harm.
1977	Parliamentary Committee (UK), considering the role of preventive medicine in the NHS, recommended that there should be more research on the long-term effects of fluoride.

Forty-eight years have elapsed since Ainsworth noticed that children with mottled teeth in Maldon, Essex, had a lower experience of dental caries than children in other parts of the country, and associated this with the very high levels of fluoride in the water supply.[2] Thirty-five years have elapsed since fluoride was added to the water supply of Grand Rapids, Michigan, USA, to bring it to the optimal level of 1 milligram per litre.[7,133] At the present time approximately 150 million people throughout the world have the benefit of fluoridated water, but 105 million of them live in the USA. In 1974, only two per cent of the population in Europe were receiving the benefits of fluoride in the water supply. Only $4\frac{3}{4}$ million people in the UK have their water supply supplemented with fluoride.[129]

The difficulties associated with the public acceptance of fluoridation are special in some respects, but they serve as an example that research evidence is merely a preliminary stage in the practical application of any public dental health measure. There is no provision at present for dental health personnel to receive training in the skills necessary to implement the results of research. Recommendations are made later in this presentation to rectify this omission by ensuring that a worthwhile career is available to those who are willing to apply themselves to these problems.

A number of other factors play a part in determining the strategy of dental research. One is the importance of fashionable trends in dictating the direction of research. These may be 'thematic' and follow major developments in allied areas. The impact of nutritional research in the 1920s probably made it fashionable to search for systemic, rather than local, causes of periodontal disease and dental caries. The current theme appears to be immunology. It is attracting a large amount of energy and resources.

Other fashionable trends are dictated by technical developments, such as the microscope and its progeny, the electron microscope and the scanning electron microscope. Each trend makes its contribution to the total progression of knowledge and yet is often wasteful because it diverts attention from the fundamental problem. An analogy can be made with a car on a cross-country journey which is constantly turning down attractive-looking side roads rather than keeping to the main route. A certain amount of wasted resource in research must be tolerated: the alternative, centralised direction, would stifle innovation. Though central direction of dental research is not to be recommended, there is a need for a central strategy so that the objectives of an optimal dental care system have some hope of realisation. It is essential to obtain the correct balance between applied and basic research. Unless enough applied research projects can be slotted into an overall strategy, progress will be erratic and disjointed. As a corollary, low level activity will mean that fewer people are trained in applied dental research, which will further retard progress. To ensure sufficient resources for research in dental care, we propose that an institute of applied clinical dental research be set up in conjunction with the Department of Health and Social Security, the Medical Research Council, Social Science Research

Council and Health Education Council. We believe that such an institute would improve the quantity and quality of applied clinical dental research in the United Kingdom. The little clinical research which is being done is uncoordinated and, until recently, the quality has been unsatisfactory. In addition, the nature of clinical research owes more to commercial interests than to the needs of the population.

The research programme would require to cover five main areas.

preventive and therapeutic substances

dental practice and dental treatment

dental materials

epidemiology of dental and oral diseases

health behaviour and health education.

The staff, therefore, should include epidemiologists, clinicians, statisticians and behavioural scientists.

The aims of the institute may be summarised.

To be a centre of excellence for the practical application of research findings to the control of dental disease.

To attract research workers of high quality who can create conditions whereby major advances may be expected.

To provide continuous monitoring of the materials and methods used in the provision of dental care.

To ensure that there is greater knowledge of the problems when applying the technology of dental care to the community.

To facilitate and encourage the involvement of dental practitioners in research and in its application to dental care.

To provide a forum for the discussion of dental care problems by the public and the profession.

To be a data centre for epidemiological and other information relating to dental care.

To be an informed 'third party' in assessing commercial claims and methods in dental care.

2
Epidemiology of dental diseases

In Britain, the two major dental diseases—dental decay (caries) and periodontal disease (gum disease)—affect every man, woman and child; indeed, they have been called 'the last epidemic'.[145] Caries is so prevalent in the United Kingdom that only three out of every 1000 adults have never experienced it, and so severe that 97 per cent of 15 year olds have had one-third of their teeth affected.[155] The number of teeth affected rises in adults to over half their teeth. Periodontal disease affects 99 per cent of the population who still possess any teeth; and in four out of ten dentate adults, it is so advanced that they are about to lose their teeth. These diseases are the principal reason for the extraction of 8 million teeth a year.[41] Three out of ten adults have no natural teeth at all, and half the adult population wears some kind of false teeth. The social and psychological toll, which is barely recognised and has never been totally estimated, must be considerable: it includes pain and discomfort, anxiety, embarrassment, dietary restriction, and restriction of other functions such as laughing, talking and yawning. The financial costs have never been completely estimated, but they include £300 million of the National Health Service annual budget for dental treatment, the training of dental personnel, the cost of materials and equipment, together with research into treatment methods. Twenty million hours a year are spent at the dentist and at least 743 000 work-certificated days were lost in 1975 due to disease of the oral cavity.

By the age of three years, most children have gingivitis and three out of ten have had decayed teeth.[155] Eighty per cent of six year olds have had

decay, and by 15 years of age, 97 per cent of children are affected by caries and periodontal disease. The number of teeth affected per person is a measure of severity. In the three year olds, 1.4 teeth per child has been attacked; eight per cent of the children had rampant decay. The number of teeth attacked increases as the child grows to adulthood (see Table 2).

Table 2 Decayed teeth in children and young adults

	age 3	6	15			
children with caries (percentage)	30	80	97			
	age 3	6	10	15	16–24	25–34
number of teeth attacked	1.4	3.9	4.9	8.4	15.6	18.5

Sources: P G Gray and others. Adult dental health in England and Wales in 1968. HMSO, 1970.

D H Silver. The prevalence of dental caries in 3 year old children. *British Dental Journal*, vol. 137, 1974.

J E Todd. Children's dental health in England and Wales 1973. HMSO, 1975.

Table 3 Periodontal disease in adults
(1624 = 100%)

age	15–19	25–29	45–49	60–65
percentage in terminal stage of periodontal disease	2.2	22.7	79.3	95.0
severity (scale 0–8)	0.93	2.6	5.1	5.9

Sources: A Sheiham and others. Patterns of tooth loss in British populations. *British Dental Journal* vol. 126, no. 6, 1969.

A Sheiham. An evaluation of the success of dental care in the United Kingdom. *British Dental Journal* vol. 135, no. 6, 1973.

The severity of periodontal disease also increases with age, as Table 3 shows. Severity was measured on a 0–8 scale and recorded a mean level of 3.39.

Of all British adults, 42 per cent were in the terminal stages of periodontal disease and about to lose their teeth because of the disease. The periodontal condition in adults aged 45 years and over was very bad indeed; between 79 and 95 per cent of them possessed teeth in the terminal stages of periodontal disease.[138,140]

One of the consequences of dental disease is the loss of the diseased tooth. One out of four five year olds and three out of four 14 year olds have had one or more teeth extracted, and by 16–24 years five teeth per person have been lost. The number lost increases to 10 teeth in 35–44 year olds, and 17 missing teeth at 55 years and over. The number of British people who have lost all their teeth increases with advancing age. One out of five 34–44 year olds, two out of five 45–54 year olds and four out of five 65–74 year olds had no natural teeth.[56]

Pain is another consequence of dental disease. In a national survey[155], one-third of five year olds and half the 14 year olds had suffered toothache. In more than a quarter of the children with toothache the pain had lasted between two and seven days and in 15 per cent of five year olds it lasted a week or more. Not surprisingly, half the five year olds and 64 per cent of the 14 year olds had the aching tooth extracted. In adults it is estimated that, on average, sleep is affected on one in 30 nights due to toothache. People without natural teeth are not immune from pain; three out of ten people aged 65 years and over had oral pain—most of them had suffered the pain for over a month. Over a third of people with false teeth, of all ages, said their dentures hurt them.

There are no comprehensive survey data on pathological lesions in the mouth, but each year in Britain about 1000 people die as a result of oral cancer.[22] However, judging by the findings of Smith that 59 per cent of elderly people she examined had some oral pathology other than that associated with natural teeth[146], the prevalence of oral pathological lesions in the British population is high. Three out of ten elderly people had angular cheilitis, 20 per cent had denture stomatitis, 12 per cent had ulceration of the oral mucosa and 10 per cent had

hyperplasia of the oral soft tissues. Many people are handicapped because of their dental condition. Nearly one-third of elderly people questioned in the same survey had difficulty chewing and 12 per cent had to change the composition or cooking method of food so that they could chew it more easily. Among younger people, 17 per cent of those with a full set of false teeth had difficulty chewing meat and 48 per cent in biting an apple. In addition, 20 per cent of elderly people were frequently embarrassed by their false teeth dropping down when they were talking or eating.

These data indicate that dental caries and periodontal disease are so widespread and so severe in Britain, and the consequences of dental diseases, tooth destruction, alveolar bone loss, tooth loss, pain and embarrassment are so frequent, that dental diseases can be considered a major public health problem. This state has occurred despite abundant evidence on the causes of dental caries and periodontal disease.

Causes of dental diseases

Both dental caries and periodontal disease are caused by the products of dental bacterial plaque. Destruction of teeth (caries) is caused by acids produced by the acidogenic bacteria in plaque when sugar has been consumed; gingival inflammation and destruction of the tissues holding the teeth in the jaws is caused by the pathological reaction to dental plaque. We must therefore ask what are the factors contributing to the formation and metabolism of plaque.

The amount and type of bacterial plaque formed is mainly related to two factors: the types of carbohydrates in the diet and the efficacy of oral hygiene measures. Evidence implicating refined sugar in dental caries is experimental, historical and epidemiological.

The organisms in dental plaque will produce organic acids if certain sugars are eaten. The concentration and quantity of acids formed vary according to the type of sugar-containing food eaten and the relationship of foods to each other. If sucrose is eaten more than three times a day, the hydrogen ion concentration of dental plaque will remain below pH 5.5 for more than three hours a day. At this level, it

has been demonstrated that decalcification of enamel will follow. Confirmation of the role of sucrose in the formation of caries was provided by von der Fehr and co-workers.[48] They produced dental caries in students by getting them to rinse with sucrose nine times a day for 23 days. Evidence of the earliest type of caries lesion occurred within 23 days—a finding repeated by Geddes and co-workers who found lesions within 14 days.[53]

Historical evidence

The historical evidence suggesting a strong association between sucrose and dental caries has been well documented.[71,73,90,91] Although human remains from early cultures where no refined sucrose was consumed showed some evidence of dental caries, the prevalence was very low and the lesions were less extensive than present-day lesions. For example, the pattern of dental caries in early Anglo-Saxon times differed from that found today.[118] In Anglo-Saxon skulls, the number of carious lesions was one-seventh of that found in present-day Britons. Most importantly, few fissure caries were found and interstitial caries was uncommon and usually occurred at the cemento-enamel junction or close to the gingival margin. In addition, caries was uncommon in Anglo-Saxon adolescents. When it occurred, it was found in middle-aged adults. In the present day, dental caries occurs mainly in fissures and interstitial areas in young adolescents.

The Anglo-Saxon period is of particular interest. The prevalence of dental caries decreased from the Roman period, and after the Anglo-Saxon period dental caries prevalence increased. The decrease in caries in the Anglo-Saxon period was related to a change from the more refined diet of the Roman period, when fine ground flour and sugary delicacies were available, to the coarser food of the Anglo-Saxons.

The prevalence of caries doubled between the Anglo-Saxon period and the seventeenth century, but the most dramatic increase in caries occurred during the late nineteenth century and by the beginning of the twentieth century dental caries had become a major dental problem.

Sugar (sucrose) was very scarce in England in the thirteenth century but supplies increased in the fourteenth century. In the fifteenth century, the price of sugar fell, and it became more available but still mainly to the rich. This pattern remained until the beginning of the eighteenth century when sugar consumption was four pounds per person per year. Thereafter, consumption increased gradually until 1845 when duties were removed. From that point, there was a dramatic increase in consumption. Between 1840 and 1890 the amount of sugar consumed per person increased from 20 pounds to over 60 pounds. In 1882, following a memorandum by the Admiralty for guidance of recruiting officers, 25 per cent of recruits were rejected in Dundee because they had five or more teeth unsound or missing. In 1885, Fisher reported that only 20 per cent of boys aged 10–16 years had sound teeth[52], and at the same time Harvey (1886) found five decayed teeth per sailor.[73] Some years later, Cunningham (1908) found 5.29 teeth decayed per 3–4 year olds and 8.25 in 13–14 year olds.[38] These rates are very similar to those found in children in a national survey in 1973.[155]

Consumption had reached 93 pounds per person per annum in 1901 and continued to increase, except during the two world wars, to over 120 pounds per person per annum in the late 1950s. The increase was so rapid that Greaves and Hollingsworth have said '. . . the rise in sugar consumption in the United Kingdom had been one of the outstanding dietary changes in the twentieth century . . .'.[67] Consumption peaked to about 120 pounds in the early 1970s.

Effect of sugar-rationing in World War II

The caries rate decreased during wartime and up to the end of sugar-rationing, when confectionery was scarce and the extraction rate of flour was raised.

When the number of calories derived from sucrose is below 150–160 calories a day (about one ounce per day), there is a marked reduction in caries. The estimate of sucrose consumption is based upon data from populations studied in Japan, Norway, England and a small but very important study in Jersey.

In Japan during World War II, sugar consumption was reduced to below one kilogram per person a year. After the war, sugar consumption increased steadily. Takeuchi and his co-workers have demonstrated a strong positive correlation of +0.8 between sugar consumption and the rate of caries. The percentage reductions in the prevalence of caries ranged from 50 to 75 per cent. At 15 kilograms of sugar a year, 90 per cent of children aged six to nine years had caries, the average six year old had nine deciduous teeth decayed. When sucrose consumption was less than ten kilograms per person a year, the caries incidence was reduced very quickly. When the sucrose consumption increased beyond 12–15 kilograms per person a year in 1962, a disproportionate increase in the rate of caries occurred.[94,143,149,150,151]

In Norway, on the basis of studies conducted by Toverud[158] and others, Schulerud concluded that when major consumption among children aged 6–12 years of age was about 28.5 grams a day, a good state of dental health was achieved. The percentage of carious teeth in seven year olds decreased from 65 to 35 per cent within five years. He also found a close correlation between sugar available for industrial production of food and confectionery and the caries rate, showing that the availability of confectionery, which is eaten frequently and in sticky forms, is directly related to caries prevalence.[136]

In Britain, sugar consumption was reduced to 30 kilograms per person per year during wartime and the immediate post-war years. This led to 30 per cent fewer teeth decaying in five year olds and 43 per cent fewer in 12 year olds—a reduction from 4.3 to 2.4 teeth decayed per 12 year old. Of the children examined, 74 per cent had four or more decayed teeth.[161]

These data indicate that levels of consumption of sugar and sugar-containing foods and confections need to be reduced below 30 kilograms a year per person.

It was reduced below 30 kilograms per person in Jersey during the war. Children there had six ounces of sugar a week until November 1944. They had markedly healthier teeth than children evacuated from Jersey to England: 51 per cent of three to seven year olds had complete dentitions free from caries compared to 11 per cent in the

evacuated children. The average number of carious teeth was 1.8 among children in Jersey and 5.1 among evacuees aged three to five years.[100] The low number of carious teeth of the children who remained in Jersey is similar to that found in the five year olds of dentists who restrict the sugar and confectionery consumption of their children. Similar reductions for five year olds were reported by Weaver.[161] In addition, he found a caries reduction of 45 per cent in 12 year olds—from 4.3 to 2.4 permanent teeth. He also found that the caries-free percentage increased from 4.8 to 26 per cent. From the end of rationing the caries rate increased. Boys in 1959–61 had between 2.5 and 4.2 times more caries than the corresponding groups examined in 1950–1.[92]

Effects of fluoride on caries

Weaver also showed that in an urban area with 1.4 parts per million fluoride in the water the number of decayed, missing and filled teeth (DMF) was 3.9 in five year olds and 2.4 in twelve year olds examined in South Shields, compared to 6.6 and 4.2 in children in fluoride-deficient North Shields. Further surveys conducted during sugar rationing in the same towns showed that caries was reduced in both towns. In fluoride-rich South Shields the DMF was 1.3 in twelve year olds—a 45 per cent reduction. The percentage of children with no permanent teeth decayed had increased from 25.8 to 50.6. The wartime diet had reduced the caries prevalence in North Shields 12 year olds to the same level as that of fluoride-rich South Shields before the effect of sugar rationing was recorded.[161] However, the wartime diet had a cumulative effect with fluoride so that the caries rate was further reduced; a 12 year old in a fluoride-rich area ingesting a low sugar diet had one-quarter of the number of teeth decayed than a child in a fluoride-deficient area eating a high sugar diet.[161] Further evidence to support this finding is available from a comparison of the DMF of 15 year old West Hartlepool (fluoride 2.0 ppm) children examined in 1949. They had 2.1 teeth decayed per child.[161] That figure is much lower than those reported among 15 year olds examined in artificially fluoridated areas in Germany (3.7), USA (6.2), Holland (6.8) and New Zealand (8.5) where sugar consumption was uncontrolled. The reduction in sugar may reduce caries in pits and fissures which are areas of the tooth not markedly affected by fluoride.

Diet and caries

Epidemiological studies clearly demonstrate the relationship between diet and dental caries. Studies of populations living primarily on starchy foods but consuming little sugar have found low caries rates. When sugar is introduced into the diet, increases in caries occur. The Tristan da Cunhans had a very low caries rate in 1937 when sugar was scarce. With the introduction of sugar the percentage of decayed teeth increased from five to 30 per cent.[78] Similar increases have been reported in African populations.[46] The results of the effect of a decrease in sucrose on dental caries have been carefully documented by Toverud[158] and by Takeuchi and his co-workers.[150] Takeuchi showed that the annual caries incidence rate was positively correlated with the annual sugar consumption in Japan ($r = 0.8$) with increases in sugar consumption from 0.2 to 15.00 kilograms per person per year. Shimamura found that the incidence rose when sugar consumption increased from 15 to 21.2 kilograms. He found a more intense attack rate at these higher sugar consumption levels. With a further increase in the annual sugar consumption to 27 kilograms per person, the caries incidence had again risen.[143]

Additional epidemiological evidence on the sugar/caries relationship was provided by a good dietary and dental study of institutionalised children in Australia.[72] The children were given their carbohydrates as wholemeal bread, soya beans, oats, rice, potatoes and some treacle and molasses. Dairy products, fruit and raw vegetables and nuts were eaten frequently. Refined sugar and white bread were virtually excluded from the diet. The institutionalised children aged 11 years had, on average, one decayed tooth whilst non-institutionalised 11 year olds had between 6.1 and 6.9 decayed teeth. As the institutionalised children got older they started eating sugar. This change in diet was reflected in the higher caries figure for 15 year olds. They had 6.46 attacked teeth, which was half the score for non-institutionalised children. In addition, the carious lesions in the children consuming a lower sugar diet were less extensive than in the sugar-consuming children.

