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Cost-Effectiveness in Dental Health

A Review of Strategies available for Preventing Caries

by

Ron Akehurst and Diana Sanderson

DISCUSSION PAPER 106

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ABSTRACT

Most decisions in public health are based on imperfect information, and this is certainly the case for dental health. Relatively little is known about the cost-effectiveness of the various options available to improve dental status. It is, however, well recognised that regular exposure to fluoride reduces the incidence of caries considerably, and it is no coincidence that oral status throughout the world has improved considerably since the widespread introduction of fluoridated toothpaste in the 1970s.

Dental status is usually measured by dmft and DMFT scores, which indicate the numbers of decayed, missing and filled teeth in the primary and secondary dentitions at various ages. The World Health Organisation set a target in 1980 of an average DMFT score of 3 or less for 12 year olds by the year 2000. The target has already been achieved by the population as a whole. However, despite the recent improvements in the oral status of Britain's children, between 10% and 20% suffer from poor dental health, and are regarded as an at-risk group. These children tend to be concentrated geographically in certain parts of Britain, and poor oral status is often associated with poverty and socio-economic deprivation.

This paper explores a number of strategies available for preventing caries. Although caries is seldom life-threatening, it causes unnecessary distress to a minority of the population, many of whom live in deprived inner city areas. Oral health currently represents an appreciable drain on NHS resources, accounting for 4% of total NHS expenditure each year. In order to effect an improvement in overall dental health, represented by average figures for the whole population, policies need to be targeted towards those most at risk of poor oral status.

Two of the possible approaches - promoting improved self-administered oral hygiene and encouraging people to make better use of the general dental service - require people to change their behaviour. Health promotion campaigns requiring behavioural change suggest that it can be very expensive to get the message to those most at risk, and even then there is no guarantee that they will change their behaviour in the desired manner. Furthermore, both approaches suggested above have some financial consequences for the individuals, and those children most at risk of caries often come from families who can ill-afford additional financial burdens. Thus neither strategy is particularly cost-effective, and lack of compliance is a major concern.

Reducing sugar consumption through dietary change is often promoted as a strategy to improve dental health, but the supporting evidence is very weak. Links between diet and oral status are complex, and many countries have reduced their dmft and DMFT scores in recent years against a background of stable or even rising sugar consumption. Much of this improvement in oral status is considered to be due to increased exposure to fluoride during this period. Dietary change can be very difficult to effect, especially given the pleasure associated with the consumption of sugar-containing foods. There is also a risk that the proportion of fat in the diet will increase if sugar consumption is reduced, especially amongst adolescents, and this may have an adverse impact on the prevalence of coronary heart disease in the future.

Water fluoridation has reduced caries levels by about 50% in those parts of the world where it has been introduced, and children living in those areas of Britain with fluoridated water consistently enjoy significantly better dental health than children living in similar areas with

non-fluoridated water. Water fluoridation is extremely cost-effective, requires no user compliance, and also benefits adults by reducing root caries. However, proposals to introduce it in a number of areas in Britain have encountered strong opposition on the grounds of unproven health risks and dislike of mass medication. It may be possible to a certain extent to target water fluoridation towards the at-risk groups by only fluoridating selected water treatment works, such as those serving inner city areas.

The community dental service also has an important role to play in improving the oral status of the at-risk groups, since it provides dental services in schools and other local facilities. Prophylactic fissure sealants are a proven way of reducing pit and fissure decay. Fluoride has the least effect upon these surfaces, and sealants are a cost-effective way of protecting these surfaces for at-risk children.

The majority of children enjoy good oral status which will be maintained by self-administered oral hygiene and regular contact with the general dental service. However, those with poor oral status often come from families who are unlikely, or even unable, to respond to campaigns to brush their teeth and visit their dentist regularly. Reducing population sugar intake through dietary change, assuming such change can occur, is unlikely to influence dental status, and may adversely affect fat consumption. Increased exposure to fluoride via selectively fluoridated water, combined with fissure sealants and regular contact with the community dental service, are the most cost-effective ways of improving the nation's oral status.

1 ECONOMICS, HEALTH AND DENTAL CARE

1.1 Introduction

The United Kingdom Government has recently stated explicitly what hitherto has only been implicit in the National Health Service - that the purpose of the delivery of health care (including preventive activities) is to maximise health gain measured in terms of length and quality of life. Because the resources available for prevention and treatment of ill health, including dental health, are scarce, a corollary of the attempt to maximise health gain is that services of all types have to be delivered cost-effectively.

In some areas, for example pharmaceuticals, there is a requirement for strong evidence of the effectiveness of new drugs before a new product can be licensed. In other areas there seem to be less demanding standards of proof, and this probably applies to most areas of medicine as practiced. The argument for policing the effectiveness (rather than the safety) of drugs is to avoid spending public money wastefully. The same argument must apply to other areas of health policy, including that towards dental health. In this paper we examine the evidence on the effectiveness and cost-effectiveness of the options available for intervention by government to improve dental health. In most cases it will be seen that the evidence is too incomplete to make secure estimates of cost-effectiveness. Nevertheless, it is possible to come to fairly robust conclusions about what the most cost-effective approaches are likely to be.

2 THE SCALE OF THE DENTAL DISEASE PROBLEM

2.1 Measures of Dental Health

There are several measures of dental health, but dmft and DMFT indices (ie. decayed, missing and filled teeth - deciduous and PERMANENT) for 5, 12 and 14 year olds are the most widely used. Other measures include the percentage of children of various ages with no decayed, missing or filled teeth; the percentage of non-dentate adults; and the average number of teeth retained by dentate adults. Table 1 shows some measures of recent dental status in

the UK.

Table 1: Dental Health Care in Britain

	1968	1973	1983	1988
Average dmft for 5 year olds:				
UK	4.5[a]	3.5[b]	1.7[b]	1.86[c]
Wales				2.27[c]
Scotland				2.73[c]
Average DMFT for 12 year olds:				
UK		4.7[d]	3.1[d]	1.58[e]
Wales				1.90[e]
Scotland				2.23[e]
Number of adults retaining some natural teeth (f):	63%	71%	80%	
Average number of teeth retained by dentate/ partially dentate adults (f):	21.9	23.2	24.4	
Average number of sound and untreated teeth per adult (f):	12.8	13.2	15.0	
Proportion of young adults (aged 16-24) with 18 or more sound and untreated teeth (f):	44%	53%	83%	

Source:
a) Timmis (1971), British Dental Journal, 130, 278-83
b) Hill (1989), British Medical Journal, 298, 272
c) Dowell and Evans (1989), Community Dental Health, 6, 271-9
d) WHO (1992), Dental Caries Levels at 12 years
e) Evans and Dowell (1991), Community Dental Health, 7, 307-14
f) Todd and Lader (1988), Adult Dental Health 1988, OPCS

2.2 Recent Trends in Dental Disease

In general, the indices reflect the steady decline in dental caries which has taken place in Britain (and indeed in many other countries) in recent years. During the late 1980s it was

recognised that about 80% of decay occurred in about 20% of the population [1]. Continued improvements may mean that this is moving to a position where 90% of the decay is confined to 10% of the population. Downer [2] estimates that 90% of the working population will be dentate with 21 or more standing teeth by the year 2008.

This fact is important because it means that effective campaigns to change behaviour - for example with respect to oral hygiene - have to affect the small group within which most caries is found. Changes in the behaviour of the relatively healthy 80% - 90% of the population will have little effect on the overall indices of dental health. Dental targets are often set globally with regard to average DMFT scores, which may not be the most appropriate objective. This issue is considered in Appendix A. It should, however, be noted that Batchelor et al [3] argue in favour of adopting a "whole population strategy" rather than a "high risk strategy" for preventing dental caries. They believe that "it appears that altering whole exposure distributions may be the most effective way of reducing the prevalence of caries, both in the population as a whole and also specifically among those who are at highest risk". A high risk strategy would focus only on those in the poor dental health tail of the distribution rather than on those who already enjoy good dental health.

There are geographical concentrations of dental decay - for example, the worst seventeen Districts and Health Boards in the 1991 National Dental League Table for 14 year olds are in Scotland or North West Region [4]. The British Association for the Study of Community Dentistry (BASCD) Report on the dental caries experience of 5 year olds in Great Britain in 1987/88 shows that many of the Districts and Health Boards with the worst dmft scores were also in the north west of England and in Scotland [5], as does the BASCD Report of the dental caries experience of 12 year olds in 1988/89 [6]. The geographical distribution in part reflects the distribution of areas with low socio-economic status.

2.3 Reasons for Poor Dental Status

Poor dental status occurs for a number of reasons. Some individuals are inherently susceptible to dental problems despite following a sound programme of dental care. Such people need to be in regular contact with the dental profession who can monitor their dental

status and take a variety of measures to compensate.

The majority of dental decay, however, is associated with low socio-economic status. For example, data for Yorkshire showed a correlation of 0.84 and 0.79 between Jarman scores (an Index of Social Deprivation based on 1981 Census data in which higher scores reflect greater deprivation) and the most recent dmft scores for 5 year olds in Leeds and Sheffield respectively [7]. A variety of hypotheses can be put forward to explain poor dental status, including poor self-administered oral hygiene (eg. do not brush their teeth, do not use toothpaste) and poor dietary habits. These may be due to ignorance and/or lack of money.

There is also a tendency towards poor dental status amongst ethnic minorities [8 - 13]. This may partly be due to socio-economic deprivation and language problems, but is also caused by cultural and religious factors relating to feeding practices, resulting in baby bottle tooth decay. However, although dmft scores for Asian children are usually considerably worse than those for other children, their average DMFT scores are often better [7, 12]. It is also important to remember that the ethnic minorities do not constitute an homogeneous group, and that different preventive strategies may be needed (eg. that take language and/or religious customs into account).

In this paper it is assumed that the majority of those with poor oral status (ie. those towards whom campaigns should be addressed) live in electoral wards with high Jarman scores. These wards are usually found in cities and some large towns. Electoral wards with high proportions of ethnic residents should also be targeted.

Some people (not necessarily from the lower socio-economic groups) are dentally anxious, and therefore very reluctant to use dental services [14]. This anxiety may be related to cultural differences and language problems, but it also may be due to fear of pain. Finally, some people may have poor dental status because they avoid visiting the dentist due to anxiety about paying for their treatment.