People with hereditary fructose intolerance virtually never consume fructose or sucrose. Dental findings in these people indicate that they have almost no dental caries.[112] This suggests that white bread and

other starch-containing products without added sugar, which were consumed by the subjects, play an insignificant role in dental caries.

An analysis of data on the relationship between diet and dental caries strongly supports the theory that the high caries levels in industrialised countries are principally due to the frequent intake of simple sugars and, in particular, sucrose. Diet does not appear to play an important role in the aetiology of the other major dental disease, periodontal, which is caused by dental plaque.

Dental plaque and periodontal disease

A positive association between dental plaque and severity of periodontal disease was reported in 1963 by Greene[68] and by Russell.[132] Russell stated '. . . less than 10 per cent of the variance in group Periodontal Index scores remain to be explained after the combined influence of age and mouth cleanliness has been estimated. A residual factor, wholly independent of age or hygiene, therefore, can have little effect on periodontal disease as scored by Periodontal Index.'[132] The severity of periodontal disease appears to depend upon the amounts of dental plaque present and the time in years that the plaque has been present on the teeth. Similar findings were reported for British populations. Within each age group, people with higher plaque scores had more severe periodontal disease than people with low plaque scores.

Experimental evidence for the relationship between plaque and periodontal disease has been presented in a number of longitudinal studies. In a well controlled study, Löe and colleagues showed that, in healthy mouths, if all active methods of oral hygiene were stopped, plaque accumulated and gingivitis developed within seven days. The gingivitis resolved one week after starting to clean the teeth again.[104] Following this study, Axelsson and Lindhe set up a controlled study where half the children had their teeth professionally cleaned every two weeks. They reported the virtual disappearance of gingivitis in the experimental group after one year.[9,10,11] These studies demonstrated conclusively the important role of plaque in the aetiology of periodontal disease.

We see then that the common dental diseases in industrial societies—dental caries and periodontal disease—are associated with the local effects of sucrose and bacterial plaque on the teeth and their supporting tissues.

3
Prevention of dental diseases

The increases in prevalence and severity of dental caries since the late nineteenth century and the high prevalence of severe periodontal disease in industrialised countries prove that the current approaches to dental disease prevention and control are largely ineffective. This is mainly because health planners and dentists have failed to recognise the major importance of environmental influences. The solution depends on the removal, or modification, of the harmful agents. There has been some recognition of the importance of specific bacteria in dental diseases. Unfortunately, this has led to the erroneous belief that dental diseases can be conquered by drugs or vaccines. Such an approach—a search for a magic bullet—fails to take into account the complex ecology of the mouth. On the other hand, dental caries can be controlled not by attacking the bacteria associated with the disease but by changing the conditions which permit the bacteria to become established, to multiply and to produce acids which decalcify the enamel.

The limitations of the traditional view of the reasons for improvement in health, and of the medical model in particular, have been eloquently outlined by McKeown in his book, *The Role of Medicine—Dream, Mirage or Nemesis?*[110] His conclusion that the misinterpretation of the major influences on health—in particular the limited role of personal medical care—has led to a distorted view of the role of medicine, and to a misuse of resources, is particularly relevant to dentistry. McKeown found that external forces and personal behav-

iour were the predominant determinants of health. In addition, he found that improvements in the health of populations are due to the fact that people do not get ill so often rather than to what happens when they fall ill. The conclusion, that the predominant influences are quite different from those that have hitherto been assumed, has very important implications for approaches to prevention and for dental disease services. Instead of over-valuing the effectiveness and efficiency of dental treatment of established disease, we should concentrate on environmental, social and economic factors contributing to the cause of dental caries, periodontal disease, accidents involving the teeth and oral cancer. When deciding on priorities for prevention, community-wide measures should have higher priority than dentist-based prevention for, in the long term, the community-based approach offers greater hope of improvements in dental health than a total commitment to individual health care which can, at best, affect only a small proportion of the population.

A system of health care which concentrates on the individual to the exclusion of social and other factors is inadequate for a number of reasons. First, the way in which dental health education and preventive therapy are given is not conducive to a permanent change of behaviour in the subject. It is given when the patient already has diseased teeth or gums and has come for treatment. Prevention is frequently added on as an extra service carried out by a paraprofessional who is given a low status in the practice. Second, most of the techniques of dental health education used by dentists do not do justice to the considerable literature on the health behaviour of individuals and on education for health. Third, the predominant fee-for-service system of payment in dentistry engenders public distrust. When dentists try to 'sell' prevention, people are frequently sceptical. Fourth, dentists often adopt a victim-blaming approach to their patients and fail to recognise the social and economical forces which affect behaviour.[134]

The present practice of dentistry is recognisable in the following allegory. A man was standing by the side of a river and heard a cry of a drowning man. He jumped in to rescue him, pulled him to the bank and applied artificial respiration. Just as the rescued man was recovering there was a cry from another drowning man. In jumped the rescuer, brought him to the bank, applied artificial respiration

and got him to breathe again. A further cry from the river. Then more cries. The rescuer could not cope on his own so he got some helpers and some machines. Still he could not cope. So he and his helpers learnt to swim faster, worked in teams—four-handed and six-handed—with more complex equipment. The numbers of people in the water became so great that those who were rescued often had permanent disabilities from being unconscious too long. The man decided that the solution was to teach people how to swim so that when they did fall in the water they would not drown. These rescuing and training activities kept him so busy that at no time did he stop to consider who was upstream pushing all these people in the river.[111]

The dentist's concentration on 'downstream' victim-blaming distracts attention from the 'upstream' activities of the confectionery companies who are 'pushing people into the water'. The 'downstream' activities of health workers against the 'upstream' efforts of the sugar and confectionery manufacturers is an unequal battle with victory assured to the more powerful. Health workers usually intervene only after the damage has been done. The manufacturers have filled the artificial needs they have created because they are more effective in their use of behavioural science methods than the practitioners of health education. They also have more money for their purpose than the health educators have for theirs. Indeed, in Britain, so little money is given to dental health education that, paradoxically, this area of research is sometimes funded by the confectionery manufacturers through such bodies as the General Dental Council and the Health Education Council, thereby allowing the former to influence the dental health education which is given. This raises the question of how dental health education may be influenced by the manufacturers. It is a question which is not dissimilar from that raised by the ambivalent attitude of the tobacco companies to smoking and health.

Defining prevention

Major contributions to improvement in health can come from environmental influences, behavioural changes and, lastly, specific preventive and therapeutic measures. We shall use a more operational definition of preventive medicine than the one usually put forward.[31] In our definition, prevention of the onset of dental disease

is ranked as more effective than arresting or delaying the progress of disease. With this comparative concept, various aspects of preventive dentistry can be arranged in an ordered sequence, the position representing the degree of preventiveness (see Table 4). The degree of preventiveness is defined by the extent to which the preventive action inhibits the onset or alters favourably the natural course of the disease. The programme or procedure which entirely prevents the disease would rank highest, whereas restorative rehabilitation would rank low.

Table 4 Preventive dentistry scale

		measures	*activity*
1	Environmental change	economic social physical	political/public
2	Behavioural change	eating habits teeth cleaning fluoride ingestion use of dental services	personal
3	Early diagnosis	screening dental check-ups	personal and dental services
4	Preventive therapy	changing eating habits fluoride ingestion oral hygiene	personal and dental services
5	Detection and prevention of disabilities/handicap	orthodontic therapy making/adjusting false teeth	dental services

Preventive dentistry can be ranked in five stages which merge and overlap.[153] The first stage can be described as measures to change the environment, including the economic, social and physical. The second stage involves persuading people to change their behaviour. This would include dissuading people from eating so much refined sugar and encouraging them to clean their teeth more effectively and to vote

for the adjustment of the fluoride level of their water supply. If water supplies cannot be fluoridated for political or practical reasons, other methods of fluoride ingestion should be encouraged. The third stage is the early or presymptomatic diagnosis of disease: screening for early signs of dental caries, periodontal disease and oral cancer. Preventive visits to dentists to see where there is disease—the dental check-up—is the most common method of prevention at present for children and young adults. The fourth stage, closely related to the third, is preventive therapy. Here efforts are made by changing dietary habits, by using fluoride and by improving oral hygiene, to reverse any early decalcification or inflammation. These preventive methods are mainly educational. If the lesions have progressed beyond the point where reversal can be expected, operative procedures will be required. Here preventive dentistry merges with therapeutic dentistry because the early treatment of the disease may alter the life history of the disease for the better.[32] The fifth stage is the detection and prevention of disability or handicap after the disease has been stopped. Orthodontic treatment and making or adjusting dentures will often reduce disability and handicap.

The dental services are primarily preoccupied with stages four and five and, to some extent, stage three. These activities have a low preventiveness rating and are predominantly palliative.[77,87,88,137] The services do not prolong the survival of teeth by a significant amount of time. This Hamlet-like reluctance of dental planners, educators and administrators to implement wide-scale preventive programmes despite the evidence presented in the studies by the World Health Organization and the United States Public Health services requires detailed investigation.[15,34,35,36] Why has there been no serious debate about the implications of these studies in Britain where the figures for loss or lack of teeth compare unfavourably with all but one of the areas studied? The low priority given to prevention is particularly disappointing because there are known effective methods of preventing dental caries and periodontal disease. For no other chronic disease are there such effective methods. The incidence of dental caries can be significantly affected by changes in diet, the ingestion of an optimal amount of fluoride—plus the application of fluorides to the teeth in the form of solutions or pastes—whereas a reduction in the amount of dental bacterial plaque on the teeth will control periodontal disease at an early stage.

The promotion of health of a particular part of the body cannot be compartmentalised. Dental health is associated with general health: any attempt to improve dental health should be fully integrated into broadly based health-promoting strategies and actions. Dental health education commonly aims at changing dietary habits, improving oral cleanliness, supporting water fluoridation and visiting a dentist. Dietary and oral cleaning habits have a strong social and economic component, whilst attitudes to water fluoridation are mainly determined by views on infringement of individual rights. Dental health planners and educators should therefore focus their attention on social, political, economic and educational policies which will make it easier for people to take the necessary action to promote health. We divide this action into three parts.

1 Sugar

Reduce the amount of refined sugar and, in particular, sucrose to below 10 per cent of the total calorie intake. This would guarantee a mixed and palatable diet containing sufficient amounts of the essential nutrients. Manufacturers should be encouraged to make more snacks which have a very low sucrose content. Foods and drinks made for infants should be sucrose-free and medicinal syrups containing refined sugars should be replaced by less harmful medicines. Advertising and promoting sugar-containing drinks and confections should be curtailed, especially those adopting the guise of health promotion.

2 Fluoridation

Information on the advantages of water fluoridation should be widely discussed and debated. The legislative tangle between health authorities and water-supplying authorities should be resolved so that the wide-scale fluoridation of water may be implemented. In communities where fluoridation of the public water supply is not feasible, individuals should be able to use fluoridated salt or tablets if they wish. Rinsing with fluoride at schools should also be considered.

3 Oral hygiene

Most people in Britain brush their teeth regularly every day. They should be given more information on how to brush effectively, and why—so that the amount of dental plaque will be reduced.

These three preventive measures are based upon a number of long-term epidemiological and field studies, and on clinical studies.

Sugar

The first recommendation concerning the amount and frequency of sucrose ingested takes into account data on reductions in dental caries which follow reductions in quantity of sucrose eaten. Of equal if not greater importance is the frequency with which it is eaten.

There are wider implications of a high-sucrose diet. There is evidence that it is a major factor in obesity and the incidence of diabetes in later life. A high proportion of sucrose in the diet will displace other essential nutrients.

By reducing the level of sugar consumption, the onset of dental decay is delayed, and its progression is retarded. Other benefits to health would follow a reduction in the consumption of refined sugars to about one ounce per person a day from the present high level in Britain of four ounces a day (which amounts to an annual consumption of 90 pounds per person). Sugar contributes about 15 per cent of the calorie intake, but calories from sugar should be reduced to four per cent, and replaced by carbohydrates derived from high-fibre-containing cereals and vegetables—but not by fats. In addition to the expected decrease in dental caries, obesity and diabetes, there should also be a decrease in the incidence of bowel disease because of the increase in dietary fibre.

A decrease in the prevalence of obesity is a widely expressed public health goal.[23] Yet the rate of obesity is increasing. Even childhood obesity is emerging as a problem. In Europe, one in four middle-aged men were found to be obese, and considerably more women.[96] In

England, 17 per cent of infants were found to be overweight, and this was attributed to a high calorie intake.[127] Obesity in adolescent girls is also increasing.

But reduction in the consumption of one high-calorie food does not have to be replaced by increased consumption of another—because people are not short of energy in Europe. The need is to promote measures to prevent or reduce obesity, because it is related to many other diseases. Therefore, there is an urgent need to evaluate the general government policy of encouraging the production of commodities, including many which are known to be health hazards. The policy has important implications for dental health and dental services. For example, Gordon Best has estimated that a one per cent increase in spending on food containing refined sugar would lead to an additional 2¼ million courses of dental treatment.*[18] The health aspects of the uninhibited growth of refined sugar production and the sale of products with a high sugar content must be tackled seriously.

Cumulative effect of fluoride and less sugar

Whereas diet is the most important factor in dental caries, general dental health can be improved by the cumulative effect of a low-sugar diet, fluoride and oral hygiene. Fluoride added to the water supply or to table salt can reduce dental caries by about 50 per cent and tooth extraction by 80 per cent. Children aged 15 years living in fluoridated areas had caries affecting an average of six to eight teeth compared to children in fluoride-deficient areas who had between 11 and 16 decayed teeth.[12] The protection is also conferred on teeth already present when fluoridation is commenced, and the benefits persist into adult life.

But a diet high in refined sugar can reduce the effect of fluoride. Bibby suggests that the increased frequency of eating sugar-containing snack foods and confections has had an important effect on the caries pattern in the United States.[20] He considers that this factor may eventually outweigh the beneficial effects of fluoride.[19] Therefore,

* G Best. *Some notes on the macroeconomics of illness and health . . . or should the socially-responsible health economist re-focus upstream?* (Paper presented at the Health Economists Study Group, Lancaster, 18–20 December 1978.)

relying on fluorides alone as a preventive agent, and ignoring the dietary control of refined sugar, may produce reductions in decay for a period, but in the long term fluoride may be insufficient to protect teeth from the frequent acid attacks produced by sugar. Even now, fluoride is only a partial solution to dental caries. Although it reduces decay by half, children in fluoridated areas need between four and eight teeth filled by the time they are 15 years old. Life-long residence in naturally fluoridated areas confers some benefit, but does not give complete protection because nine out of ten adults examined had seven teeth filled.[133]

Fluoridation

Fluoride is the most effective tested method of preventing the onset and the progression of dental decay in children and adults. In areas with water containing 1 ppm fluoride, there are consistent findings of less than half the amount of dental decay compared to areas with water containing 0.1 ppm fluoride.[12] Some studies have reported reductions in caries as high as 65 per cent in the deciduous dentition of young children and in the permanent teeth of 12 year old children.[12] Adults living in fluoridated areas also benefit by having up to 60 per cent less caries than 44 year olds in a very low fluoride area.

In addition to the lower incidence of dental caries, water fluoridation results in savings in cost, time, pain and suffering. It has been estimated that if all people using public water supplies in the United States drank fluoridated water, there would be a saving of at least 700 million dollars a year.[116] The savings are made by employing fewer dentists: not least because each dentist can care for about 40 per cent more children who have had fluoride protection.[39] Indeed, 12 years after the fluoridation of a water supply, the number of dental personnel required in a city was reduced by half[101], and the cost of treating children was only about 43 per cent of the cost for treating children in a non-fluoride area. The treatment time per child in a fluoride area was 63 per cent less than in the non-fluoride area.[7] The dental health benefits of water fluoridation, the safety of the measure[47,129] and the savings in costs and suffering make fluoridation of drinking water a major public health measure which should be promoted wherever it is technically feasible.

Where fluoridation is not feasible, alternative methods of adding fluoride to the diet can be implemented. The three methods which have been tested and shown to be effective are school water fluoridation, salt fluoridation and individually administered fluoride tablet consumption. Of these three, salt fluoridation is the most promising as a public health measure. Fluoridated salt has been available in Switzerland since 1955 and by 1967 three-quarters of packaged domestic salt sold in one canton contained added fluoride. Reduction in caries was found when 250 milligrams of fluoride for each kilogram of salt was used.[115] In Columbia, reductions in decay of up to 50 per cent were found, and it was concluded that the cariostatic effect of salt fluoridation is equal to water fluoridation provided the fluoride of salt is adjusted to provide urinary fluoride excretion levels similar to those found in areas with 1 ppm fluoride in water.[115]

Fluoridation of school water supplies is also a satisfactory method. Studies conducted in the USA suggest that when fluoride at a level of four and a half times that recommended for community water fluoridation was added to school water supplies, children experienced 40 per cent fewer decayed tooth surfaces than before fluoridation. The rate of tooth extractions also decreased, by 65 per cent during a 12 year period.[79]

The third choice is fluoride tablets and drops. Most studies have reported caries reductions in deciduous teeth of approximately 50–80 per cent when fluoride tablets were begun before the age of two years and continued for three and four years. In permanent teeth, reductions ranged between 20 and 40 per cent.[21] However, when the tablets were sucked and then swallowed, a dramatic 80 per cent reduction in decay affecting the first permanent molars was reported.[147]

Prevention in schools

The most successful method of distributing fluoride tablets is by school-based programmes when the tablets can be sucked and swallowed under the supervision of a teacher or dental health worker. In Zurich, since 1963, there has been supervised toothbrushing after sucking fluoride tablets, combined with dental health education. They encouraged sugar restriction, and encouraged the use of fluoride

toothpaste and fluoride tablets. The reductions in caries which followed among 12 and 14 year olds was 47 per cent and there was an improvement in gingival health and less dental calculus.[113,114] In Denmark, a preventive programme in schools led, within five years, to a reduction from 11.3 to 5.9 carious tooth surfaces per child in the third grade of school. The programme included rinsing with a 0.2 per cent solution of sodium fluoride, regular instruction in tooth brushing, and lectures to parents and pupils. To assist the programme, the vulnerable fissured surfaces of the participants' teeth were sealed to prevent caries in these sites.[128]

All the Scandinavian countries have had school-based fluoride mouth-rinsing programmes since the early 1960s. This measure has led to an average decrease of 2.8 in the number of fillings per child. After considering all the expenses of the programme, it was calculated that the monetary savings for the 40 000 children of Göteburg was 4 813 500 Swedish krone, or 100 krone per child.[157]

Community-wide preventive programmes have led to a dramatic improvement in dental health in Norway. The Norwegian prevention programme involves teams of the dental, medical and nursing professions. At the child health centres, parents are given information about diet, fluoride tablets and oral hygiene by dentists, public health nurses and doctors. At school there is regular fluoride rinsing and tooth brushing. Fluoride toothpastes are promoted by dental practitioners and toothpaste manufacturers, and dietary advice is given at various centres. There is a national food policy directed at ensuring a safe diet, which includes a reduction in the frequency and quantity of sucrose consumption. These measures have led to a reduction in caries of over 60 per cent among three year olds[160], and in children aged six to 17 years the number of filled surfaces per child had decreased from six in 1970 to less than four in 1976. The saving was 880 000 fillings in 1976, which corresponds to the number of fillings that 220 dentists would do in their lifetime. So a 25 per cent reduction in caries and a 45 per cent reduction in the number of fillings were achieved among 325 000 children by implementing simple preventive measures.[105] But despite the nutrition and health programme, the figures have shown that a high rate of caries still exists in Norway. The average 14 year old had 24 tooth surfaces decayed, missing or filled in 1975. On the other hand, because 30–35 per cent

of the 767 000 children in Norway aged 0–11 years are now taking fluoride supplements every day[105], the caries rate can be expected to fall as these children grow up. When sugar consumption decreases and oral cleanliness improves, the dental health of the population is likely to get better, provided the dental profession adapts its present pattern of treatment to the effect of a higher level of prevention.