2.4 Expenditure on the General Dental Service

In 1991 the NHS contributed £1.3 billion to the General Dental Service (GDS), and this was supplemented by £0.5 billion from patient payments [15]. Not all of this expenditure was caries-related. Some was directed, for example, at preventing and treating gum disease. Non-surgical periodontal treatment accounted for 14% of GDS expenditure on adults in 1991/92, and examination and diagnosis for almost 12% [16]. Table B.1 in Appendix B shows the breakdown of GDS expenditure for adults in 1989/90, 1990/91 and 1991/92. The introduction of the new dental contract in 1990, with its increased emphasis on prevention and capitation payments for children, means that it is no longer possible to compile equivalent information for children and adolescents. However, Table B.2 in Appendix B shows some data for 1989/90 which reflect the expenditure breakdown for children and adolescents before the new contract came into effect [17]. Tables B.3 - B.5 consider caries related and non-caries related treatments and expenditure. Table B.3 shows that the proportion of expenditure on non-caries related treatments for adults has increased slightly between 1989/90 and 1991/92 from 30% to 32%.

A similar breakdown for children and adolescents in 1989/90 is presented in Table B.4, and shows an almost even split between caries related and non-caries related expenditure. Overall, about one third of total GDS expenditure in 1989/90 was on non-caries related treatments, as shown in Table B.5.

GDS expenditure per person increased in real terms by 40% between 1980 and 1991, even though dental health improved steadily over this period [15]. In 1991/92 the average annual GDS cost per adult registration in England and Wales was £50.21 [14]. It was noted above that a considerable proportion of GDS expenditure relates to the prevention of gum disease, and the annual number of scaling and gum treatments for adults almost doubled between 1970 to 1989/90, from 6.7 million to 12.5 million [15]. Such treatments are likely to become increasingly important as the proportion of dentate adults continues to rise, since gum disease is a greater problem for adults than for children.

2.5 NHS Expenditure on Dental Health and Other Diseases

Table 2 shows how GDS expenditure as a percentage of gross NHS expenditure compares with gross NHS expenditure on other major disease areas [15]. Overall total expenditure on dental health will exceed NHS expenditure due to patient co-payments.

Table 2: GDS Expenditure in Comparison with Expenditure by the NHS on Other Diseases, 1991 (% of Gross NHS Expenditure)

DISEASE AREAS	%
Genito-Urinary System	2
Neoplasms	3
DENTAL HEALTH	4
Digestive System	4
Musculo-Skeletal System	4
Nervous System and Sense Organs	4
Respiratory System	5
Circulatory System	9
Mental Disorders	9

3 ASSESSING THE COST-EFFECTIVENESS OF STRATEGIES TO PROMOTE DENTAL HEALTH

3.1 Strategies to Promote Dental Health

Strategies to promote dental health may be split into two broad categories, according to whether or not they depend for their effect on changing the behaviour of all or part of the general population. Most strategies suggested depend on a behavioural change of some sort for success. They include as elements:

i) encouraging brushing with fluoride toothpastes;

ii) using fluoridated mouthrinses (for adolescents and adults);

iii) using fluoride tablets or drops (for babies and young children);

iv) using dentists (and hygienists) for preventive work either directly, such as by undertaking fissure sealing, and/or indirectly by using them as a source of persuasion in i) - iii) above and v) below;

v) modifying dietary habits (eg. reducing sugar consumption).

There is a further strategy which has been suggested that does not require behavioural changes for its success. This is the fluoridation of public water supplies.

Any of the above preventive strategies can either be addressed towards the entire population or focused on particular at-risk groups. These strategies are considered in turn below.

3.2 Improving Dental Hygiene

3.2.1 Methods of Improving Dental Hygiene

There is evidence that regular brushing, particularly with a fluoride toothpaste, is beneficial to dental health, and indeed much of the improvement in dental status that has occurred since the 1970s has been credited to this [eg. 18, 19]. Furthermore, brushing techniques can be improved to the benefit of the individual concerned when the technique is initially defective. Additional improvements may be achieved if individuals can be encouraged to use dental floss (which removes food and plaque from hard-to-reach areas and promotes healthy gums), and to use supplementary fluoridation via mouthrinses (for adolescents and adults) and drops or tablets (for babies and children) in areas where fluoride levels in the water supply are less than 0.7 parts per million (eg. [18], although Axelsson [19] found no additional benefit from fluoride mouthrinses).

3.2.2 Costs of Improving Dental Hygiene

If the population were to improve its dental hygiene overnight the costs of the change would

fall on the individuals concerned and would consist of the money spent on extra toothbrushes, toothpaste, mouthrinses and other such products. It has been estimated that about £250 million is currently spent in the UK on toothbrushes, toothpaste, mouthrinses and denture products each year (ie. about £5 per person per year) [20]. Surveys have shown that 6% of dentate adults clean their teeth less than once a day [21] and that people only change their toothbrushes about once per year [22].

It is estimated that an average of £8 - £12 would have to be spent per person per year if the entire population were to undertake regular self-administrated oral hygiene and buy four new toothbrushes (as recommended by the dental profession) per year. This would consist of £4 on toothbrushes, £4 on toothpaste (300 grammes) and perhaps £4 on fluoride drops/tablets/mouthrinses/dental floss. This would imply extra expenditure of between £150 million and £350 million per year.

It is likely that such a change in behaviour by the whole population would result in some improvement in dental health, with respect to both caries and gum disease. However, the magnitude of the improvement cannot be identified. The majority of the population, whose disease experience is already low, would be likely to benefit only to a small extent.

However, it may be possible to achieve some success amongst the at-risk population if they spent as little as £5 per year (ie £1 on a toothbrush and £4 on toothpaste). If it is assumed that the 10% of the population with the poorest dental status currently spends nothing on dental products, significant benefits could be obtained for an increase in expenditure of about £25 million (ie. 5 million x £5). This expenditure would be borne by the individuals rather than by the NHS (unless the campaign provided free toothbrushes and toothpaste to those at risk of caries, in which case the costs would be borne by the NHS, plus the associated administration costs).

3.2.3 Estimated Benefits

It is not easy to estimate the likely benefits of such a campaign. As the overall levels of dental health improve, remaining caries is occurring on the pit and fissure surfaces of the

molars, which are the surfaces which are least susceptible to the benefits of fluoride [23]. Therefore any campaign which affects the behaviour of those whose underlying oral status is already good is likely to have at best a marginal effect on this sector of the population.

If it is assumed that those most at risk of caries face an equal risk of caries on pit and fissure surfaces as on all other surfaces, then a campaign that persuades them to change their behaviour could be expected to reduce dmft and DMFT scores by a maximum of 50% (ie. if it prevented all non pit and fissure caries). Therefore children with a DMFT score of 6 at 12 years could have had a score of only 3 if they had practiced good dental hygiene, and all non pit and fissure caries had been prevented. (Strategies to reduce pit and fissure caries are discussed later.)

3.2.4 Problems Associated with Changing Behaviour

Unfortunately, population behaviour with respect to dental health will not change spontaneously. People have to be persuaded to behave differently via public campaigns. To be effective a campaign initially has to change attitudes - in this case towards the importance of dental health - and then has to change behaviour. Furthermore, as suggested above, to have a really significant impact the policy has to change the behaviour of that part of the population where dental hygiene is worst, since increasing the awareness of those who already have good hygiene will have little, if any, marginal effect. It will also be necessary to repeat the campaign message frequently, otherwise there is a risk that people who have changed will revert to their former behaviour.

3.2.5 Effectiveness of Campaigns to Change Dentally-Related Behaviour

There is very little evidence about the effectiveness of campaigns in the United Kingdom to improve oral hygiene. North Western Regional Health Authority was awarded £0.5 million by the Department of Health to spend between 1988 and 1991 on a campaign to improve dental health in the Region via health education. The project is described in more detail in Appendix C, but in essence it included a variety of strategies, including one which aimed at improving the dental health of pre-school children from Social Classes IV and V and another

which considered using the Community Dental Service to provide school-based care for at-risk children. The campaign has been described fully for the Health Authority [24 - 26], but unfortunately its cost-effectiveness has not been assessed. However, the campaign focusing on pre-school children appears to have had limited success at best, and a number of problems were encountered during its operation. The programme to target school-based care for at-risk populations using the Community Dental Services seems to have been more effective and less controversial.

A more useful study is that of Axelsson [19], which describes work undertaken in Sweden. Twenty years ago caries prevalence in Swedish children was amongst the highest in the world, and the highest values in Sweden were found in the County of Varmland. A needs-related preventive programme was introduced for all children and young adults in Varmland in 1978, and has been evaluated yearly since then. Children visited school-based dental clinics 1-6 times per year, according to their individual need/risk, which was assessed using salivary streptococcus mutans counts. The programme has been extremely successful at reducing caries - for example, caries incidence decreased by 75% - 85% between 1979 and 1991; the percentage of caries-free three year olds increased from 51% to 94%; and DFS scores for 12 year olds dropped from 6.5 to 1.0. Axelsson believes that it has been very cost-effective, although his paper does not include cost data. However, the programme involved considerable effort and staff resources, plus a compliant population who responded favourably to the programme. It cannot be assumed that the UK population would be as compliant as that in Sweden and such an approach may not be as appropriate here.

Other campaigns that have tried to encourage behavioural change suggest that maintaining compliance may be a problem and that other strategies may be more effective. A ten year dental health education programme was carried out in Askov, Minnesota, which involved toothbrushing twice per day in the classroom, the provision of free toothbrushes and toothpaste for home use, the application of topical fluorides, and continuous efforts to control excessive intake of sweets. At the end of the ten year period those conducting the experiment concluded that it had cost fifty times as much as water fluoridation would have cost, and was less than half as effective as fluoridation had proved to be in comparable communities [27]. Grembowski [28] considered the cost, efficacy and practicality of administering fluorides in

various forms. He concluded that fluoride dentifrices were good with regard to practicality, but could only be expected to reduce caries by 15% - 30%, whereas the home use of fluoride tablets or drops could reduce caries by 35% - 65%, but was a poor strategy with regard to practicality. He also favoured water fluoridation, finding it to be cheap, effective and very practical (water fluoridation is discussed in more detail in Section 3.5). People may change their habits for a while, but they tend to revert to their former behaviour over time.

3.2.6 Effectiveness of Other Campaigns to Change Health-Related Behaviour

There is little to be learned from other United Kingdom health promotion activities such as, for example, those undertaken in the field of prevention of Coronary Heart Disease or Stroke. Although we know what preventive programmes might cost in these areas - for example it has been estimated that it would cost between £20 million and £30 million per year to run a modest but comprehensive anti-smoking campaign nationally [29] - we have little evidence on their effectiveness.