A fall has been observed in the caries prevalence of children of 14 years and younger in the West of England.[124] No obvious change in the National Health Service or in the consumption of confectionery[135] could account for this trend. Fortunately, the data from a clinical trial of fluoride toothpaste spanning the years 1970–3 in Bristol are available. These data were compared with an examination in 1979 of 11 and 14 year old children. There had been no introduction of fluoridation in Bristol's water supply since 1970. One major change between 1970 and 1979 was the change of toothpastes to formulae including fluoride. In 1970 only 5 per cent of toothpastes contained fluoride, whereas in 1978 as much as 97 per cent of toothpastes contained fluoride. It was incorporated in toothpastes in the UK at the 1000 ppm level, as either sodium monofluorphosphate or stannous fluoride. The 11 year old group showed a reduction in the mean number of decayed and filled teeth from 4.21 in 1970 to 2.7 in 1979. Those who had not experienced any caries rose from 5 per cent in 1970 to 16 per cent in 1979. The 14 year old group showed a fall in decayed and filled teeth from a mean of 8.76 in 1973 to 6.24 in 1979. Those without caries experience rose from nil in 1973 to 4 per cent in 1979.*

Such an association does not constitute proof but it indicates that fluoride toothpaste may have been dismissed too easily in the past as being of minor importance in the prevention of caries.

Plaque and oral hygiene

Fluoridation and a change of diet to reduce sugar consumption are

* Personal communication from N Lawson and C K Burchell, Unilever Research, 1980.

effective in reducing the amount of dental decay. But these measures have little effect on periodontal disease. At best, tooth loss in the lifetime of the individual will only be reduced by 15 per cent due to fluoridation. This is borne out in areas with natural fluoride-rich water, such as West Hartlepool, where tooth loss is still very common.

Periodontal disease is caused by bacterial plaque—and a reduction in the quantity of plaque will lead to a reduction in periodontal disease.[8] A programme which successfully reduces plaque will have an effect on the severity of periodontal disease and on tooth loss.

The problem is unlikely to be solved using conventional methods. It has been estimated that if each general dental practitioner in the United Kingdom treated his 1000 regular patients for periodontal disease, it would require 160–165 days a year to reduce the severity of periodontal disease by 40 per cent.* Such an improvement would reduce the percentage edentulous by only 0.7 per cent per year. If, as an alternative to this expensive approach, community-wide health education were employed, the same improvement could be achieved. Levels of dental bacterial plaque can be reduced by oral hygiene. In the USA, oral cleanliness has improved by 4.5 per cent over a ten year period; 6–7 per cent fewer white people over 45 years have lost all their teeth.[28] Similar improvements in oral cleanliness in the UK should result in a decrease in the numbers who become edentulous. Such an improvement would be due to a change in behaviour and not the consequences of more dental treatment.

Considerable attention has been given here to the first two stages of prevention—environmental and behavioural—because they are so important. The sparse references to dental health education reflect not its unimportance but the neglect of well coordinated community dental educational programmes. Despite these preventive measures, there would still be some dental disease because no system can be fully effective. Therefore, early diagnosis of disease becomes important and allows other preventive measures to be instituted which will halt or reverse its progress.

* A Sheiham and F C Smales. Suggestions for improving dental health and dental services. Evidence submitted to the Royal Commission on the National Health Service, 1977. (Unpublished)

Screening

The most common screening method to detect early dental disease is the dental inspection. Unfortunately, the opportunity is used to detect the need for treatment rather than for prevention. In their early stages, dental caries and periodontal disease can be reversed by applying fluoride, by modifying the diet and by effective tooth cleaning. These measures should be instituted whenever dental diseases are detected. Other treatment should be delayed until the disease is under control. Individually applied preventive measures should also be used for people at high risk, because of either medical and physical impairments or a particular susceptibility to dental caries or periodontal disease. For example, people participating in contact sports should be encouraged to wear mouth guards to prevent tooth fractures; the elderly should be shown how to examine their own mouths to help detect any premalignancy, persistent ulcer or white patch.

Treatment principles

When operative procedures are required to treat caries, the principle of 'small is best' should be applied. A system of dental practice which bases its rewards upon high outputs of restorations allows no opportunity for the evaluation of alternative therapeutic regimens. A more conservative approach to restorative dentistry, as advocated by Elderton[44], could relate operative treatment more closely to need. Similarly, when treating advanced periodontal disease, a conservative approach is indicated because surgical intervention to control the disease is not always successful.

Detecting and preventing disability and handicap

The fifth stage in prevention is the detection and prevention of disability or handicap. It includes the detection of severe malocclusion in children, and of inadequate dentures which do not permit the wearers to enjoy eating, speaking or laughing. However, criteria of need for treatment are vague and should be strengthened by using reliable clinical criteria in addition to social indicators.

Within the past decade, convincing evidence has been presented that, for defined groups chosen for study, periodontal disease and dental caries can be entirely prevented by tooth cleaning and dental health education.[10,11] However, field trials using these methods have not been as successful as the original clinical trials.[70] Children in the test group, despite having their teeth professionally cleaned for 10–15 minutes every three weeks, developed on average about two new carious lesions a year. These studies of professional tooth cleaning and other preventive measures carried out by dentists in their surgery are of great significance in the fight against dental diseases, but they illustrate the limitations of operative 'downstream' activities in preventing dental diseases. On the other hand, changes in food policy, fluoridation—a public health measure—and general improvements in education and living standards have led to changes in dental disease patterns. The public should be encouraged to demand changes in the policies affecting refined sugars to achieve lower levels in manufactured foods and pharmaceutical products. In addition, the public should demand that the benefits of fluoride should be more widely available. A greater emphasis must be laid upon dental health education, including the adverse effects of some advertising.

Policy and legislation

The need for government policy and legislation on these topics has been recognised for many years. The Interdepartmental Committee on Physical Deterioration found in 1904 that dental caries was a common cause of physical deterioration.[66] In 1911, Pickerill demanded legislation to control the consumption of refined sucrose-containing foodstuffs because of the gravity of dental disease.[126] He urged, on humanitarian grounds alone, action to reverse the advance of 'this most prevalent of all diseases'. If 90 per cent of people went about with decayed or suppurating finger nails, there is no doubt that urgent and extensive measures would be adopted to suppress that disease. Yet almost no systematic attempt has been made in the United Kingdom to prevent and control dental diseases. Instead, the emphasis has been on treatment. The sound advice given by Pickerill has not been heeded.

'If, during the past one hundred years, half as much time, money

and brain power, had been spent on evolving means for the prevention of dental caries, as has been spent on the perfecting of ways and means for replacing artificially tissue lost by disease, there can be no doubt that the present condition of affairs would not have come about.'

4

An international comparison of methods of providing dental care

A number of dominant features characterise general dental services in Western Europe, North America, Australia and New Zealand. They are all dentist-centred, reparative services rather than preventive, and are based mainly on a fee-for-service method of payment. The provision for adults depends upon demand, not need, and the payment is often made by a third party, such as the government or an insurance company. In all general dental practice systems, dentists provide and finance their own practices.

Treatment services for children often differ in their organisation from those provided for adults. The dentists and auxiliaries work in publicly owned premises and are salaried. They screen children to assess need for treatment, as well as responding to demand. Most of their time is spent on reparative dentistry but they also organise prevention for special groups such as children, pregnant women and disabled people.

Apart from the differences between dental services for children and for adults, the main international difference is whether the patients pay all of the fee directly to the dentist, as in private practice, or whether some of the fee is paid by a third party. Another difference is that some countries—such as the United Kingdom—allow dental hygienists or clinical technicians (Denmark) to work on patients, whilst others (Federal Republic of Germany) do not use dental auxiliary personnel.

Effectiveness

What effect have the dental services had on dental health? To answer that question the World Health Organization and the United States Public Health Service conducted an international collaborative study in six countries: Australia, Federal Republic of Germany, Japan, Norway, New Zealand and Poland.[34,35,36] The countries were selected on the basis of four major criteria

degree of government or private enterprise involvement

use or non-use of auxiliaries

system of financing

target groups receiving the services.

All the systems selected for study had been in existence for 20 years or more. They were

predominantly private practice with a fee-for-service system without many auxiliaries (Australia)

an insurance-based system, part of general health care, in which patients and employers contributed to a sick fund (Federal Republic of Germany)

a social insurance system of payment and a service using dentists and many hygienists (Japan)

a dentist-based system with both private practice and government-paid practice co-existing (Norway)

a system similar to Norway's but employing operating auxiliaries for treating children (New Zealand)

a predominantly government-financed system without auxiliaries (Poland).

In addition, Denmark, Canada and the USA carried out replication studies using the protocol developed by the WHO/USPHS study.

The findings of these comprehensive surveys have provided very important insights into the strengths and weaknesses of the systems studied. Their most significant finding was that none of the systems studied was able to prevent a large number of teeth being extracted from people by the age of 35–44 years. Further evidence of failure to conserve natural teeth is provided by the proportion of adults wearing removable dentures (see Table 5).

A better idea of the amount of unmet need can be obtained by combining the restorative, periodontal and prosthetic needs. By constructing a combined status index (CSI) which gives a score of one to each tooth with untreated caries, one to a tooth affected by periodontal disease and two to each missing tooth, Nippert and Keil reported that 64 per cent of the 35–44 year olds examined in Hanover had a CSI score of between 31 and 56 (the maximum score). The mean score was 33.4 (±8.6).*[95] These high figures for unmet need suggest that, in an area with a highly favourable ratio of dentists to the population (1:1402 in the metropolitan area and 1:2680 in the non-metropolitan area where the sample was drawn), a demand-oriented reparative dental service was not satisfying the normative dental needs of the adults. The service was not fulfilling the needs of the children either. On average, 83 per cent of 8–9 year olds needed restorative treatment to 25 per cent of their permanent teeth, and 13–14 year olds needed four teeth treated. Five per cent of children needed pulp treatment, and five per cent had to have one or more teeth extracted. In addition, the 13–14 year olds had, on average, 18.2 teeth with gingivitis. Thus, in 1973, this service cost 4.5 billion deutschmarks, including 1.9 billion for dental appliances. This amounted to 11 per cent of the total costs of the national health insurance sick funds for health services. None the less, it was not coping adequately with dental disease and its consequences.

Hanover does not have a structured dental service for children, and that may explain the high unmet need in children there. Trondelag (Norway) and Canterbury (New Zealand) have well organised dental services for

* R Nippert and U Keil. *Research on services in relation to need in the Hanover area (FRG).* Paper presented at the International Association for Dental Research conference, Copenhagen, 1976. (Unpublished)

Table 5 Dental state of adults: international comparison

	missing teeth (average per person)	*no teeth*	*false teeth*	*need for more prosthesis care*	*unmet need*
		(percentage of sample in each town)			
Canterbury (NZ)	15	36	55	60	20
Sydney (Australia)	11–9	13	47	60	20
Aarhus (Denmark)	11–9	10	31	85	—
Trondelag (Norway)	11–9	16	27	70	20
Baltimore (USA)	7	11	41	68	29
Hanover (FRG)	6	2	23	35	20
Hamanashi (Japan)	3	0	14	40	50

Source: WHO/USPHS studies described by L K Cohen, Dental care delivery in seven nations: the international collaborative study of dental manpower systems in relation to oral health status, *in* International Dental Care Delivery Systems, edited by J I Ingle and P Blain, Ballinger Publishing Company, 1978.

schoolchildren, and in these two areas over 90 per cent of the restorative dental needs were met. But the amount of unmet need in adults in those areas was the same as the places where children did not participate in an organised, school dental service.

The findings from this study highlight four important factors about improving dental health.[15,34,117]

1 Oral health is closely affected not only by manpower arrangements but also by consumer behaviour and beliefs.

2 Utilisation of dental services in the areas studied does not reduce the incidence of dental disease.

3 The availability and accessibility of even the best system does not ensure good utilisation by the public.

4 The findings in adults indicate that even a well organised, widely available, school-based dental service does not necessarily lead to a satisfactory level of oral health in adult life.

The analysis of the data from the WHO/USPHS study has some important policy implications. The main one is that the preventive efforts of the public and the profession are both important but as yet inadequate. Some countries provide a school dental service for children and subsequently leave them to seek private dental treatment as adults. Other countries encourage children and adults to attend the same dentist throughout life. This encourages continuity of care.

There is no difference in the effectiveness of these alternative systems when judged by their ability to prevent tooth loss in middle age. Whilst this is generally true, some individuals benefit from each system. This suggests that no single method of dental care is suited to all sections of a population. A number of methods should be available and each should have equal status and not be identified with a particular socio-economic group. None of the methods should neglect the treatment of children whilst concentrating on elaborate restorative work for adults. The WHO/USPHS study points to the importance of involving consumers in discussions concerning the acceptability of dental care.

The study also highlights the relationship between a repair-oriented dental service, the rate of dental disease, the way adults pay for dental care and the socio-economic status of the community. In New Zealand, children have free dental care in an organised system but adults have to pay privately. The fees are fairly high relative to the average income. Norway has a system similar to New Zealand's, but

average incomes are higher in Norway. In New Zealand, the children's teeth are filled and refilled frequently. The technical standard of the work has been judged as very good. The cavities prepared are relatively large, and conform to conventional principles of cavity preparation.[44] Each time a tooth is refilled the cavity is enlarged, and with each enlargement the life expectancy of the restoration is diminished.[55] By the time New Zealand children leave school, half their teeth have been restored and the fillings are relatively large because of successive restorations. During the 1950s and 1960s, each New Zealand child had, on average, five fillings per year. This had dropped to four fillings a year in 1975. Thus, a child who started school in 1960 could have received 41 fillings by the age of 13 in 1967.* Eleven of these fillings were done on deciduous teeth and 30 on the permanent teeth. According to the WHO/USPHS survey, only 10 permanent teeth were filled, so it appears that each filled permanent tooth had received three fillings, and a fair percentage of the children would have had teeth filled four or five times.

In adulthood many fillings replaced in childhood have to be replaced with larger and more expensive fillings or crowns, for which people have to pay privately. Consequently, New Zealanders often decided to have their teeth out rather than restored. That decision was influenced by the belief that tooth loss is inevitable: a belief reinforced by the large number of people in New Zealand who are edentulous. Norway has a similar pattern of treatment for children, but the readily available dental services for adults, at costs which until recently many could afford, tended to encourage restoration rather than extraction despite the high incidence of disease. In addition, social attitudes to retaining teeth played an important role.

In countries without organised school dental services, between 40 and 60 per cent of dental caries is untreated or requires retreatment.[34] The disease is allowed to progress in children and thus more complex restorative treatment or extractions are required in the adults. For example, in the German and Japanese adult samples studied, between 28 and 32 per cent had dental bridges compared to one per cent in New Zealand. Time-consuming and expensive procedures such as bridge-construction place a large financial strain on the patient or

* J C Rodda. *The restorative philosophy—success or failure?* in H Brown, *editor. Oral health needs of the adult population.* Proceedings of a symposium, Dunedin (New Zealand), April 1977. pp. 57–62. (Unpublished)

health insurance system, and mean that a small part of the population takes up a large part of the dentist's time. For example, in Sweden, after the introduction of insurance to cover some of the costs of dental care, it was estimated that half of all dental measures were carried out on only seven per cent of the population. The cost for each person having dental care increased from 297 Swedish krone among 17–44 year olds to 622 SKr for 65 year olds. This was in spite of the decrease in the number of dental procedures carried out among the older group. Altogether, crown and bridge work accounted for about 40 per cent of the total expenditure for dentistry in Sweden in 1975.[152]

These trends are portentous: they suggest that, in the absence of broadly based preventive measures, an increasingly greater proportion of resources will be devoted to restoring the teeth of a smaller segment of the population. Important steps in reversing these trends will include prevention on a wide scale; a change in the philosophy of restorative dentists; a greater emphasis on controlling periodontal disease; and the organisation of dental services which are acceptable and accessible to all. These measures require an extensive programme of public health education to encourage a change of diet, fluoridation of water supplies or supplementary fluorides, and improvements in oral hygiene. In addition, the public should be involved in the planning of dental services as an integral part of the general health service. To isolate the dental service from the general service jeopardises the effectiveness of dental care. Only a system in which all these factors are given the correct emphasis will stand a chance of making an impact on the present high levels of dental disease, and on the utilisation of preventive and reparative services.

5
Evaluation of dental health services in Britain

The General Dental Service of the British National Health Service costs over £300 million per year, and if the rate of inflation continues costs could double by the turn of the century.[41] Such a costly service, concerned primarily with the treatment of two diseases and their consequences plus the correction of malpositioned teeth, ought to have clearly stated, measurable objectives which should have been evaluated over the past 30 years. However, not only has there been no comprehensive evaluation but there are no clearly stated goals or objectives. Neither is there any worthwhile debate about the objectives of the General Dental Services and the appropriateness of the methods currently used to improve dental well-being.

This inexplicable lack was recognised by Moser and colleagues in 1962.[119] They found little reference to what can be considered reasonable dental health at different ages. Neither could they find data on what constituted reasonable standards of treatment.

In the absence of any obvious stated goals or objectives, evaluation is difficult. For evaluation is an assessment of the adequacy and appropriateness of a programme to meet needs. It is a check on the correctness of the planning and of the recommended methods and procedures.

Most researchers in health care tend to think of evaluation in terms of the effectiveness of particular programmes. However, there are

serious conflicts because policy-makers and administrators have other views on evaluation. They assess the effectiveness of the whole organisation, and question the proportion of resources allocated to particular sections. Thus particular goals often remain subservient to wider political issues. Every organisation has several goals, the important one being survival! It has been suggested that instead of rigorous goal-oriented criteria, the central question should be: How close does the organisation's allocation of resources approach an optimal distribution? 'Optimal' includes a balanced distribution of resources to serve all the goals of the organisation. This approach assesses the emphasis given to particular objectives and the under-emphasis of others.