A recent study of two smoking education programmes in schools showed that although the projects increased pupils' awareness of the risks of smoking, there was no difference in the prevalence of smoking among pupils in the schools using the programmes and in those receiving no intervention [30]. Studies relating to smoking need to be treated with some caution because of its addictive nature. Nevertheless, the evidence that we have is not encouraging. Anti-smoking statements and campaigns have been promulgated for many years, yet 30% of the adult population continues to smoke and in some groups, notably young women, the proportion is rising over time. This is despite the fact that the adverse health consequences of smoking (notably lung cancer and coronary heart disease) have been irrefutably demonstrated and are much more serious than those which follow from failure to clean one's teeth regularly.

3.2.7 Summary

- There is some weak evidence that behaviour can be changed so that oral hygiene and dental status would improve, although the exact quantitative relationship is unknown.

- Improvements in oral hygiene which promote fluoride are primarily effective on non pit and fissure surfaces.

- If all of the at-risk group (defined as the worst 10% of the population) started brushing their teeth adequately with fluoride toothpaste it would cost them about £25 million per year.

- The cost of a total population campaign to change behaviour can be estimated at £20 - £30 million per year (based on campaigns to reduce smoking and Coronary Heart Disease). Costs for targetting specific wards at risk would be less than this, but would depend crucially on the type of campaign implemented.

3.3 Dietary Change

3.3.1 The Relationship Between Sugar and Caries

There is known to be an association between the scale and frequency of intake of sugar (usually defined as sucrose) and the incidence of caries, with frequency being the more important factor [18, 31, 32, 33]. There is, however, very considerable dispute about the quantitative strength of these relationships, especially where good oral hygiene and fluoride are in use.

The most influential study was probably the experimental verification of the relationship in the Vipeholm study [31]. More recently Sreebny [34] reported an almost linear relationship with a high coefficient of determination between average DMFT and average sucrose consumption per person per year in a cross-sectional study of 14 countries. For 12 year olds in 47 populations he calculated that sugar intake alone can "explain" about half the variance in caries experience in human populations. Although the study was published in 1982, it used prevalence data that often related to ten years earlier, and his statistical analysis was limited.

In fact, the nature of the relationship between sugar consumption and caries incidence is far from straightforward [18, 23, 32]. Woodward and Walker [35] have recently examined data

on dental caries amongst 12 year old children and sugar consumption for 91 countries. They found for the whole data set that DMFT scores do tend to rise with sugar consumption, with a log linear relationship between the logarithm of DMFT and sugar. However, since sugar accounts for only 28% of the variation in DMFT, a high consumption of sugar does not necessarily imply a high DMFT score. More relevant to the UK, however, is the fact that when the data for 28 industrialised nations were examined separately there was no evidence of a sugar-caries relationship. This suggests that the full study by Woodward and Walker [35] and the earlier Sreebny [34] study might be picking up a relationship between caries prevalence and economic development, with sugar consumption in turn being correlated with the latter. Axelsson [19], points out that the drastic reduction in caries in Swedish children occurred at a time of unchanged daily national average sugar consumption (which remained at about 115 gram per day per person between 1960 and 1990). Indeed a study by Ericsson [36] shows that the consumption of sweets and soft drinks in Sweden actually rose during this time. Therefore the reduction in caries in Sweden cannot be attributed to reduced sugar consumption.

3.3.2 Defining "Sugar"

It should be noted that the definition of "sugar" is itself difficult. As Marthaler [18] points out, "the border between 'sugar', once synonymous with sucrose in most dietary studies, and other short-chain carbohydrates is becoming indistinct" and the substitution of one for the other may have little impact on cariogenic potential. Furthermore, it was studies relating to early data that showed the clearest sugar/caries relationship. As the use of fluoride dentifrices has become widespread in developed countries and fluoridation of water supplies has increased, so dmft and DMFT indices have reduced, in some cases dramatically, against a background of constant or rising sugar consumption [18]. Burt [23, 33] has suggested that reducing sugar intake in a population that is well protected in oral terms may only or mainly reduce caries on proximal surfaces rather than pit-and-fissure surfaces. His studies in the USA and analysis of work in the UK suggested that proximal lesions are becoming rarer. The implication of this is that the potential to reduce caries further by reducing sugar intake is small where good oral hygiene and use of fluoride are already occurring.

3.3.3 Benefits of Reduced Sugar Consumption

In attempting to assess what the effect on the incidence and prevalence of caries might be of a policy that tries to persuade people to reduce sugar intake, it has to be concluded that there is little clear evidence to go on, but that in the context of a good standard of oral hygiene and use of fluoride there may be only small potential for improvement. Furthermore, the degree of improvement may also depend on the nature of the change induced. If the effect of publicity is to encourage the use of, say, fructose in place of sucrose little positive change may occur. Similarly, the substitution of starches or fruit may have little positive effect.

3.3.4 Other Links between Caries and Diet

It should also be noted that the cariogenic potential of foodstuffs is multifaceted, and is also influenced by factors such as how long the food takes to clear from the mouth. The Committee on Medical Aspects of Food Policy (COMA) reviewed the role of sugar in the diet during the latter part of the 1980s [37]. The Report recommended that sugars that are contained freely in foods that are processed, such as sucrose and fructose, or in foods such as honey (the so-called "non-milk extrinsic sugars") should be replaced by sugars contained in fruit ("intrinsic sugars"). It should be noted that this distinction is not recognised in other countries. Furthermore, studies have shown that various fruits can cause caries due to their acidic properties and because of the sugars which they contain. For example, Grobler and Blignaut [38] showed that in the fruit growing areas of South Africa, where fruit consumption is higher than average, the incidence of tooth decay is higher than in cereal growing areas. Rugg-Gunn et al [39] showed that an apple has an almost identical effect on plaque pH over a thirty minute period as a Mars bar.

Indeed, all fermentable carbohydrates have the potential to cause caries - which means that cooked starches as well as sugars activate the demineralisation process which can lead to caries. Frequent snacking will subject the teeth to more acid attacks, and Newbrun [40] concludes that between-meal consumption of sugary foods is a risk factor for the cario-susceptible person. The retentiveness of the foodstuffs is also influential, and Bibby [41] showed that some foods, such as white bread, take a considerable time to clear from the

mouth. Thus caries-related dietary advice is more complex than simply reducing the amount of sugar consumed.

It is also interesting to note that the studies of Bowen et al [42] which investigated the cariogenic potential of various foods found that cereals with a content of 8%, 14% and 60% sucrose were equally cariogenic, suggesting that reducing the amount of sugar in a product from 60% to 8% would have virtually no effect on teeth.

3.3.5 Possible Adverse Effects of Reduced Sugar Consumption

So far we have concentrated mainly on the effect of sugar on caries formation, but the substitution of sugar in the diet may have other effects. Other things being equal, the percentage of fat in the diet will automatically increase if people reduce their sugar consumption, and in addition people may switch from surgery foods to foods with a higher fat content. Sheiham [43] has suggested that sugar consumption should be restricted to no more than 15kg per person per year in the industrialised world. Burt [23] calculates that if the boys from his Michigan study [33] were to replace half of the energy loss from reducing sugar intake to this level with fat, the proportion of their total energy intake from fat would rise from 38% to 47%. The Health of the Nation [44] recommends an English target of 35% of energy from fat. A switch from sugar to fat of the type considered above would increase the risk of cardiovascular disease, which is the most serious threat to the public health.

An assessment of the cost-effectiveness of changing dietary habits would therefore have to take into account both the doubtful potential for a substantial effect on caries and the possibility of an adverse effect on other public health objectives.

3.3.6 Effectiveness of Campaigns to Change Dietary Habits

We have not yet discussed the issue of the effectiveness of campaigns for getting people to change their dietary habits. However, campaigns to encourage this are rarely evaluated for their cost-effectiveness - for example the Good-Hearted Glasgow campaign of 1986 has not been evaluated. Many of the same considerations apply here as were discussed in the context

of changing oral hygiene behaviour. Indeed, the same attitudinal change towards the importance of oral health might have to be achieved to influence either or both of behaviour towards diet and oral hygiene. However, it may be harder to influence diet. Positive messages to "do something" are in general better received by the public than negative "give up" messages [45]. Ericsson [36] notes that in Sweden "propaganda for improved oral hygiene and reduced consumption of sweets have been very intensive over several decades", and he further notes that during that time the per capita consumption of sweets and soft drinks has increased considerably (although caries has reduced substantially). Pollard and Curzon [46] refer to a Swedish study by Johanssen on diet counselling and behavioural change amongst Swedish 13 year olds which concluded that it is extremely difficult to influence behaviour.

The conclusion has to be that there is no more evidence here than in most other areas of prevention to indicate what the quantitative relationship might be between spending on a campaign to change dietary behaviour and the changes in attitude and behaviour that result from it. This uncertainty has to be put with the uncertainties around the effect of the behavioural change, should it occur, when assessing the overall cost-effectiveness of a policy of prevention through dietary change. What the literature does show, however, is that it is possible to improve dental status dramatically through improving oral hygiene (especially by ensuring exposure to fluoride via dentifrices or other methods) against a background of stable or even increasing sugar consumption. Dietary change may have some positive impact on the dental status of those who are not carrying out regular oral hygiene, but it will probably be easier to encourage them to improve their dental habits than to change their diet. Furthermore, improved dental habits do not carry the risk of increased fat consumption that may occur if sugar consumption is reduced.

3.3.7 Summary

- Links between population consumption of sugar and caries are not straightforward. In many countries caries has fallen significantly against a background of constant or rising sugar consumption.

- It is therefore not clear quantitatively what reduction in caries, if any, would follow from a reduction in the amount of sugar (sucrose) consumed.

- Reduction in sugar intake carries with it the risk that fat may be substituted for sugar in the diet, with adverse effects on, in particular, Coronary Heart Disease.

- As in the case of oral hygiene, there is no evidence on which to base reliable estimates of the quantitative effect of campaigns to change dietary habits.

3.4 Making Better Use of the General Dental Service

3.4.1 The Role of the Dental Profession and Future Treatments

Dentists may have an important part to play in any campaign that was set up in pursuance of the policies of Section 3.2 or Section 3.3. When patients come to them, they may persuade them to carry out better hygiene or instruct them in brushing or flossing techniques, for example. They may also advise them against frequent snacking. In addition, the dental profession may have a role in using gels and varnishes (deciduous dentition) or sealants (permanent dentition) on teeth and surfaces which are felt to be susceptible to decay.

Trials of intra-oral devices in the form of copolymer membranes and glass devices which cause an elevation of fluoride in the saliva are currently underway in the USA and at Leeds in England respectively [1, 47]. Developments of these types may further improve the range of preventive treatments available to the dental profession. One of the problems associated with the use of fluoride tablets, drops and mouthrinses (even if recommended by the dental profession) is that of poor compliance, especially by those from the lower socio-economic groups [28]. Professionally applied gels, varnishes, sealants and slow-release fluoride devices prevent this problem.