Another type of evaluation looks at the relative effectiveness of different programmes, strategies and methods. The function of this type is to provide information which will assist in designing future programmes or in changing a programme. Evaluating effectiveness tests the validity of our assumptions: assumptions that are the basis for linking resources to activities, activities to lesser objectives, and lesser objectives to main objectives.

An important but little applied form of evaluation is relevance evaluation. This takes into account new knowledge, or socio-environmental, demographic or value changes. It asks other questions. Is it time to reorder our goals? Has the problem been reduced as far as we would wish? Are there other problems of greater concern? Is there new scientific information which renders the programme obsolete? Most importantly, is the programme designed to deal with the fundamental problem or is it just directed at a symptom?

Very little evaluation of this type has been applied to dental health services because dental epidemiology is at an early stage of development, and because of the intrusion of political factors. A few dentists and a few civil servants have dominated the discussion on the appropriateness and success of the methods of dental care. Because of this dominance, any assessment of dental health services must include an evaluation of the methods by which policy-makers come to their decisions. The Department of Health and Social Security pays lip service to 'prevention and health, everybody's business'[58], but the health service lacks a democratic structure and makes most of the

decisions in secret. Neither the public nor most of the people working in the health service have any sense of participation in determining the priorities nor feel they can influence decisions and, thus, events.

Another important form of evaluation is that of the appropriateness of the major approach to reducing avoidable pain and suffering, and to improving well-being. Here one is forced by the weight of evidence to conclude that the current approach—treating the disease when it occurs—is inappropriate.

Because there is so much untreated dental disease, it is considered imperative to treat the disease before considering prevention. This leads to the vicious circle: the amount of disease can be reduced only by preventive measures; but there is so much disease that there are not enough funds or time to consider prevention; this leads to more disease and more need for treatment and palliation.

The restorative approach is inappropriate because it assumes an engineering approach to the body. The mouth is considered as a collection of distinct parts, and as a mechanical device with teeth which are isolated from the individual. Thus any fault has to be corrected using a technology which becomes more advanced and more expensive with each new problem. The technical evolution of dental practice described elsewhere has led to increased output of work, but no concomitant improvement in quality of care.

The evolution of dental care via the development of the dental profession is described in Chapter 6. The pattern of development has been technologically based and oriented towards solving the technical and economic problems of treating the vast mass of existing dental disease. Great advances have been made in technical problems such as increasing throughput and lowering the unit cost of treatment. These have included techniques which diminish the pain and discomfort of such treatment. Unfortunately, there is no evidence that this has been accompanied by an increase in quality or that the ultimate result of these technical improvements has made a major contribution to reducing the prevalence of dental disease. This is not surprising because the system is not designed to achieve these objectives.

An indictment of the restorative approach to dental care has been

made by Allred and Elderton following a longitudinal study funded by the Department of Health and Social Security.[4] A disparity was found between those characteristics of restorations advocated by clinical teachers and textbooks and the restorations placed by dentists. Such disparity would, if important, lead to the eventual failure of the restorations. Newly placed restorations had one site in every five sampled judged to be poor enough to cause the premature failure of the filling. This prediction gains credibility when viewed in the light of restrospective studies which showed a 50 per cent loss of restorations in eight years and a 90 per cent loss in 15 years.[3,55]

The consequence of these findings is that each filling placed in childhood may need removal several times before the age of 35 years, which is the age when the rate of tooth loss increases. Every time a filling is replaced it becomes larger and consequently more complex, needing more time and attention on each occasion. The skill demanded also increases but, according to Allred and Elderton, this is unlikely to be achieved. This problem is not unique to the National Health Service and can be found in any country with a restorative philosophy as the basis for dental care.

In Sweden, for example, 30 year olds have three per cent of their teeth restored with crowns or inlays while 50 year olds have 24 per cent similarly restored.[69] Because of this technological imperative, in countries like Sweden with a 'good' ratio of dentists to population, 40 per cent of the total expenditure for dental care is for crowns and bridges.[152] And in England, the proportion of the General Dental Service expenditure on crowns has increased from 1.6 per cent in 1965 to 12 per cent in 1977.[41]

The principle of early operative intervention is followed by many dental practitioners. Their training and the method of payment encourage them to do so. Thus, it is difficult to form any valid conclusion regarding the optimum time for placing a restoration, an important consideration if it has a limited life. The natural history of the early carious lesion in the presence of fluoride is, therefore, untested and the capability for remineralisation is unknown. There is need to apply the existing knowledge to the rate of carious initiation and progress in a practical sense, and also to apply recent knowledge on arresting lesions or even remineralising them. This has implica-

tions regarding the frequency of dental examinations, which should ideally be related to an individual's susceptibility to dental caries. The six-monthly recall would no longer be a magic routine with all the false sense of security it engenders. People would be less dependent on professionals but better informed and more able to care for themselves.

Even if the restorative approach were reasonably effective, it would still be very expensive. To repair completely the damage caused by dental caries in the United States population would cost about 8 billion dollars more each year than the 13 billion now being spent. If we take into account such factors as the limited life of restorations, their increasing size and the cost of each replacement, the cost increase would be enormous. Each dentist would be treating fewer people because the work becomes more complex and more time-consuming as the restorations enlarge. In New Zealand, one dental nurse was capable of treating all the cavities of 472 children.* Her work was confined to one-tenth of a person's lifetime. For the remaining nine-tenths of their lifetime, adults require frequent attention to service their restorations. In England and Wales it was found that there are about 1200 regular attenders per dentist and that many patients were far from dentally fit.[56] It appears that on this basis a British dentist would only cope with the needs of approximately 500 people per year, which is the number seen by the average Swedish dentist. However, Swedes who attended dentists regularly once a year or more still had over 15 per cent of their remaining teeth decayed; those aged 20–34 years who visited dentists regularly had five decayed surfaces per person. They also continued to have teeth extracted at the rate of one every four years.[69]

The results of the 1978 England and Wales survey of adult dental health have enabled a comparison to be made with the 1968 survey although the sampling procedures were slightly different.[156] The average number of decayed teeth in dentate persons has fallen from 2.2 teeth in 1968 to 1.9 teeth in 1978 but the difference was not statistically significant. Regular attenders at the dentist were found to

* J C Rodda. *The restorative philosophy—success or failure?* in H Brown, *editor. Oral health needs of the adult population.* Proceedings of a symposium, Dunedin (New Zealand), April 1977. pp. 57–62. (Unpublished)

have 1.1 decayed teeth compared with 2.9 decayed teeth for irregular attenders. Amongst the group who had lost no teeth, the 16–24 year group of regular attenders showed no change and represented four per cent of the total, whereas in the same age group the percentage of irregular attenders who had lost no teeth had increased from two per cent in 1968 to five per cent in 1978. In the 25–34 year old group, the regular attenders possessing all their teeth had improved from one per cent to five per cent of the total sample, and irregular attenders of the same age with all their teeth had improved from three per cent in 1968 to five per cent in 1978.

At the other extreme was the group who had 18 or more missing teeth. The regular attenders in this group, in both age ranges, remain unchanged at one per cent and two per cent, respectively, of the total. The irregular attenders with 18 or more missing teeth remained unchanged at one per cent for the 16–24 year old group. The 25–34 year old irregular attenders had, however, improved from 12 per cent of the total in 1968 to only five per cent in 1978.

More recently there has been a hopeful sign of lower caries prevalence amongst children of 14 years old and under in the West of England.[124] There has been no change in the National Health Service which readily explains this trend, but an interesting association with the move to fluoride toothpaste has been demonstrated. This has been discussed in Chapter 3.

There is no doubt, from the evidence, that the restorative approach is, relatively, both ineffective and costly. The disturbing fact is that the large financial and educational resources given to restorative dentistry have only a marginal effect on dental health.

Restorative dentistry, albeit the dominant part of dental services, does not encompass the whole dental care system. The other parts also need to be evaluated. In 1973, the success of dental care in the United Kingdom was assessed.[137] The criteria for effectiveness included an estimation of the number of people free of dental disease and the numbers of teeth extracted. These were taken as a measure of success in preventing the sequelae of disease. The percentage of people who were edentulous or wearing dentures was also estimated and taken as a measure of success in maintaining a natural functioning dentition

for life. It also reflected the attitudes and behaviour of people about dental health. The quality of treatment was assessed using the tooth, the mouth, the person and the community as bases for evaluation. Costs and the manpower requirements for alternative services were analysed and, lastly, the flexibility of the administration of the service was evaluated. The main conclusions which emerged were, first, that many methods of treatment and practice were of questionable value. Second, that current methods were not successful in coping with dental disease in the community. Thus, unsuccessful methods continued to be used, whereas proven effective methods were not.

In spite of evidence showing that the current methods and systems are ineffective, civil servants and an influential part of the dental profession remain preoccupied with data showing that the number of fillings and courses of treatment are increasing—implying that with more treatment the health of the public must be better. This is like measuring health by the number of hospital beds occupied and the number of operations carried out. This unfortunate attitude emphasises a need to examine the present methods of making decisions. These decisions must be progressive and not merely perpetuate the *status quo*. Answers must be found to the following questions.

Why do not people who attend for regular dental care have a major advantage over irregular attenders?

Why are dental ancillaries not used more frequently when their proven abilities and lower cost are well known?

Why are proven preventive measures not incorporated into the dental health service?

Why have policies for dental health produced no major development in preventive dental care?

Why has the important role of refined sugar in dental caries been given so little attention?

6
Established and future patterns of dental care

One of the many problems militating against new proposals for the provision of dental care is the reluctance to accept change, both by the dental profession and the public. New concepts are seldom welcome in an atmosphere of stable and accepted thought. It is therefore important to understand fully the background of dental care against which any changes would be made. Although there are many differences between countries, there is nevertheless a basic similarity of the dental care which has evolved in most of the societies with developed economies. The differences are mainly in methods of funding dental care, while the dominant pattern is that of treatment actuated by individual demand. At this level there is considerable acceptance of dental care, with the consequence that the idea of treatment carried out by a dentist in a surgery or an office has become synonymous with the totality of dental care. This limited concept is understandable: the high prevalence of dental disease requiring treatment has brought this mode of dental care into the realm of personal experience for a sizeable proportion of the population, including those with the most influence. The pattern is so widely established that the largest part of the dental profession in many countries is committed to earning a livelihood on this basis. Moreover, the pattern seems to be independent of political philosophy and is found in both capitalist and socialist states. As a general rule, the economic load for dental care, whether borne by the individual or the state, is based upon payment for each item of treatment provided. It is this system which was adopted in the UK after discussions with

the dental profession, and formalised in the General Dental Service (GDS) of the National Health Service.

It therefore follows that this type of dental care (service on demand) represents an established social institution of some stability which has evolved over many years.

Questioning the effectiveness of the present system

The general acceptance of the present system of dental care has probably been one of the prime reasons why its effectiveness has not been questioned. The merits of a dental service on demand has been regarded as self-evident. Consequently, development has been mainly in technical procedures, in which considerable advances have been made, but the concepts for providing dental care have undergone no radical change. It is only recently that the need for a critical review of dental care has been thought necessary.

One step in this direction has been the collaborative survey of dental care in several countries, carried out under the aegis of the World Health Organization (WHO) and the United States Public Health Service (USPHS).*

The conclusions drawn from this study are important and do not allow those responsible for the provision of dental care to be complacent. The survey, which looked at children and adults, found that all systems studied not only failed to affect the levels of disease but also failed to prevent the loss of large numbers of teeth by the ages of 35 to 44 years.

The importance of factors other than dental disease in causing tooth loss became evident because of the lack of correlation between tooth loss and disease prevalence. This had also been indicated in an earlier dental survey undertaken in industrial populations in the UK.[142] The regional difference in tooth loss was not matched by the regional difference in levels of dental disease.

* See Chapter 4, pages 36–42.

Although the dental profession acknowledges the importance of consumer education in the prevention of disease, there is a remarkable lack of resources devoted to research, development and the demonstration of consumer-educational activities relating to dental health.[36]

This is really not surprising if considered in the light of the evolution of dental care. The present system makes it difficult for any procedure to be accepted which does not fit into the 'fee-for-item' basis, and particularly if it does not involve the consumer in a visit to the dentist.

Evolution of the present system of dental care

Because the present system of dental care is inextricably linked with the organisation of the dental profession, it is understood more easily if the salient features of the profession's development are also explained.

Both the educational and the legislative changes of the last 100 years have contributed to the emergence of the dental profession from a poorly organised craft which had its origins with the barber surgeons.

Although the first Dental Act in the UK received assent in 1878, it was not until 1921 that the right to practise dentistry was limited to those entitled, by examination, to have their names entered on a register.[45] This was a major step forward in protecting the public from the many unprincipled and untrained charlatans who abounded at that time.

The autonomy of the dental profession is of more recent origin. Under the Dental Act of 1956, the General Medical Council relinquished its control in favour of a General Dental Council, and the dental profession became responsible for regulating its own standards.[45] Because of the time taken to reach this position, the profession would not favour changes which could diminish its independent legal status.

Relationship of dentistry to medicine

The evolution of dental care has been closely linked with medicine. This relationship has been debated at great length, fiercely at times,

especially with regard to the professional education of the future dentist.

General surgery was at one time regarded as a craft, but eventually gained recognition as a branch of medicine. Dentistry, practised by general surgeons, was carried along with this change in status. The consequence was that, in many European countries, dentistry could be practised only by the medically qualified. Subsequently, a more pragmatic compromise was reached in most countries, but the dental profession is still not separate from medicine in some countries; for example, Italy. The recent changes in EEC regulations, to allow reciprocity of dental practice between member-states, will help to resolve such anomalies.

The history may have influenced the type of dentistry practised in the UK: in the early part of the century it was dominated by the extraction of teeth and their subsequent replacement by dental prostheses. This early effort by the dental profession to render the nation edentulous was undoubtedly influenced by the work of Hunter who condemned extensive restorative work, such as gold crowns and bridges. He considered these as a source of considerable oral sepsis.[81,82,83,84] The theory of focal sepsis was advanced which cited septic teeth as the cause of disease in many organs distant from the mouth. The development of radiography reinforced the theory by revealing unsuspected areas of infection surrounding the root ends of teeth with dead pulps.

The consequence of this medical development was the wholesale extraction of teeth in an attempt to alleviate systemic diseases as diverse as rheumatism, kidney disease, anaemia, gastrointestinal disease and many others with insubstantial links to dental disease. After many years, it became obvious that the theory was untenable in the majority of cases, but the influence on the British philosophy of dental care was profound and the repercussions can still be detected at the present time.

The dental profession in the USA followed an independent course. It led the world in the development of technology which eventually allowed the treatment of dental caries and periodontal disease without the loss of so many teeth. A greater understanding of oral

biology and pathology was then matched to the high technical standards so that the philosophy of repair and conservation of the dentition came to be generally accepted. At its best, the work carried out is an example of how superb craftsmanship can overcome the inherent inadequacies of the materials used. The work, carried out by a graduate dentist, is time-consuming and expensive. Indeed, meticulous standards of workmanship play such an important part in the success of restorative work that some bridgework can occupy more time than major general surgery. So the service is available only to the wealthier sector of the population unless alternative funding can be found. Naturally, this state of affairs generates great pressure to lower the cost of dentistry to suit the pocket of the consumer and to widen the availability of dental treatment. As the time factor is critical in the cost equation, there has been considerable activity within the dental profession to increase the throughput of work. Great advances to this end have been made in the ergonomic studies of dental practice procedures which have radically changed the methods of working.[97]

Technical advances have shortened the preparation time for dental restorations and have made these procedures less of an ordeal for the patient and the dentist. The choice of pharmacological and technical materials is now far wider and more is known about them.

The advances which have made the greatest impact on dental practice, such as the air-turbine handpiece and the ergonomically based design of equipment, have been developed largely outside the dental schools rather than as a consequence of their research. This has led to a divergence in methods of dental care developed in the dental schools and the technical improvement of dental treatment by the dental practitioners and of dental equipment and materials by the manufacturers.

The effectiveness of these developments in spreading the benefits of dental care and improving the standards of dental treatment has been examined in Chapter 5.

The other, less acceptable, methods of increasing throughput are to spend less time on each procedure and to narrow the range of procedures carried out by concentrating upon those which can be completed quickly. The dilemma which faces any dentist working in

the GDS or in private practice is the necessity of running a business which must be profitable and at the same time provide a dental care service. It is too easy to label as inefficient those who fail to solve this dilemma: the conscientious dentist trying to provide high quality dental treatment is sorely pressed to make a good income. Coupled with this may be a feeling of inadequacy in failing to match the 'efficiency' of demonstrably more successful colleagues. Once having embarked upon a career in dental practice, the dentist accepts a commitment of personal or borrowed capital which is bound to influence any future decision.

The impact of the NHS

Because dental care in the UK is by now virtually monopolised by the General Dental Service of the NHS it will be used to illustrate the current treatment service. The problems encountered are, however, not unique to the UK; they are found in one form or another in the dental services of most developed countries.

An account of the evolution of dental care would be incomplete without some consideration of the impact of the NHS since 1948. Its founders, recognising the social inequalities in the provision of health care, made the bold attempt to remove the economic responsibility from the individual to the whole of society. The State, the representative of society, became the paymaster for dental care, although private contracts were allowed to continue. No change was made in the pattern of dental care, but a piece-rate system of remuneration was adopted for dentists who contracted to supply treatment. These arrangements were made with the agreement of the dental profession. An alternative method of payment was adopted for the medical profession, however. Doctors were remunerated by a capitation fee for registered patients, plus supplementary payments for additional responsibilities.

The initial reaction of the public to the new NHS was to flock to dentists, especially for the provision of 'free' dentures. The original scale of fees based on the estimated time needed to complete treatment procedures proved to be an unexpected bonanza for dentists, and their new wealth became a source of jokes for comedians

of the day. It was no surprise when fees were cut; further economic adjustments over the years mean that the present-day dentist is faced with tight margins, and most adult patients have to pay for each course of treatment. Exceptions are made for patients under 21, expectant and nursing mothers and those on a low income. More recently, it has been proposed that the age of exemption be lowered to 18 years.

The income of both dentists and doctors in the NHS is now reviewed annually by an independent body headed by an eminent industrialist. However, in recent years national restrictions on income levels have reduced the effectiveness of the review mechanism. In 1978 it precipitated an open breach between the British Dental Association and the Department of Health and Social Security.[51]

Economics and technology have therefore dominated the development of dental practice in the UK and have perpetuated the system of dental care. Because so much energy has been focused upon these aspects of the system, very little has been devoted to the examination of alternative systems. This role has been taken over largely by the dental schools and other university departments.