3.4.2 The Use of Sealants

Sealants are particularly effective at preventing decay in the pit and fissure surfaces of molars,

which is where the majority of decay now occurs [21, 35, 47, 48, 49]. If each cohort of children were to receive full fissure sealing on twelve teeth this would cost about £34 million per year (ie. 700,000 children per annum at £4 per tooth, or £48 per full sealing). However, it would not be necessary to undertake such comprehensive coverage, and instead such treatment could be targeted at those who are likely to benefit the most. If the 10% of the population most at risk from caries (ie. 70,000 children per annum) received full fissure sealing this would cost £3.4 million per year, or £1.8 million per year if only half their teeth were sealed (assuming a cost of £4 per tooth sealed).

Fissure sealants can be used both preventively and therapeutically, and their use to date has varied widely across the country. Unfortunately it is usually not possible to determine from the data whether they have been applied for preventive or therapeutic purposes.

Axelsson [19] does not believe that the general use of fissure sealants can be justified from a cost-effectiveness perspective. He recommends that the fissures in selected risk and high risk individuals and "risk fissures" be "sealed" with glass ionomer as early as possible during eruption. The glass ionomer in the fissures acts as a slow release agent for fluoride during eruption. He cites a four year longitudinal study by Mejare and Mjor [50] in which it was shown that 100% of occlusal surfaces sealed with glass ionomer were caries-free, even though more than 60% of the material was lost within 6 - 12 months and 95% after 30 - 36 months. The surfaces of the control groups were sealed using traditional etching-resin fissure sealant techniques, but 5% of the occlusal surfaces were decayed and had to be filled. This suggests that sealing with glass ionomer during eruption may be more effective than using traditional sealants, but there is no discussion of the relative costs of the two types of treatment in Axelsson's paper.

3.4.3 Promoting Contact with Dental Services

Of course, in order for a public policy of using sealants (or any other similar devices) to be effective, children have to go to their dentist (or receive dental treatment via the Community Dental Service). Once again the unknown is how effective a campaign might be in producing the necessary behavioural changes.

One part of North Western Regional Authority's Dental Care Programme (see Appendix C) focused on occasional dental attenders [26]. The programme was targeted at the 20% of the 9 - 11 year old age group who were receiving irregular or no dental care. It recognised that the Community Dental Service should concentrate resources on groups of children who were not receiving treatment from General Dental Practitioners. The programme consisted of school-based dental health education lessons and dental treatment at selected schools, and the results showed that such a programme can be run satisfactorily on school premises.

By removing many barriers to dental care such programmes are appropriate in circumstances where there is a core of children who are not receiving regular dental care from the GDS (ie. the at-risk population). Such programmes of taking the treatment to at-risk children may be more appropriate than campaigns to encourage them to use the GDS, since compliance will be much greater.

3.4.4 Evaluation of School-based Programmes

No analysis was undertaken on the cost-effectiveness of the programme in North Western Region. Klein et al [51] studied the cost and effectiveness in the USA of school-based preventive dental care where he compared the experience of almost 10,000 first, second and fifth graders in five fluoridated and five non-fluoridate communities. He concluded after four years that the dental health lessons, brushing and flossing, fluoride tablets and mouthrinsing, and professionally applied topical fluorides were not effective in reducing a substantial amount of dental decay, even when all of the procedures were used together. The study also found that occlusal sealants prevented one or two carious surfaces per head of population over the period. Communal water fluoridation was reaffirmed as the most cost-effective way of reducing tooth decay in children.

These findings do not necessarily mean that school-based programmes cannot be cost-effective in the UK, but do suggest that there is a need to evaluate those which are undertaken. School-based programmes also need to be compared with other strategies which promote contact with dental services. Indeed, the above discussion suggests that the Community Dental Service has a vital role to play with regard to providing school-based

dental care to at-risk children. Fissure sealants are particularly relevant for this group, and Section 3.4.2 suggested that 10% of children could receive full sealing at a cost of £3.4 million per year, providing that the CDS already has access to the relevant schools. If this is not so, then some additional expenditure will be required to establish such access.

3.4.5 Promoting Use of the General Dental Service

If adults are to make good use of professional dental services, it is also important that they are not deterred by anxiety about meeting the treatment costs that they will have to pay, for patient co-payments have risen steadily in recent years. Furthermore, adults and children in some areas are encountering problems of registering for NHS dental care, especially if their underlying oral status is poor.

It may be necessary to make some revisions to the Dental Contract or to defining those who are exempt from co-payments. For example, patient co-payments in 1991/92 totalled some £0.5 billion. A 50% reduction in this total (either across-the-board for all patients or targeted at those on low incomes) would reduce patient contributions by £250 million. Changes could also be made to the Dental Contract to encourage the registration of people with poor dental health.

3.4.6 Summary

- The dental profession has a role in the general promotion of oral hygiene, although both the costs and the effectiveness of this are impossible to quantify.

- If the 10% of the population most at risk could be induced to attend dental surgeries for preventive work, fissure sealants and related measures this could significantly reduce tooth decay and gum disease.

- The Community Dental Service may be the most effective way of ensuring that those most at risk receive professional dental care, especially among children.

- It would cost about £3.4m per year for the Community Dental Service to apply fissure sealants to 10% of children, providing the CDS has access to the relevant schools.