The role of the universities in changing the pattern of dental care

The influence of the universities in dental training gathered momentum after World War II, and this has brought about a change in emphasis in both undergraduate and postgraduate training. There has been a departure from a style of training akin to apprenticeship, which included many hours at the bench making dentures. Training is now more biologically based, with greater emphasis on and acceptance of scientific method. The dental graduate embarking upon an academic career will in most cases undertake research leading to a postgraduate degree. In addition to the existing university postgraduate degrees, the royal colleges have introduced further clinical qualifications which broaden the opportunities for postgraduate work.

A major difference between medical and dental training is the degree of practical experience required. The dental student spends a large amount of the clinical instruction time carrying out treatment on patients, over several terms.

The graduate dentist is able to and allowed to practise immediately upon qualification, whereas the medical graduate embarks on a year of clinical instruction and supervised work before registration.

The list below compares the dental courses at one dental school in 1954–5 and 1977–8.

1954–5 (4 academic years)	1977–8 (5 academic years)
First year anatomy, physiology, biochemistry, dental mechanics.	*First year* biology, biochemistry, medical chemistry, human ecology, anatomy, physiology.
Second year senior dental anatomy, prosthetics, mechanics (dental), dental materials, dental histology, junior operative dental surgery, hospital (practical), senior operative dental surgery.	*Second year* anatomy, biochemistry, physiology/pharmacology, oral biology, dental technology and materials science, pathology/microbiology.
Third year pathology and bacteriology, anaesthetics, orthodontics, hospital (practical) surgery, dental pharmacology and therapeutics, radiology, operative dental surgery, advanced operative technique (operative dental surgery), dental diseases of children.	*Third year* dental technology and materials science, pathology/microbiology, medicine, surgery, dental clinical techniques, dental clinical teaching.
Fourth year medicine, dental surgery and pathology, hospital (practical), dental prosthetics, oral surgery, maxillo-facial dental surgery, venereal diseases, dental jurisprudence and social administration, preventive dentistry, paradontal disease.	*Fourth year* dental clinical teaching, anaesthetics, child dental health, dental radiology, dental therapeutics, oral biology, oral pathology, oral surgery and oral medicine, orthodontics, dental jurisprudence, maxillo-facial surgery, preventive dentistry, periodontology, prosthodontics, advanced clinical techniques, elective.

Fifth year polyclinic (restorative dentistry and specialist clinics), dental teaching clinics (rotating), topic teaching.

The list shows no dramatic difference, other than an increase in duration. The comparison disguises the increasing demand on the available teaching time due to the growth in dental knowledge. It is now doubtful if the dental graduate is ready for dental practice immediately upon qualification. There is a case for both an induction period and for continuing postgraduate education.

Although dental education has become more oriented towards biological concepts and scientific method, there is little evidence that it has accepted the challenge of a radically altered pattern of dental care implicit in the advances made in preventive dentistry. The organisation of dental (and medical) schools on a departmental basis fosters teaching which is analogous to engineering where the sum of the parts comprises the whole. The graduate either continues this approach into practice, or develops an appreciation of the inadequacy of such a mechanistic model from practical experience.

Teaching remains hospital-oriented and a great deal of the student's clinical time is occupied in repair work. The problems posed by the dental care of the community and by working with groups such as the handicapped and long-stay patients have not really been tackled at undergraduate level. Opportunities for students to move out of the hospital clinic into the community have not been seized. The important social and psychological problems which have a bearing on the effective provision of dental care have not entered into the dental syllabus.

A growing awareness of community needs

There is increasing awareness in the UK of the need to study the provision of dental care at community level as well as the traditional studies of individuals. The overwhelming need for epidemiological

data as a basis for future action was pinpointed by a report in 1962 published by the Nuffield Provincial Hospitals Trust[119], which paved the way for the first National Dental Survey in 1968.[56] The establishment of a new professorial chair in community dental health at the University of London is a sign of the increasing academic activity in this area.

The delivery of dental care is also receiving attention and has been the subject of a study funded by the Department of Health and carried out at The London Hospital Medical College. The Scottish Department of Health has initiated a long-term investigation, based in the Dundee Dental School, of the dental care provided within the National Health Service.

A new postgraduate diploma in dental public health (DDPH) has encouraged graduates to undertake organised instruction in the varied disciplines associated with dental care of the community.* A vigorous British Association for the Study of Community Dentistry is providing a valuable forum for those interested in the subject.

In the later years of the 1970s a number of important reports on health matters were published, all of which contain recommendations on dental services and the prevention of dental diseases. We quote from and comment on these reports in Chapter 11.

Such an unprecedented collection of collated evidence and formally expressed opinion should provide a firm base for future intended changes in the provision of dental care.

Mechanisms of change

The metamorphosis of informed opinion into practical action is a difficult and uncharted area which must, because it involves the use of public resources, work through public opinion, political action and executive action via agencies of the government or civil service. The time and difficulties to be faced in this phase are often totally

* The Nuffield Inquiry into Dental Education should provide further impetus.

underestimated by specialists such as dentists. This is not confined to the UK. It has been examined with some insight where fluoridation is concerned in the USA.[125] The role of the politician in this phase is crucial, yet dentistry has consistently failed to arouse any major interest in spite of the resources devoted to dental care and the ubiquity of dental disease.

In the UK, political incentives in health matters often devolve upon dedicated individuals who maintain their interest over a lifetime. In dental health, for example, there was the working party report to the Parliamentary Labour Party on the future of dental care, which was accepted as the official policy of the Labour Party.[102] It would have been naive to expect immediate action to follow that report, because other factors are of crucial importance in initiating change. The widening of the dialectic on dental care outside the dental establishment is resented by an influential proportion of the profession. There are genuine grounds for restraint and caution because the dental specialists are amateurs outside their limited range of activities, and the hazards to be faced in the uncharted areas of political action are considerable. In the UK, nearly the whole of the dental profession is paid by public funds, whether through the General Dental Service, universities, hospitals or community dental service. It is unrealistic to consider that there should be no public accountability. There is no real alternative but to accept these 'real politik' circumstances. The dental profession must either evolve to face this new world or withdraw from any public sector support. If the profession does not accept this challenge, the public service will be operated and organised by those less able to guide the future pattern of dental care.

There is a point at which debate and published informed opinion must be translated into action. The question is, how is this next stage to be achieved? The aim must be to lower the prevalence of dental disease for the whole population by applying knowledge, acquired through research, to prevention of the two major chronic dental diseases.

As the WHO/USPHS study has indicated[34], the present system of dental care is unlikely to achieve this aim without radical change. Unfortunately, the concepts of prevention are easier than its practice,

and only practical measures can demonstrate effectiveness. Yet some remarkable results have been achieved in Sweden[9,103] and in Scotland[148] using vastly different methods. Though the ultimate forms of dental care have yet to be formulated, it is unlikely that they will be developed without a radical change in the existing system. Many preventive techniques are educative in nature and do not require a dental surgery or expensive equipment. This type of care can be taken to 'captive' groups such as those in schools, preschool nurseries and at work. Because of the relatively simple nature of preventive procedures, the exclusive use of graduate dentists is extravagant. The practicability of using ancillary personnel with a more limited range of training will need to be explored. The role of the graduate dentists will, therefore, have to change. Their functions will not be limited to treatment, but will also include the coordination of a multifunctional team working in the community, beyond the confines of the dental surgery. This concept of dental care organisation has implications for dental education and for the practising professional dentist who would have to be willing to accept a new role. The multifunctional nature of a dental team, working at many different levels in the community, poses many new problems of organisation and control. To develop the optimal method will require practical experience and a need for flexibility which is unlikely to be found in the UK while the majority of the dental profession is committed to one system. We suggest, therefore, that one solution would be to expand the community service in the UK and obtain a better balance between the salaried and the fee-for-item sections of the profession. This would provide an opportunity for developing the preventive content of dental care. The salaried section will not succeed unless people of high calibre are attracted. So it is essential to offer careers with opportunities equal to any other branch of the profession. This applies also to the ancillary workers who will work in community teams.

If a large slice of public resources is to be devoted to a community dental service, it must be used wisely and economically. Unfortunately, the public services are not renowned for cost-effective efficiency, and the dental service may have to show the way. To this end, it is essential to gain expertise in quality control and in measuring efficiency. These matters are of utmost importance to the success of any scheme which is intended to work through the public service.

7
Administration of the future dental care service

The combination of good careers and competent staff will not, in itself, ensure an efficient dental care service that can attain its objectives. The organisational framework within which the service functions must at least make it possible to reach these objectives and to control the resources available so that expenditure is matched to needs.

The National Health Service underwent a radical reorganisation in 1974 which was designed to produce an integrated service rather than the tripartite structure which preceded it. Subsequent developments have attracted a great deal of criticism, mainly directed towards the growth of bureaucracy since reorganisation and the failure to delegate authority or responsibility. The vast amount of resources controlled within the NHS, and its peculiar type of administration which, in deference to democratic representation, operates with a blend of part-time amateur and full-time professional managers, is not a combination which is compatible with efficiency. The problems generated are those which would daunt the most enthusiastic of industrial managers and therefore call for staffing with managers of outstanding ability. Without such people there is little chance that the NHS will ever become really efficient. The familiar companions of poor management are over-staffing, poor communication, a failure to delegate authority, under-investment, a failure to anticipate, and the failure to distinguish between strategic and tactical goals. All of these are evident within the NHS today and will persist unless the malady

is diagnosed and treated.* As part of the NHS, any salaried dental care service is vulnerable to the same defects and this is possibly the most valid objection raised by dental practitioners today to any expansion of the salaried dental service.

Some of the criticisms, however, arise from the NHS administration trying to fulfil its legitimate strategic role in a time of unprecedented limitation of resources in the public services. This has led to a redistribution of already inadequate resources to supply deprived divisions of the health service, such as mental health care. Such decisions are difficult but cannot be sidestepped, and in a time of economic depression are inevitably the source of protest and dissatisfaction amongst those deprived of resources.

This is the dilemma of the health service which will have to be shared by any future dental care service. Some of the resources must be allocated to the prevention of dental disease and some effort must be made to reach those people who do not, at present, receive adequate dental care. Whatever changes come about in the structure of the NHS, there is a tendency for the administration of services to have a static rather than a dynamic influence. Because information is never absolute or complete, a system must be kept under constant review and treated as an organic, developing system. But the pace of change should be geared to the pace of work and the temptation to 'keep pulling up the plant to examine the roots' should be resisted.

The monitoring and control of a dental service are therefore essential, and important enough to form a separate career pathway, but it is clear that the development of such expertise will not be developed overnight. It must be part of that same organic development of the system.

If the development and function of a total system of dental care are to be effective, it follows that the responsibility for ensuring this must be allocated to individuals. The post-1974 NHS divided the organisation into 14 regions, 90 areas and 171 districts, in diminishing demographic order. Individual responsibilities have followed this pattern

* Parliament has since passed the NHS reorganisation Act of 1980, which proposes further changes to the structure.[64]

although there is no experience to justify it except administrative tidiness.

We would hope that, in the future administrative structure, the regional dental officer would be the strategic link between the dental service and the Secretary of State for Health, and would have a two-way role in ensuring that national policy is implemented and that the reactions of the dental service and its users are known to the Secretary of State and thus to Parliament. We propose that the primary allocation of resources and the distribution of specialist units throughout the country would be the responsibilities of the regional dental officers. The monitoring, epidemiological, clinical and social research services would be centred at the regional level but available to the operational services. Inservice training and career progression would be the concern of all levels, but the coordination of training requirements and facilities would be monitored by the regional dental officer. In this way, it could be assured that the numbers of staff were matched to available posts so that there would be no question of over- or under-supply.

Liaison between the university dental schools, training centres, postgraduate centres and regulatory authorities, would be the concern of the regional dental officer as a major employer of personnel.

The occupant of a regional post would therefore need to be a person of considerable intelligence, tact and experience, whose influence should contribute in a creative way to the development of the dental service. Ideally, each regional dental officer would be expected to be sufficiently expert in one field of dental knowledge to act as a national authority. Thus, the combined expertise of all regional officers should provide a reliable and authoritative body of opinion to the Secretary of State.

The Secretary of State would effectively control the dental service via a board of regional officers and a chief dental officer. The anachronism whereby the chief medical officer is ultimately responsible for dental affairs should be abolished so that liaison with the medical services could take place on an equal footing.

The position of regional dental officer calls for a person of outstanding ability, both in dentistry and management, who would be in a position to influence the development of the dental service. Such an appointment would have to be made on the basis of demonstrated merit and not a political appointment or a retirement sinecure. In time the candidates for regional posts would rise through the various career pathways within the service, but initially suitable candidates will be difficult to find.

It seems likely, as we write, that the responsibilities of the area health authority and area management team, set up in the 1974 reorganisation, will be joined with that of the district in a further restructuring of the NHS administration. Management of a district will include local planning responsibility, within the overall planning of the region. But the district's chief responsibility will remain the operation of services. The difference between the two administrative responsibilities is essentially that of strategic and tactical, or executive, functions.

In the district's dental service, the clinical function will be of prime importance, and the dental officer will have management responsibility for the efficient day-to-day running of a dental unit. It is at this level that the career pathway divisions will be seen to function effectively. The organisation of care for the handicapped and disadvantaged would be one responsibility, and that part of the service would operate differently from the oral surgery unit. Preventive care carried to children at school would be another mode of care. In this way the whole field of dental care would be covered. Specialist units serving large populations, such as maxillo-facial surgical units, would be distributed on a national basis by agreement between the regional dental officers.

The day-to-day functioning and integration of the various clinical functions would be the responsibility of the district dental officer. Ideally, this appointment would also carry a clinical component so that the problems of working within the service would be appreciated at first hand.

One of the greatest problems in managing such a dental service is the high degree of specialisation among the personnel. Because of the different career structures (outlined in the next chapter), it would

frequently be the case that a clinician of high standing would be confronted with an administrative impasse by a district dental officer of a much junior level. Although an appeals procedure must operate, it should be invoked only rarely and a high degree of tact and diplomacy should be a requirement of any administrative officer.

This would be necessary not only when encountering staff problems but also when communicating with members of the community. As the resources for the dental service originate from public funds, it is essential that the public be given adequate representation. The formation of the community health councils (CHCs) was a bold attempt to replace theory by action in this respect. The ideal relationship between the CHCs and the dental service would be that of two-way communication. At its best, the relationship can be a source of improvements and support for the service and of better use of the resources by the public. At its worst, it can become a recital of bitter recriminations and distrust.

Considerable changes have taken place in the rights of all workers over recent years, which have led many major industrial companies to overhaul and update their staff consultative procedures. The health service employees have not as a general rule enjoyed an up-to-date consultation procedure and the inevitable outcome of a division of interest was industrial dispute. Staff consultation will have to be a part of the dental service at all levels. For, whatever philosphy is advanced for industrial harmony, a failure to be aware of an employee's point of view is a recipe for conflict.

8
Staffing the dental service

It has been suggested in an earlier chapter that dental care in the UK, and elsewhere, has reached an evolutionary plateau. There are no grounds for believing that the present pattern of dental care will have any major effect on lowering the prevalence of dental disease, and certainly will not achieve the major reduction in prevalence that current knowledge could provide. This is not a criticism of the National Health Service but a consensus of opinion from the examination of dental care delivery systems which, throughout the world, are based primarily on treatment.

Practical objectives

Although the treatment of dental disease and the relief of pain will always be of the greatest importance in any dental care system, there is no chance of progress towards the objective of preventing disease without two essential components in any projected scheme. These are an allocation of a significant proportion of total resources to prevention, and a system of dental care which reaches that part of the population with the greatest need. It makes little sense to issue statements of intent on these two issues unless practical steps are taken which will give them a fair chance of becoming reality. It is readily accepted that further answers are required to resolve the sociopsychological problems uncovered by the need to translate research knowledge into effective action. The lack of definitive

knowledge is too often used as an excuse to paralyse action, whereas it should be a spur to removing areas of ignorance.

The balance of these important components of dental care is unlikely to be determined by theoretical expositions alone and must be tested by practical experience. The skills required to investigate and solve these practical problems are not covered by the present training of dentists. To suggest changes in the training without providing opportunities for the newly trained graduate to apply this knowledge is to place an insuperable handicap on the effectiveness of the system.

Distribution of personnel

The NHS provides a very limited number of alternative careers for the dental graduate. In 1978, the Dental Register contained the names of 20 383 dentists, and in 1976 there were approximately 13 500 dentists in the General Dental Service of the NHS. Only 22 dentists undertook full-time salaried employment in general practice working from health centres. The community dental services provide salaried employment for the whole-time equivalent (WTE) of 1850 dentists and the hospitals a further WTE of 1250. The dental schools provide employment for 500 dentists. Other salaried careers are available in the armed services and occupational group health services, but these represent a smaller number of opportunities than the General Dental Service.

The most common mode of dental care is operated by the dental surgeon from a dental surgery or office. The consequence of this can be seen within the NHS, where 79 per cent of the total number of practising dentists in the UK are employed as individual contractors to the General Dental Service and are paid on a fee-for-item basis. The difficulties of operating a preventively biased service using this method of remuneration is a recurring theme throughout this book.

To deploy such a large proportion of dental resources in this fashion requires unequivocal evidence of its value. Such evidence cannot be assembled, and powerful reasons are advanced for casting doubt on the ability of such a system to achieve a reduction in the amount of dental disease.

An increase in the salaried career opportunities is, therefore, proposed as a strategic move to gain experience in providing a dental service with a possibility of achieving the objectives of preventing dental disease.

Present use of dentists

Another important consideration of any dental service is whether it makes full use of knowledge gained by the dentist during training. The records of the Dental Estimates Board show that the bulk of work carried out in the GDS consists of simple amalgam restorations and extractions (Tables 6 and 7). If this is compared with the curricula set

Table 6 Work pattern in the General Dental Service

	per dentist per annum
Fillings in permanent teeth (including 1978.4 amalgams and 586.2 synthetics)*	2412.0
Examination	1877.3
Scaling (of which other periodontal treatment was 16.4 with and without surgery)	699.7
Extractions of permanent teeth	419.8
Extractions of deciduous teeth	124.9
X-ray examinations	356.2
Fillings in deciduous teeth	209.0
Removal of calculus in deciduous teeth	155.6
Plastic dentures	121.8
General anaesthetics	90.0
Root treatments	73.0
Porcelain crowns (post and jacket)	50.5
Denture repairs and additions	49.6
Treating sensitive dentine	30.0
Emergency treatment (including domiciliary visits)	14.0

* Only 15.2 amalgams and 2.0 synthetics required a pin for additional retention.

Source: Report of the Dental Estimates Board 1976 derived from a 5 per cent sample of estimates submitted by 13 102 dentists.

Table 7 Regional differences in treatment: North East Thames and Wales

	NE Thames	*Wales*
Number of dentists	1080	573
Population per dentist	3415	4817
Treatment items per dentist per annum		
Fillings	2727	2579
Extractions (permanent teeth)	304	600.7
Ratio of fillings to extractions	9.0:1	4.3:1
General anaesthetics	21.7	82.8

Source: Report of the Dental Estimates Board 1976 derived from a 5 per cent sample of estimates submitted by 13 102 dentists.

out in the lists on page 57, it can be seen that a valuable resource—the dentist—is underutilised. It is probably true of all the vocational professions that only a proportion of the training is used. Much of this is because professional training implies knowledge in depth of a wide range of subjects, thus enabling the graduate to further, rather than just continue, the state of knowledge. Nevertheless, if there is a gross discrepancy between the knowledge gained and the subsequent use of knowledge, there will be pressure to modify the training to suit the practice. Such a move would be disastrous for the future of dental health because it would irrevocably set the seal on a technologically based dental repair service.

The importance of a good educational base for the dental graduate has been discussed in Chapter 6. We move on now to discuss the critical nature of the career structures on the type of service. Of all the incentive schemes to produce maximum work output, the piece-rate is probably the most primitive and crude. It has been

largely rejected by many successful industrial concerns throughout the world.[107] In spite of this and the recommendation of alternative methods of payment[54], it is a method which has found favour, as a fee-for-service payment, with both the dental profession and the Department of Health and Social Security. It is not difficult to see why. Top level incomes do not depend on career progression and can be earned by the newly qualified graduate merely by producing a large number of items of work. There is no capital grant available from the public sector, so the amortisation of any loan which the new graduate takes on to begin practice provides an added incentive to the high output of work. For the DHSS it is a method which produces a vast quantity of dental treatment at low cost. In fact, the proportional cost of the dental service has decreased from 5 per cent of a rising total cost of the NHS in 1965 to 4 per cent in 1975. The product is therefore an inevitable outcome of the system which, in its own way, is remarkably efficient at producing fillings. However, it has little to do with an optimal dental care system and its limitations as a dental treatment service are now obvious. It does not fulfil the two essential components of preventing disease: the allocation of resources for prevention and providing dental care to those most in need.

Improving the salaried career structure

Because of the defects of the piece-rate treatment system and the lack of worthwhile alternative career pathways for dentists in the NHS, it is proposed that the salaried sector be expanded and strengthened. The intention is to form a dental care service which will promote the prevention of dental disease and lead eventually to a lower prevalence of disease, which implies that all sectors of the population will be served. Alternative careers should be competitive in order to provide an attractive choice to the best graduates. The advance along a career pathway should not be viewed with regret after some years, because of meagre financial returns. Although the motivation for employment in the provision of dental care is complex, and not necessarily dominated by the need for material gain, this can be no basis for the design of a dental care system. Inequalities of opportunity will inevitably lead to the majority of better quality staff following the career pathways which offer greater opportunities.

At the present time, salaries in the NHS are dominated by the hospital

service, and the post of consultant which is a hierarchical as well as a functional clinical post. There are only 400 of these posts, representing the top of the career pyramid. In practice, the earnings pyramid is even steeper, because the top salaries are supplemented by merit awards which in a very few cases can be as much as the basic salary. Merit awards are secret and very few of the top awards are made to dental consultants. Without the merit award, the apex of the pyramid does not represent an income competitive with the private sector. Consequently, the full-time career consultant is at a disadvantage compared with a part-time colleague. This present arrangement is unsatisfactory; and it affects all other levels in the salaried service. The only other posts at present which approach the consultant salary level are the mainly administrative ones. Management functions will continue to be of extreme importance in any future dental care service projected in this book. However, the greatest rewards in any career structure should not become the sole prerogative of the administrator.

Alternative career pathways

Unless this fundamental question of career structure is tackled in a satisfactory manner, the quality of service provided by the salaried community dental service will suffer. The intention is to spread the apex of the remuneration pyramid so that a real alternative of a salaried career is offered to the dental graduate.

Six career pathways are suggested as parallel choices, with the possibility to advance by demonstrated ability.

1 Paedodontics, including orthodontics

2 Adult restorative and preventive practice, including periodontics and prosthetics

3 Oral surgery, oral medicine and oral pathology

4 Teaching, in conjunction with the universities and regulating authorities

5 Evaluation, including epidemiology, clinical and social research

6 The care of special groups, such as people with physical, mental and social handicaps.

As a general rule the careers should be based upon people, not institutions. This will require a change in concept, especially about hospitals. The hospital should be seen as a facility, not as a career division. It is the best place for the provision of specialist services such as maxillo-facial surgical units. There are also advantages in having centres of excellence which will encourage both intra- and interdisciplinary communication. But it should no longer be a *sine qua non* that all senior appointments will be hospital appointments. The intention is to take dental care into the community as much as possible, using the very expensive hospital facility only when it is essential. We believe that the present concept of hospital utilisation is derived from inherited practice originating in Victorian times, and a rethink is long overdue especially concerning effectiveness and administration.

The title of consultant would be retained for senior clinical posts to keep dentistry on an equal footing with other clinical disciplines. Whatever the title, every prospective dental consultant will advance along a career pathway which has its own maximum to be reached by demonstrated merit. The present system of merit awards will become open and included in the maximum job value.

Each of the parallel career pathways will contain several jobs of increasing complexity, but the top salaries of the most complex jobs will be comparable across the choice of careers. It should be possible for a dentist to have a reasonable career at any job level in the career pathway, but the more ambitious will progress through jobs to the top of the scale. Each job will have a maximum job value and the individual will progress towards it by merit. Once at the maximum, there will normally be no further merit increases without a change of job. Two important facts about this type of career structure are that the job determines the maximum salary which can be earned, and the individual's performance determines how rapidly the maximum is reached. Appointments to the available posts within any career structure will be determined by expertise, past experience and the degree of responsibility undertaken. The consequence of this is that no dentist will be able to gain appointment to a top job solely because of length of service.

Obtaining the correct balance between career pathways to ensure a spread of talent over all six groupings will be a complex operation. A great deal of thought and care will be necessary to obtain the correct slope of the pyramid within each career because the number required will vary according to the need of the service. Flexibility of the system will be important, especially in the early stages. Opportunities to change careers must exist, but these are likely to be easier at the level of the less complex jobs. The system described in outline here is similar to that used by many large industrial firms which have developed skills in handling the processes involved.

Job evaluation

Market value and comparability are important elements in the concept of fairness in any occupation. But there has been an effort to bring a degree of organised skill into analysing the components of any one job to determine how it relates to other jobs. Job evaluation will be necessary both initially and as a continuous process to ensure the efficient staffing of the salaried service. Experts in job evaluation will be required to supply this specialised advice. The criteria at present used for deciding the suitability of dental candidates for hospital and academic posts will be unsuitable for the wide variety of skills and experience necessary for the selection of personnel for the new range of careers suggested. A great deal of planning will be necessary to establish realistic criteria of selection to the abilities required and not to those connected with unrelated jobs.

The ancillary dental worker

If the suggested scheme is accepted, it must be accompanied by a system of inservice training which will afford all employees the opportunity to advance their knowledge and widen their experience in order to advance their own careers and to raise the standards of the dental service.

The proposed development of dental care will involve preventive instruction of people outside the dental surgery and the delegation of simple dental tasks. The dental team, therefore, will consist of dentists

and ancillaries. The latter will include those involved directly in providing dental care (such as the dental hygienists and dental therapists), those indirectly involved, such as dental chairside assistants and dental technicians, and those whose function will be limited to education in prevention and to simple preventive procedures.

Teams are not formed merely by placing together individuals with the requisite skills. There must be a common purpose and clarity of the goal which the team is attempting to achieve. This can be realised only if the members of the dental team are trained together rather than in isolation.

All ancillary workers will be within the same type of career structure, which must include the opportunity for those with the ability and inclination to advance their jobs. It is hoped that some ancillary workers will wish to become dentists, and will be given the opportunity to do so.

The ancillary workers will form an important element in the future provision of dental care and must be given democratic representation and a voice in their own development. We propose that a Board of Ancillary Dental Workers be established to develop guidelines for training, careers and employment of dental ancillaries under the Council of Professions Supplementary to Medicine. This board will be represented in negotiations with the DHSS and will make representations to government on the scope of duties of ancillaries.

The training of ancillaries should match as closely as possible the anticipated demand. This should avoid the prospect of trained ancillaries being unable to find employment or hope of career progression. Equally important with employment opportunity is the need to provide an environment in which they can function with optimal efficiency.

The established practitioner

Although the salaried system outlined is intended to increase the range of opportunities for dentists embarking upon careers in the NHS, it presents a quandary for the established practitioner who

recognises the defects of the present piece-rate system of remuneration and would like to work in a different way. Opportunities should be provided to absorb such practices without financial penalty. Selected practitioners who undertake a firm commitment to treat all patients in the NHS and to accept the principle of continuing postgraduate education should be allowed to change to an alternative method of payment. The possibility of capitation fees for patients accepted as dentally fit could be the basis for a phased changeover. To encourage the formation of group practices and the spread of preventive dental care, the salaries of suitable ancillary staff would have a contribution from the health authority. Those practitioners willing and able to undertake the preventive care of special groups, such as the handicapped, would be offered further incentives to encourage these activities.

The whole question of incentives for individual initiative and endeavour is one that will need to be kept under continuous review. The method of career advancement described should provide material rewards for the ambitious, but it is recognised that direct methods of incentive are also required, especially at the lower levels of any career pathway. Caution is required in adopting any incentive scheme to ensure that it does not create a bad working relationship and that quantity is not rewarded at the expense of quality. In no case should any incentive reward account for a major portion of regular material reward. It should blend into the career patterns adopted and should not remove the advantages of promotion.

9
Assessing dental health manpower

It is over 20 years since the McNair committee reported on the dental personnel requirements for Great Britain[61], and some authorities maintain that the estimates suggested in that report now require reassessment. The Royal Commission on Medical Education concluded that forecasts for periods as long as 20 or 30 years must inevitably be tentative, and plans based on them must be flexible enough to be modified as circumstances change and as more information becomes available.[130] A detailed study of the dental personnel required in the United Kingdom has never been done. Instead, progress has been on an *ad hoc* basis towards estimating the probable changes in working patterns of dentists. An important factor in forecasting future trends, which has been given insufficient attention, is the tendency for women to enter the dental profession.

In this chapter we shall review different methods of assessing the need for personnel as a guide for a group which should be set up to plan how many and what types of dental personnel should be trained.

The term 'manpower' is usually restricted to those possessing or gaining education and training for specific occupations. Dental health manpower generally includes the number of individuals available for, or undergoing, training in the different dental occupations; the demographic characteristics of those individuals and the educational qualities and experience they can bring to such occupations;

plus the changes required, both in their numbers and qualifications, in order to provide the service needed by the population.

Planning is the process of developing a set of policies which comprise a strategy for achieving a stated objective. Manpower planning is a strategy for the acquisition, utilisation, improvement and preservation of the human resources in any enterprise. Dental health manpower planning is the process of estimating the quantity and type of knowledge, skills and abilities needed to introduce predetermined functions of the health services so as to improve the status of dental health of a population. It must specify the complete spectrum of working relationships for the present and future. It should then be possible to forecast expected behaviour, as well as the knowledge and skills for adequate performance which can then be stipulated and made available. This should be a continuing process and not a sporadic undertaking. The goal of dental health manpower planning is to provide the most economical 'mix' of health workers needed for the effective, efficient and safe delivery of the required dental health services. These will have to be of a quality compatible with the social and economic level of the population.

Many different methods have been adopted in the estimation of health manpower needs; among these are the ratio of health personnel to population, the need for health services, supply and demand, functional analysis, target setting, economic analysis. A combination of these methods has also been employed. The lack of a satisfactory method is reflected in the popular denigration of most of the foregoing methods because of their limited validity—and yet they are still used. Each of the methods focuses only on a particular aspect of the problem. For instance, the ratio of dental health personnel to population ignores demographical distribution and the fact that effective demand for health services by a population is associated with socio-economic determinants, such as income and education, cultural background, conditions of physical environment and occupational structure. Furthermore, the provision of dental services is conditioned by the way the available manpower is used and the prevailing conditions of work and social facilities.

Most of the traditional methods of assessment disregard the question of whether a dentist is the best person to provide particular services.

Some of the tasks might be provided more effectively by other categories of dental personnel.

Ratio of health personnel to population

The most common method of gauging manpower requirements is the ratio of dentist or health personnel to population. Projections using the dentist/population ratio are based typically upon assumptions about the rate of population growth and the limitations imposed by training facilities.

When this ratio is used to measure an objective, it implies that adequate services are supplied when the given ratio equals the ideal ratio. The significance of this tautology turns on the method used in determining the ideal ratio. If a historically observed ratio is selected, it is not clear how its adequacy is to be tested, except by definition. Its use as a sole measure of effectiveness is therefore inadequate. Further information is required, especially to apply the improved knowledge of prevention to the practical advantage of dental care.

The problems relating to 'adequacy' are well summarised by the Canadian Royal Commission on Health Services.[93] The commission concluded that it was difficult to determine the optimum dentist/population ratio required to serve adequately the dental health needs of any population. In addition, a ratio which might be considered 'adequate' at one time, may be totally 'inadequate' at another—'inadequate', that is, if the test of 'adequacy' were that the profession had to meet all the demands for service being made upon it. (Such variation could be due, for example, to an increased demand from an educated public or a reduction in dental disease.) Alternatively, if the test of adequacy were that all dentists had to be guaranteed a minimum number of patients per year, the service might be judged inadequate. While such tests may be imperfect, it is generally assumed by the dental profession that the better the dentist/population ratio in any area, the better the dental needs of the population will be served.

The need for health services

As the existence of disease is the *raison d'être* of health services,

manpower needs could be defined in terms of the physical and mental conditions of the community and the capabilities of the prevailing medical and dental methods to deal with them. Indeed, if resources were unlimited, the objective of the health service could be to provide for all the health needs of the whole population. Therefore, a population's needs for medical and dental services require a knowledge of the state of its members' health, the existence of well defined standards of good health and a knowledge of what contemporary medicine and dentistry can do to improve health. However, there is no consensus among doctors and dentists of what constitutes good health and which methods are the most effective in achieving that state. Neither is there a consensus on what constitutes the need for treatment.

Some authors divide need for health care into three categories: met demand, identified but unmet need and unidentified need. Met demand is measured by the extent to which the service is utilised. Identified but unmet need is that for which the services do not provide, or can provide only after harmful delay. Unidentified need represents the undiscovered but existing disease in the community which is capable of being alleviated.

Alternative classifications of 'need' also exist. Bradshaw has enumerated four categories of need: normative, felt, expressed and comparative.[26] Others have defined 'needs' as those demands which, in the opinion of a doctor, require medical treatment. Titmuss, however, has pointed out that felt needs are probably not expressed because of ignorance about services and barriers to obtaining care.[154]

In spite of these difficulties, many authors have attempted to quantify the medical and dental need. For example, Bellini drew on the prevailing professional judgment of good periodontal practice and derived a standard of required services from estimates of the incidence and prevalence of disease. The number of hours required for the prevention, diagnosis and treatment was then estimated in terms of the number of hours required for adequate therapy to be given.[17]

A more sophisticated approach was employed by the Centre for Development Studies (CENDES). This used a social diagnosis in which the total cost of combating each disease and the cost of each

death prevented were estimated in terms of the relative influence asserted on the total number of deaths. Estimates were then established of the relative costs of preventing death from a specific cause, and of restoring to health a person suffering from the effects of a particular disease. The types of required services were estimated on the basis of an index of vulnerability established for each disease.[30]

There has been a considerable number of studies on the needs for dental services. Ast and others conducted a study of time and cost factors to provide dental services for children in fluoridated and non-fluoridated areas.[6,7] Bellini estimated the time and personnel needed to treat periodontal disease.[17] In New Zealand, Beck developed an index of dental needs based upon the times taken to carry out a large range of dental treatment.[16] His method was adapted by Hill to apply to the United Kingdom. He used the timings of the Dental Rates Study Group to develop an index of need for dental treatment.[74]

The use of 'need' as a basis for manpower estimates is open to question. Baker and Perlman contend that, although this approach has the seductive appeal of apparently scientific appraisal, it is unworkable for practical reasons. First, no country has the detailed and accurate morbidity and mortality statistics required. Second, one cannot measure the total professional time required to combat a given disease if there are alternative methods for its control requiring different types of health workers. Third, even if the need could be calculated, it is not a measure of public demand for services.[13]

Other problems stem from ill-defined criteria. For example, it is not clear what constitutes the optimal management for most diseases. There is seldom any uniform treatment for a disease but, commonly, several preventive or curative procedures may be tried.

Supply and demand

The method of assessing manpower requirements on the basis of supply and demand also has drawbacks. Studies using this method appraise the size and the characteristics of existing numbers of workers and the potential recruits. The studies analyse deficiencies of educational facilities, and describe the existing health facilities and

their capacity for expansion. The demand from consumers for health services can exist at two levels separating the pragmatic from the ultimate. The unqualified desire for dental care is defined as 'potential demand' whereas the desire for, and the ability to obtain, dental services is defined as 'effective demand'. The use of the service is often equated with this effective demand.

Many indices have been used as measures of the demand for health services. For example, health service costs are expressed as a percentage of the gross national product. The utilisation of health services is also used as an index of demand. In the study of medical manpower in Canada a number of indices was employed. Four estimates of future requirements were developed. These constituted a projection based on the physician/population ratio of 1961, which included an assumption that this ratio would increase at the same rate as it did between 1951 and 1961, using as a constant the annual per capita number of visits by patients for 1961. It was assumed that the average number of visits would increase annually by approximately 25 per cent.[93]

In Sweden, estimates for the numbers of doctors required were based on the differences in demand that various age-groups make on the medical services. Consumption units for age-groups, rather than numbers of people, were used to estimate future demand for personnel.[120] This method takes account of changes in the age structure of the population and has been used as one indicator in projecting medical manpower requirements in the United Kingdom.

The supply-demand model, like other approaches, does not reflect the total picture of personnel needs. Recommendations resulting from studies of supply typically do not reflect changes which occur in the functions and the productivity of health workers. They overlook the fact that the work of various health personnel can both complement and substitute for each other. For example, if dentists are considered essential, any shortage will be accompanied by a reduction in demand for hygienists and other ancillary personnel; while an increase in the number of dentists will be accompanied by an increase in the employment of ancillary personnel. On the other hand, if hygienists and auxiliaries are substitutes for dentists, a shortage of dentists will add to the demand for those ancillary workers, while an increased supply of dentists reduces the demand for ancillary workers.

Recommendations for supply-demand studies often assume that present staffing patterns are adequate, and that changes in demand can be met or balanced by changing the number of health workers. Conversely, some studies of the demand for medical care assume that the supply of personnel will be constant, or will rise to meet demands. Others assume that the organisation of the health service system will remain constant forever. Yet others neglect the rising social expectations of the population and do not take into account the effect that relevant population attributes, such as birth and death rates, will have upon productivity or economic indicators.

Studies of demand can be more usefully undertaken if they are limited to specific areas of demand or particualar types of institutions. Dental manpower studies, by restricting the scope of the demands studied, have made substantial progress in estimating trends in demands in states, regions and nations. Increased demand for dental services was based on trends in population, per capita expenditure for dental services and income levels, as well as on estimates of expected decreases in the incidence of caries from fluoridation. The resulting estimates of the demand for services were compared with estimates of the likely increase in the number of dentists as well as with changes in productivity through improved equipment, better office management and the increased and improved use of ancillary personnel.

Functional analysis

Based in part on the assumptions of the cost-benefit and supply-demand approaches, functional analysis of health manpower has turned on attempts to match the qualifications of personnel with the requirements of the job-performance. Although there are many studies of what doctors, dentists and nurses do, the relationship between such activities and the actual functions of the tasks being performed has seldom been explored. Nor has there been sufficient analysis of the extent to which programmes have been redesigned as a result of these activities.

An example of how functions have been transferred and realigned is found in the training and use of dental auxiliaries in the United States Division of Indian Health dental programme.[85] Trained auxiliaries in

this programme carry out tasks which are usually carried out by dentists. The relative efficacy of such care has been compared with that rendered to the remainder of the American population. The many functions traditionally assumed to be integral parts of a dentist's task are being carried out by auxiliaries among selected population groups. Their more widespread use is opposed by the United States dental profession.

In the United Kingdom, dental therapists have taken on some of the tasks normally carried out by dentists. A functional analysis of the tasks carried out by dentists, dental therapists and dental surgery assistants was made by Hobdell.[75] On the basis of the results from that study, the cost-effectiveness of dental services using traditional and therapist-aided dentists may be assessed.

Hoff used functional job analysis as part of a systems approach to personnel utilisation.[76] By this method, the health objectives are identified and the activities to be carried out are determined. Next, the tasks necessary to achieve the objectives are determined. Once the tasks have been identified, they must be analysed to obtain data to guide the recruitment and selection of personnel. The data will also be helpful in writing job descriptions and developing career structures, in designing and conducting training programmes, and in evaluating subsequent performance. Tasks and activities should be grouped and restructured according to their complexity and the level of responsibility they require. Often, tasks will fall into patterns which differ from existing jobs because the latter are usually discipline-oriented. This little-used method has a direct application to dentistry. One defect in the method is its failure to take sufficient account of the market values of various personnel, which may have a strong effect on carefully calculated schemes especially in the public sector.

Target setting

The target-setting model concentrates on identifying the deficiencies in the present health service. The targets to be achieved must be clearly specified although they are seldom the result of objective analysis but rather are derived from statements made by public leaders, professional associations and the community. The method is

not to make forecasts, but the approach seeks to establish goals to be achieved within a specified time.

This approach has been adopted by the US Division of Indian Health and used effectively for the past ten years. The goal of the dental division is to elevate the oral health status of American Indians and Alaskan natives to the highest possible level. The objectives are to reduce the loss of teeth, and to lower the incidence and prevalence of dental caries, periodontal disease, malocclusion and oral trauma. Generally, the aim is to reduce pain, disfigurement and dysfunction. Specific epidemiological indices are used to assess the status of all patients and the objectives are stated in measurable terms.

The limitation of resources in the UK is such that all dental needs cannot be met within the period for which it is useful to plan. Targets need to be defined for the next planning period, but only when dental needs are defined in operational terms is it possible to set realistic targets and to identify the types of information which are required. The sequence would be first to identify particular groups in need of care, and second to compare alternative types of treatment, where this is appropriate.

Economic targets

Economic targets must also be considered and it is necessary to identify those expenditures which are not being successful in meeting dental health needs, and to search for ways of making the same or more rapid progress towards stated objectives with a smaller use of resources. This is one of the central objectives of the economic analysis method of assessing manpower use.

Economic analysis

The central problem of health economics is to make the best use of resources. Embodied in this principle are two important conditions. First, any given health objective should be attained at the lowest real cost of resources used. Second, the objectives should be matched to present resources and those likely to become available in the future.

The application of economics to health care planning is an attempt to reduce the complex problems to a formula or mathematical model by the selection of a few significant parameters. No observer of the general economic scene can fail to have noticed that this is more efficient with past and present data than with handling the future.

The economic techniques which have gained prominence in health are cost-effectiveness, which can be defined as the best way of using resources to achieve a given objective, and cost-benefit, which can be defined as the choice of an objective from several alternative objectives.

It is probably true to say that the initial enthusiasm which greeted these two techniques has now faded, but they have effected an irrevocable change so that the economic content of any dental care scheme or technique will be subjected to some analysis now and in the future.

Cost-effectiveness has been used for the analysis of various methods for applying fluoride solutions which enabled nine out of forty-five methods to be selected as more economically effective.[39] It has also been used to compare the effectiveness of dentists to treat new cavities against hygienists to prevent caries by the topical application of fluoride.[109]

A further study examined the cost of maintaining regular dental care to children when the interval between recalls was varied.[24] It was found that, by extending the recall time interval from the usual six months to 22–24 months, a dental team was able to treat 2243 five to nine year old children a year instead of 748. This ratio was further improved for those aged from 10 to 19 years. The improvement of over 300 per cent in children receiving dental care must mean that the recall interval deserves serious consideration by those concerned with the economics of community dental care. This would appear to be the prime achievement of the cost-effectiveness method to focus attention on alternative ways of using resources to achieve an objective.

Government departments have encouraged investigations into less costly but effective methods of providing dental care. The Louisville experiment in the USA is one example[106] and the Experimental Dental Care Project in London is another.[4] Both have demonstrated the

cost-effectiveness of using teams with ancillary dental workers doing delegated tasks including operative work. Regrettably, decisions seldom follow such studies. Perhaps this is an indication that more attention should be paid to the mechanism of making decisions in government before expending more resources on cost-effectiveness studies.

Cost-benefit analysis attempts to set benefits against cost as an aid to determining objectives and priorities. The weakness of this method is the necessity not only to have a definite set of output categories but also to have the means of attaching costs to these outputs. The removal of the bulk of the health services in the UK from the market and, with this, the criterion of consumer choice have imposed an urgent need to find new methods of evaluating efficiency and benefits. The difficulties of expressing the full implication of health costs and benefits in economic terms have led many economists to have doubts about the usefulness of cost-benefit analysis. Fein has claimed that the problems associated with cost-benefit assessment in health and welfare are so formidable that it is questionable whether any precise cost-benefit ratio can be substantiated. Furthermore, he considered that there is much that is immeasurable and non-economic in medical care. Thus, it is unsatisfactory and perhaps dangerous to use economic factors when they support an argument whilst reserving the right to ignore them when it is convenient. He went further in his criticism of cost-benefit analysis and stated that not only was its correctness questionable but also the weakness of the data and the analytical techniques casts doubts on its usefulness.[49,50] Klarman had similar doubts about the ability of cost-benefit studies to be used in setting or allocating priorities.[98]

The scope of cost-benefit analysis is aptly summed up by the Council for Science and Society.[37] It has concluded that, at one time, it seemed that the techniques of cost-benefit analysis would enable the evaluation of social and technical policies in terms of a common unit—a form of social money. The hopes of an objective solution to problems which are, in fact, dominated by political considerations were soon frustrated. At its best, cost-benefit analysis is restricted to being a rough guide to policies rather than a precise measure.

Davies has measured the benefits of water fluoridation by assessing

the savings in costs of dental treatment, but recognised the limitations of his analysis.[39] For example, no account was taken of the savings in accommodation and maintenance effected by the reduction in treatment. The intangible benefits such as freedom from pain, of not missing school, work or leisure, were not included. Neither were the benefits of having sound natural teeth. Few authors applying cost-benefit analysis to dental care have valued satisfactorily a sound tooth or placed any value on avoiding a carious lesion.

Offensend and Merkofer have, however, attempted to place a value on preventing a carious lesion, which included pain, functional loss, plus the time lost in attending for treatment and other such negative items.[122] Against this they set the costs of prevention, which included the cost of toothbrushes, toothpastes, fluorides, personnel, and also of research and development. They concluded that preventing one carious lesion could be worth 50 dollars or more. The cost of pain was valued at one dollar, the patient's time at one dollar per hour and intangible losses at 15 dollars. This example serves to illustrate the labyrinth of inexactitudes which confront any attempt at cost-benefit analysis.

The conclusion which emerges from this review is that there is no single method which will enable the allocation of personnel, with a view to effective use, to be made on a clear-cut scientific basis. There is evidence, however, that the use of dental workers possessing a differing range of skills deserves serious consideration as an effective means of providing dental care. It would be short-sighted to base all future plans on the use of only one category of dental worker. Any group that may be established now or in the future to formulate plans for dental personnel can draw upon the existing body of statistical and methodological procedures. However, if such planning is to work, the scope of the information they will need must be extended and made freely available to those whose interests and livelihoods will be involved so that the democratic process may play a part in deciding priorities and that these will not remain the exclusive domain of civil servants and a professional élite.

It is recommended that a dental resources study group, with special interest in personnel requirements, should be formed to function on a

continuous basis. It is essential that the group has people who are skilled in manpower planning and epidemiology. They should be involved in the dental services and be responsive and responsible to both the planners of the dental service and the public.

10
Economics and dental health planning

The present practice of health economics is mainly concerned with helping policy-makers understand the nature of the choices facing them and, thereby, with helping them to make better choices. This involves helping administrators and other decision-makers to make the necessary trade-offs when formulating policy and to deal with allocating scarce resources. In contrast, Gordon Best considers that the concept of an economics of health should be to shift attention to the problems of how illness and disability are produced. How do economic factors and macroeconomic policy influence the incidence and severity of illness, and how, in turn, does this influence the demand for health services?*[18] Some answers to these questions can be found in connection with dental health. There is a strong positive relationship between the production and consumption of sugar-containing foodstuffs and the observed incidence of dental disease. This demonstrates a link between a macroeconomic objective, increasing production and consumer expenditure, and the 'derived need' for more public spending on dental services.

These findings emphasise the importance of the conclusion by many health economists and epidemiologists about the misguided equation that medical and dental care equals health. The best estimates are

* G Best. *Some notes on the macroeconomics of illness and health . . . or should the socially-responsible health economist re-focus upstream?* Paper presented at the Health Economists Study Group, Lancaster, 18–20 December 1978.

that the medical service affects approximately 10 per cent of the usual indices for measuring health. The remaining 90 per cent are determined by factors over which doctors have little control but could have a strong influence. The same can be said for dental services. It follows that there seems to be little direct relationship between a national expenditure on health care and the nation's health. A country which is spending more on health care may be providing either a high level of care or more expensive services, or both. Thus, international comparison of expenditure on health care is of little use, unless the level of expenditure influences policy-makers to focus upon alternative methods of improving health rather than reducing costs. Unfortunately, the main feature of debates on changing systems or parts of systems of health services is how to reduce high costs.

How can studies of the economics of dental health help to guide the prevention of dental diseases and the systems for dealing with dental improvements? First, they quantify the cost of dental suffering which society is paying and try to demonstrate any relationship to the expenditure on the consumption of refined sugar. Economists also assist in quantifying the costs of preventing disease compared with the costs of treating and retreating affected people. At present, cost-effectiveness studies are erroneously calculated by comparing the cost of prevention of a tooth decaying with the cost of a single restoration. Little account is taken of the pain, suffering, time for treatment and the fact that a 'restored' tooth will require a number of subsequent fillings. Studies should also be carried out to estimate the costs of the restorative approach over the lifetime of an individual. A single tooth would be a useful unit of measurement. This is likely to demonstrate that maintaining teeth by restoring them is a very costly exercise.

It would also be worthwhile to assess the effect of different methods of paying the dentists on dental health. In the past, studies of dental practice have concentrated on efficiency and increasing productivity—productivity being measured by the amount of treatment. In particular, investigations should look at the effect that the fee-for-service system of payment has on the pattern of treatment. This would determine whether this method of payment encourages doctors and dentists to perform more investigations and operations and to prescribe more drugs than necessary.[1] Does, for example, the fee-for-service system of payment to doctors in Canada account for

the doubling in frequency in haemorrhoidectomies and the fivefold difference in gall bladder operations there compared with England and Wales? Why do doctors paid a fee-for-service write 40 per cent more prescriptions than doctors in a capitation system?[42] Is the difference in productivity between salaried and fee-for-service dentists due to over-treatment or to an added incentive offered by fee-for-service? Can economists quantify how the fee-for-service system of payment influences the pattern of dental practice and the inequitable distribution of dental services?

There may be a distortion of practice because dentists choose between the more remunerative and the less remunerative items. Many dentists consider that fees for treating deciduous teeth are inadequate, and between 20 and 30 per cent of children attending dentists regularly had deciduous teeth with advanced decay.[155] These same children with untreated disease in their deciduous teeth had had numerous small fillings placed in their permanent teeth. Periodontal disease, the most common dental disease and one that leads to extensive tooth loss in adults, is virtually untreated in the NHS. The NHS fees are low and are completely outpaced by the high fees which this work attracts in private practice. Prevention is difficult to promote on a fee-for-service basis because much of it is based on educating the patient. This does not lend itself to a fee-for-service method of remuneration. Introducing prevention into the General Dental Service would, therefore, require a major revision in the system of payment—a move which, regrettably, has so far found no support by the dental profession.

There is also some evidence that this method of payment encourages the early placement of fillings, rather than observation and the avoidance of intervention until it is necessary. Early placement of fillings, and the frequency of radiological examinations, should be based upon the information available about the rate of development of dental decay.[139] This is strongly indicated by a study which found that a group of people who attended dentists irregularly had more sound teeth than a similar group of regular attenders. The irregular attenders were not less prone to dental decay than the regulars: they also had decayed teeth.[56]

It seems altogether wrong to perpetuate a scheme with a strong incentive to fill teeth and with no incentive to the dentist who is most

successful in helping patients to avoid fillings. A pattern of care which has an initial treatment phase involving most necessary work, with a rapidly diminishing rate of treatment over subsequent years, should be encouraged. But, in a fee-for-item service, a dentist would be faced with diminishing economic returns.

There are no economic incentives in the present system for the dentist to prevent disease by spending time on education which would diminish the amount of treatment required. There is also no incentive for the dentist to accept the difficult restoration of teeth or the treatment of patients with difficult dental problems, such as the elderly. Many of these time-consuming problems are avoided when time is at a premium. Each item of treatment carries within the fee a proportion for costs, and the margin which remains as profit varies between items.

The selection of items with preferential cost margins is a natural corollary of this, in spite of the attempts of the Dental Rates Study Group to obtain a balance.[131] This has led to the refusal of practitioners in some areas to make dentures in the NHS. In more affluent areas, it is now accepted by many people that a proportion of their dental treatment will be by private contract. The rule of *caveat emptor* has resulted in confusion for the patient about the availability of dental treatment within the NHS, or whether the payment is for NHS or private treatment.

The dangers are that dental care within the NHS will become regarded as second-class and that this will be accepted with resignation as inevitable. The question may be asked—why is a system which is so obviously unsuitable still in existence? Answers to that question highlight some of the shortcomings of health economics. Power relations, the desire to maintain independent contractor status, the distaste for bureaucratic control as well as the more attractive tax arrangements and opportunities to supplement income, dominate the current dental service. They are not properly considered in cost-effectiveness studies, but they override any considerations of economic efficiency and improvements in health of the public.

11
Some paths to dental health

Since 1976 a number of important reports on health have been published in Britain. They all contain recommendations on the dental services and prevention of dental diseases. There are only minor differences between the recommendations reviewed below and our own.

Fit for the Future[62], a very good report of the Court committee on child health services, had this to say about the 'path to dental health'. 'Despite extensive and increasing treatment, there is still a daunting amount of untreated disease.' (13.2) The committee considered that this '. . . clearly points to the failure to contain it by conventional treatment, particularly amongst the younger age groups.' (13.2) The 164 000 handicapped children in England and Wales were further disadvantaged by having a large amount of untreated dental disease. The committee felt that '. . . society has a special responsibility for providing them with dental care.' (13.10) Education for dental health should be part of the routine care of expectant and nursing mothers and provided regularly for mothers of preschool children. Therefore, dental health education should be emphasised in the training of midwives, child health visitors, paediatricians and paediatric nurses. The committee believed that the mass media should be supplied with up-to-date information on dental health subjects and that the content of advertisements for confectionery should be monitored. Also, the sale of sweets, biscuits and foods containing sugar should be discouraged. The committee also suggested the appointment of dental

health education officers, and encouraged research on different methods of dental health education.

The committee was unequivocal in its support for water fluoridation: '. . . the procedure is safe, effective and cheap'; '. . . immediate steps should be taken to introduce fluoridation on a national scale, if necessary with legislation'. (13.18) Topical fluoride applications for children at special risk from dental caries, especially the handicapped, but not for all children, were recommended. Turning to the treatment of dental diseases, the committee expressed a view with which we strongly agree: 'Through more and better treatment, and with immense effort, dental disease in children is partially contained. The most astonishing fact of all is that we are describing a preventible disease.' (13.25) It concluded that the dental services are unequally distributed and administratively divided, and anticipated that more children will be treated in the General Dental Service. It went on to suggest that a model should be set up to evaluate a primary care service for children based on the General Dental Service, with the dentist being remunerated by a capitation fee similar to that outlined by the Tattersall committee[54] and recommended by the Pavitt working party[102] and by the report *Access to Primary Care*.[144] It suggested that such a model would be best accommodated in health centres and should encourage the practice of prevention as well as good restorative dentistry. Furthermore, the community dental service should be strengthened.

To attract dentists to areas deprived of adequate dental care, a system of preferential remuneration and good accommodation in health centres should be offered. The Court report also felt that a review of the manpower required for the provision of a good dental care service was needed and, in particular, an increase in dental manpower with special training in children's and community dentistry in the community dental service. Another recommendation was to improve the career structure of the salaried dental service. The types of manpower required were also reviewed. It was convinced that the dental therapist was an effective dental health worker and their numbers should be increased by establishing two new training schools. In addition, legislation should be introduced to allow them to work in general dental practice. The school dental officer is seen as a general paedodontist, and consultants in paediatric dentistry should be appointed.

The Court report had some controversial views on the hospital dental service, which we agree with. It considered that the emphasis in dental care for children should move to the community—the hospital being '. . . one instrument in a network of community services.' (13.54) It suggested that the hospital service should be replaced by the supporting consultant and specialist service and that expensive hospital facilities should not be used by children who can be treated in the general and community dental services. The hospital specialists should move into the community and fewer cases should be treated in hospitals.

On the subject of research, the Court report suggested that evaluation of different methods of delivering dental treatment to children, dental health education research, long-term studies on preventive measures and cost-benefit should receive priority.

In 1976, the Department of Health and Social Security issued a policy document, *Prevention and Health: Everybody's Business*.[58] The publication reviewed the trends in mortality and morbidity in Britain, the major disease problems and the scope and practicalities of prevention. Much of the thinking behind this report was influenced by the work of Professor McKeown, who concluded that improvements in the environment, in food and in health-related behaviour have had the major influences on health.[110] The possibilities for reducing dental caries were good. 'Very few preventive measures are as effective or are so easy to implement as the fluoridation of water supplies.' In addition, the harmful effects of the consumption of sugar-containing confections, particularly when eaten between meals, was stressed. The document created a lot of discussion and was followed up by a large-scale campaign by the Health Education Council to encourage people to look after themselves.

Prevention and health came under the scrutiny of the House of Commons Social Services and Employment Sub-committee of the Expenditure Committee, which was the motive force for a government White Paper, *Prevention and Health*, in 1977.[60] This report was rather disappointing on the prevention of dental disease and summarised some of the conclusions of the sub-committee about increasing dental health education.

A sequel to *Prevention and Health* was a discussion booklet, *Eating for Health*[57], which stressed the importance of sugar as a causative factor in caries. 'Throughout the world the incidence of dental decay in children is related to the consumption of sugar.' In addition, a deficiency of the essential nutrient, fluoride, is implicated as a factor in poor dental health. In a summary of the state of knowledge on diet and health, the following suggestions were made about dental health.

> 'People need to watch the amounts of fats and sweet foods they eat. Many people will need to cut down their intake of . . . sugar in sweets, chocolate, puddings, soft drinks, tea, coffee and other beverages.'

The advice is sensible but, as with the remainder of the report, too much emphasis is placed on individuals changing their food patterns; the strong influence of food and nutrition policy and the role of advertising is ignored.

All these reports were available to the Royal Commission on the National Health Service which reported in 1979.[131] The conclusions of the commission should have a major influence on dental services in Britain because most of the recommendations, which agreed closely with those of the Pavitt working party[102], are sound, practical and timely.

The commission concluded that the state of the nation's dental health was poor. It listed some allegations of failure within the general dental services. For example, people were finding difficulty in getting treatment in the NHS; emergency treatment was not readily available; the lack of preventive items and certain kinds of treatment in the NHS; high charges to patients; and decline in the quality of treatment. On the positive side, the commission reported an improvement in attitudes to dental care. Paragraph 9.17 justifies being quoted in full.

> 'Nevertheless, in no other area of health is the way forward so clearly signposted as in the handling of the two major dental diseases. Wholehearted application of known preventive measures would bring treatment needs to manageable proportions. The control of dental caries in children could be a reality in twenty

years' time and the full effects felt in a generation. Although it is a more difficult area, much can also be done to control periodontal disease.'

Because dentistry is likely to change significantly, a recommendation was made to set up a committee to review the development of dental health policy, preventive strategies and the future functions of the community dental service.

The commission analysed the system of remuneration of dentists. It received complaints about the method of payment and the amount. It appeared to the commission that no one system could suit every type of practice in every part of the country. Preferably, practitioners should opt for a particular method of payment—a suggestion which accords with our recommendations.

Other passages and recommendations relevant to our discussion are as follows.

'. . . the development of group practices should be encouraged whether in private accommodation or in health centres . . .' (9.27)

'The reluctance of general dental practitioners to work in them [health centres] may stem from conditions imposed by health authorities.' (9.28)

'New initiatives are required to improve dental care in areas of social deprivation . . .' (9.28)

'We recommend that dental care for long-stay patients should be as readily available as it is for men and women in the community.' (9.33)

'A much greater increase in their [dental hygienists] numbers must be an important element in a preventive programme.' (9.39)

'We endorse the recommendations of the Court Committee for an expansion of training facilities for dental auxiliaries.' (9.40)

'The training of ancillaries should take place alongside that of dental students.' (9.41)

'. . . their [dental technicians] career prospects should be improved, and we recommend that the present technical college/dental hospital training schemes should be expanded . . .' (9.42)

'We recommend above a review of the future functions of the community dental service . . . The community service might develop into a high quality specialist service . . . or into a comprehensive service for children . . . or into the spearhead of a preventive dentistry programme.' (9.49)

'We recommend that manpower in the community service should be increased . . .' (9.51)

'If we regard the retention of a natural set of teeth for life as a fundamental aim for a national service, the present approach via the treatment of established diseases has little prospect of success.' (9.56)

'A major shift in policy towards prevention is long overdue. This will require changes in the attitudes and practice of dentists and teachers and in the public's apparent indifference to dental health. A much more positive approach to dental health must be adopted if progress is to be made. Four main measures seem to be required:

fluoridation of water supplies;

better financial recognition for preventive work by dentists;

effective dental health education supported by relevant behavioural studies;

and increased support for biomedical research directed towards prevention.' (9.57)

The commission went as far as to recommend that the government introduce legislation to compel water authorities to fluoridate water supplies at the request of the health authorities. When discussing alternative means of using fluoride, it doubted whether the item-of-

service system of payment could provide the structure for a satisfactory preventive programme—a conclusion with which we agree.

The faith in prevention was clearly expressed by the commission.

> 'The prevention policies which we recommend for the future offer a real and attainable—perhaps unique—improvement in public health. A determined swing of policy towards a greater emphasis on prevention is needed.' (9.73)

Any government or profession who ignores such a conclusion could be accused of negligence. Here we have a detailed analysis of the dental services and methods of improving dental health. The recommendations we have quoted could almost serve as a summary of our own views. The question is—will they be enacted?

12
Summary and recommendations

We have examined aspects of dental care with a view to matching the system of providing dental care to the objectives it should achieve. Although the principal area of interest has been the United Kingdom, a discussion of international dental care has been included (Chapter 4, pages 36–42) to illustrate that the problems are not unique to the UK, and that the proposals for change have wide application.

Control of dental disease

Two major insights have emerged about the control of dental disease. The first is the growing body of research that firmly incriminates dental bacterial plaque in the causation of the two main dental diseases (dental caries and chronic periodontal disease) and sucrose in the causation of dental caries (Chapter 2). The prevention of both diseases has become possible as a direct result of this knowledge. At present the regular removal of bacterial plaque is the only practical way of preventing periodontal disease. Dental caries can be controlled by restricting consumption of refined sugars which become a substrate for the bacteria, and by the use of fluoride to increase the resistance of the tooth to bacterial attack (Chapter 3).

Objectives of the dental care system

The second major insight is the manner in which the dental pro-

fessions have evolved to treat the vast amounts of existing dental disease. This has resulted in an emphasis upon technology and treatment, an arrangement which, however worthy, is not designed to tackle dental disease at source (Chapter 5). All countries with established dental professions have followed this pattern, and nowhere more faithfully than the General Dental Service of the National Health Service in the UK. This is a system designed to produce a very high number of treatment items at low unit cost. That objective is achieved, but it can no longer merit serious consideration as the principal objective of dental care. The aim of any dental service must be the prevention of disease, as well as treatment, and the long-term objective must, therefore, be to lower the prevalence of dental disease. The outcome will be a decrease in the items of restorative treatment, not an increase (Chapter 6).

The conflict between the objectives of the present system and that proposed has implications which can only be accommodated by a change in the form and function of the present service. If the concepts are accepted, a large proportion of the resources used to support the existing system cannot be justified. A good proportion of the resources should be allocated to a system with the objective of lowering the prevalence of dental disease in the total population. To achieve this aim, with a balanced and integrated dental service as part of a total health service, the following recommendations are made.

Oral health education

A determined effort to inform the public about the prevention of dental disease is unlikely to be initiated unless specific staff and resources are allocated to concentrate on health education. To execute this responsibility, staff appointments should be established at the Department of Health and Social Security with a specific duty of pursuing these aims. In addition to the required coordination between region and district within the dental service, it is considered essential to establish a close liaison between dental and other health interests so that the overall programme for health education can be considered. The programme will require to develop a working relationship with the mass media and commercial concerns in which health interests have the power to effect changes. It is strongly

recommended that ancillary workers be developed with prime responsibility for dental education. They will form an important part of the dental team.

Food and nutrition policy

Present knowledge indicates that major improvement in dental health would follow decreased consumption of confections, foods, drinks and medicines containing added sugar. The public should be helped to become aware of the facts and to have a chance to make a choice.

More education for the public on the sensible use of sugars and possibilities of sugar-related diseases should be part of the health education programme. It would include education for specific groups such as catering establishments, training colleges and schools. The objective would be the general, social and commercial acceptance of a diet low in added sugar.

Regulations should be introduced to control the amount of sugar added to manufactured foods, particularly infant foods and medicines. The claims made by manufacturers on behalf of sugar-added products, especially infant foods, should be examined. The possibilities of lowering the sugar content of food products, especially snack meals, should be explored conjointly with the food and confectionery manufacturers. Such negotiations should be conducted as part of a total health programme. These measures could help to reduce the refined sugar consumption to below ten per cent of the average total calorific intake.

In line with the government's recommended reduction for average sugar intake, it is logical to reverse the policy of subsidising the increasing growth and production of sugar in Britain and to oppose the EEC policy of sugar over-production.*

A reduction in sugar consumption plus the use of fluoride could virtually eliminate dental caries. The fluoridation of water supplies is

* This is assuming that all or most sugar production is destined for diet, and that no major advance is made in the technology for the use of sugar as a raw material for fuel or polymers.

the most cost-effective method of providing optimal fluoride levels to large populations. Where water fluoridation is impractical, the use of fluoride in tablet form, table salt or in rinses should be promoted. Fluoride toothpastes provide part of the total fluoride requirement. Counselling on fluoride dosage should be freely available to every mother and to all those responsible for the institutional care of children. It is not enough for this to be passive education; it should be actively promoted for the community as a whole.

Expanding the role of the community dental service

The three decades of the General Dental Service have produced a change in emphasis from extractions and dentures to restorations, but there has been no accompanying change in the piece-rate system of payment, the defects of which have been discussed in Chapter 6.

There is a need for an organisation which can ensure that no part of the population is deprived of dental care because of geographic isolation or social, mental or physical handicap. It must have the ability to identify need, and to initiate and carry out community-wide dental care schemes—especially preventive schemes. The choice of the best preventive measures needs to be unfettered by the necessity to fit them into a fee-for-item structure. Dental health education will play a large part in preventing disease, and much of this work can be done by ancillaries who cannot carry out their task effectively if they are restricted to dental surgeries. Where a lack of dental care is identified, it should be possible to tailor a service to fit the required need, drawing from a mixture of expertise which will be flexible and capable of being used where and when it is needed.

If this is accepted, the organisation must also have the potential to analyse the results of its efforts and, thus, to effect change and strive for improvement. In this way, the service should develop in an organic fashion and avoid becoming a rigid and inflexible bureaucracy.

We can see no alternative to satisfying these requirements than by expanding the community dental service to fulfil this role and, thereby, correct the present numerical imbalance, referred to in the

text, between the General Dental Service and the community dental service.

Personnel and career pathways

There is no point in expanding the community dental service unless it has an equal opportunity of competing for high-quality personnel with other branches of the dental service. A career pathway for dentists or ancillary workers must be provided which will be intellectually, socially and materially satisfying, if the whole system is not to be jeopardised. For reasons discussed in Chapter 8, it is recommended that six main career pathways will offer equal but alternative opportunities, within an integrated dental service. These pathways should be independent of the institutions in which the work is carried out. They are

1 Paedodontics, including orthodontics

2 Adult restorative and preventive practice, including periodontics and prosthetics

3 Oral surgery, oral medicine, oral pathology

4 Teaching in conjunction with the universities, Royal Colleges of Surgeons and regulating authorities

5 Monitoring, epidemiology, clinical and social research related to the dental service

6 Handicapped persons—physically, mentally and socially.

Details of the recommended salary structure are also contained in Chapter 8.

Manpower planning

The responsibility for assessing the demand and regulating the supply of manpower for the dental service is of paramount importance, yet,

at present, there is no dental manpower planning unit in the UK. This is considered to be irresponsible. Failure to provide a scientifically based estimate of the numbers and types of dental health workers required will be expensive in both economic and human terms. The Royal Commission on the National Health Service (1979) considered that NHS dentistry was likely to change significantly in the future.[131] To match the changes to manpower requirements, it is recommended that a permanent dental manpower group be established to forecast and monitor needs.

Ancillary personnel

The widening of dental care to include activities outside the dental surgery, or with limited responsibility, requires an expansion of the dental team. This means an increase in the use of ancillaries and a responsibility for their training and career progression along with that of the dentist. The use of more dental technicians, dental health educators, dental hygienists, preventive ancillaries and chairside assistants is recommended.

Dental technicians

The unique position of dental technicians should be recognised and their status must be improved because they are such important members of the dental team. Many problems are caused by the nature and siting of the dental technicians' work, and the need to relate the technicians' work to biological knowledge about the teeth and mouth. It is recommended that a national diploma, such as that awarded by the Technical Education Council, be encouraged. A register of technicians and licensing of laboratories are strongly recommended. A technician should be able to follow a career in the community dental service without being at an economic, social or intellectual disadvantage in comparison to fellow technicians in private practice.

Representation

An efficient consultation procedure is recommended to ensure good

communication between members of the dental service. To avoid the ancillary workers becoming a submerged group within the dental service, it is recommended that a board of ancillary dental workers be established under the Council of Professions Supplementary to Medicine. The board could take over the functions of the Ancillary Dental Workers' Committee of the General Dental Council.

Dental training

If the members of a dental team receive their training in separate establishments and come together only after qualification, failure of the team is almost guaranteed. The dental schools should accept the responsibility for training all members of the dental team. Training should include experience in the dental school and in the community, and the members should have plenty of experience in cooperative activity and teamwork.

This implies a reorientation of the undergraduate course to give full weight to new concepts, including the sociopsychological and economic presumptions and consequences of dental care provision. Continuing education will always be important and programmes must be provided. Career progression will depend on demonstrated ability, not merely time of service, and this requires facilities for updating knowledge. All members of the team must be required to attend continuing education courses as a condition of practice.

Integration of the dental service

The wider role of training for dental schools should be accompanied by a recasting of the traditional departments of school, hospital and clinic. Specialist advice and treatment, or clinical teaching, should not be restricted to any one building, unless it is also the most suitable for the purpose. For example, the hospital is the best place for concentrating the expensive resources required for oral surgery, and the laboratory facilities required for oral pathology and oral medicine. It is also considered important that the role of the hospital as a centre of excellence and a focal point for the health care teams should continue. What is considered indefensible is that the expertise avail-

able should remain encapsulated in the hospital and become an isolated group. Function should be viewed quite apart from facility so that, where possible, the expertise provided by specialist staff may move out into the community, and the staffing of the health service should become dynamic, within the career pathways described. It is hoped that the range of work would be increased and a more even spread of expert ability obtained. Some collaboration between the hospital and community dental service has been taking place since the reorganisation of the NHS, but a great deal more is required to raise the level of care to the whole population rather than restricted to a proportion of it.

Siting dental care

The places where dental care can be provided need to be defined. These will be in health centres, schools, practices, hospitals and dental schools, industrial units and long-stay institutions.

More rarely, a dental centre will be required to operate as an independent unit; for example, a mobile unit in rural areas. The correct mix of facilities can be provided only if sufficient and correct information is available, which it may require a pilot scheme in each region to provide. Although the committee is not a source renowned for innovative plans and brilliant implementations, the planning required must incorporate the views of all members of the health care team, and the consumers.

Dental care centres in practices

Some established practitioners should have the opportunity to incorporate their practices into the community dental care service. Some practitioners would welcome the opportunity to offer a preventive dental care service without abandoning the practice which has been carefully built up over the years.

It would require a new contract negotiated with the Department of Health and Social Security, which would include contributions by the government towards the salaries of the ancillaries in the dental team.

The method of remuneration for the dentist will require discussion with the representatives of the dental profession. An important principle would be to establish that income should not be directly related to treatment items. A capitation fee, similar to that outlined by the Tattersall committee[54], is proposed for patients whose initial treatment has been completed.

It would be necessary for all dentists accepting this alternative contract to give a commitment to treat all patients within the NHS and to accept the need for continuing postgraduate education.

Administering the dental service

Planning has acquired a bad reputation in almost every public endeavour, but it is difficult to imagine the recommended changes coming about in an *ad hoc* fashion, without some planning and coordination.

There must be a mechanism to ensure the balanced disposition of resources, and that those resources (money, staff, equipment, buildings) are being properly used and not wasted. This action must be taken at a strategic level by the DHSS through its regional dental officers. The people responsible for it will need to be of the highest quality with outstanding management ability. Each of the appointed officers will need also to possess expertise in at least one branch of dentistry, so that jointly they can advise the minister at national level. The present training of dentists does not develop all these qualities; thus, selected personnel will have to be trained for these jobs.

The regional dental officers should take responsibility for so monitoring the functioning of the dental service that it becomes adaptable to change. Skills required for this responsibility need to be developed, and one career pathway has been devoted to it. Information will be supplied to the region and the DHSS by the executive arm of the service and the Division of Applied Clinical Research. There will be an enormous responsibility to match the training facilities and the number of students to the personnel requirements of the service so that trained people will not face unemployment, nor the service a

shortage of trained staff. Career progression in the region must also, therefore, be matched to training.

The strategic and executive functions must be clearly defined so that day-to-day decisions rest with the person on the spot. Sufficient time must be allowed for the executive level to function effectively, and local accountability must be vested at this level.

For example, the decision to site specialised units such as maxillo-facial surgery must be taken at national and regional levels, but the running of such units must be delegated to the local (district) level. The ability to delegate, but not abrogate, authority is one of the important differences separating the effective manager from the ineffective.

Democratic representation

It is considered crucial to the success of the dental service that the consumers be fully involved and the feeling that 'they' are providing a service for 'us' should eventually disappear. The work of the community health councils is, therefore, considered essential in the total functioning of the dental health service.

On the other hand, the executive function in the dental service must be reasonably free from interference and the time-scale of change be such that progress can be made. The process of democratic representation must be learned by the consumer as well as the manager.

An applied clinical dental research centre

The quantity and quality of applied clinical dental research being conducted in the UK require improvement. The little clinical research which is done is uncoordinated and, until recently, the quality was unsatisfactory. In addition, the nature of the clinical research owes more to commercial interests than to the needs of the population.

We recommend that an applied clinical dental research centre be set

up under the Department of Health and Social Security, Medical Research Council, Social Science Research Council and Health Education Council.

The centre would carry out research into

preventive and therapeutic substances

dental practice and dental treatment

dental materials

the epidemiology of dental and oral diseases

health behaviour and health education.

It should be staffed by epidemiologists, clinicians, statisticians and behavioural scientists.

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