3.5 Water Fluoridation

3.5.1 The Benefits from Fluoridated Water

This is a slightly better researched area than other areas of prevention, and studies in a number of countries [52] show benefits of a 50% - 60% reduction in dmft and a 40% - 50% reduction in DMFT, whilst another shows up to a 50% reduction in adult root surface caries for those receiving fluoridated water throughout their lives [28]. A recent update by Rugg-Gunn and Murray of their 1979 survey of world literature [53] leads them to conclude that "the statement that fluoridation cuts caries by half seems justified".

Birch [54] draws together figures from a number of studies to show the expected reductions in dmft and DMFT scores at various ages as a consequence of water fluoridation for high, medium and low risk groups. These suggest that fluoridated water would be expected to reduce caries by 50% - 60% for high risk children (eg. dmft at 5 years from 3.3 to 1.3, and DMFT at 14 years from 5.0 to 2.3) and between 30% - 50% for medium and low risk children (eg. dmft at 5 years for medium risk group from 2.0 to 1.0, and DMFT at 14 years for low risk group from 2.6 to 1.7).

3.5.2 Water Fluoridation in the UK

In the UK fluoride in water (at about 1 part per million) is introduced into water supplies at water treatment plants. About 12% of the population of England and Wales receive water fluoridated at 0.9 ppm and over, while about one sixth of these receive naturally fluoridated water [55].

The cost-effectiveness of artificially introduced fluoridation depends on the number of high risk individuals that the water from the plant reaches. In general, urban populations, and particularly those living in deprived inner city areas, tend to have high proportions (ie. greater

than 15%) of high risk individuals and offer the biggest potential for reduction in caries. Once the water supply has been fluoridated no behavioural change is required on the part of the population. The costs are borne by the NHS and no private contribution is necessary.

3.5.3 The Cost-Effectiveness of Water Fluoridation in the UK

Several studies referred to above have highlighted the cost-effectiveness of fluoridation in the USA [27, 28, 51]. Appendix D shows some calculations using a model developed by Sanderson and Wilson [7] pertaining to the cost-effectiveness of UK water fluoridation.

The model has been used to calculate the expected costs and benefits that would accrue to various hypothetical populations with different percentages of high risk children. A population of 200,000 with 20% at high risk of dental caries would expect a reduction of total dmft/DMFT of about 100,000 over 14 years for children born post-fluoridation, plus lesser benefits for those born pre-fluoridation. The annual equivalent cost per person (including the capital costs) would be about 38p, with an annual revenue cost of about 20p. The net annual equivalent cost per person (ie. after valuing each dmft/DMFT prevented at £10) is 4p if 20% of the population is at risk, and 8p if 10% are at risk.

Given that most of the population with poor dental status live in cities, considerable improvements could be made in the nation's dental status if all cities received fluoridated water (Newcastle and Birmingham already receive fluoridated water). If, say, 50% of the UK population were to receive fluoridated water at an average annual equivalent cost of 38p per person, this would cost about £10.5 million per year, and would result in a reduction of total dmft/DMFT of about 10 million over 14 years for children born post-fluoridation. This cost compares favourably with the costs of even a modest publicity campaign to promote dental hygiene, and is likely to be far more effective.

3.5.4 Opposition to Water Fluoridation

Although water fluoridation has been introduced widely and successfully in some countries - for example the USA and Australia - attempts to introduce it in some areas of the UK (eg.

North West England, Scotland, Yorkshire) have encountered very strong resistance from the anti-fluoridation lobby, who object on principle on the grounds that it is mass medication and/or that there are possible adverse medical side effects. The latter case is argued despite the fact that communities that receive naturally occurring fluoride in their water supplies show no excess morbidity or mortality. Thus introducing fluoride to public water supplies is far from straightforward.

3.5.5 Summary

- International studies have shown water fluoridation to be by far the most cost-effective preventive measure, reducing caries by about 50%.

- If 50% of the UK population were to receive fluoridated water, this would cost about £10.5 million per year and reduce total dmft/DMFT by about 10 million for those born post-fluoridation over a 14 year period.

- There is opposition to water fluoridation on the grounds of unproven health risks and dislike of mass medication.

4 CONCLUSIONS

4.1 As in most areas of public health policy, the evidence on which to base decisions is less than perfect. In the case of caries prevention two kinds of relationships are generally important. These are the relationship between policy and behaviour of the population or some sub part of it, and the relationship between changes in behaviour and changes in dental health status. In general it can be said that the relationships between policies targetted at changing behaviour and their effects are very uncertain.

4.2 In terms of cost, effect and the certainty of that effect the most cost-effective policy is fluoridation of water supplies. Coverage of half of the total population of the UK, including the majority of those most at risk of caries, would be cheap at about £10.5 million per annum, and would be associated with about a fifty per cent reduction in

caries for those receiving fluoridated water.

4.3 The strategy of improving oral hygiene could be costed if the scale of the campaign were determined, but how effective such a campaign would be in changing behaviour is unknown. The effect of changed behaviour on dental health would be positive, but its scale is uncertain.

4.4 The same uncertainties apply about the effectiveness of campaigns to persuade people to visit their dentists regularly, and to ensure that their children also do so. However, there is evidence that the use of fissure sealants for the 10% of children most at risk, at an estimated annual cost of £3.4 million, would have considerable potential to reduce caries. This suggests that a campaign targetted at high risk children through schools with the aim of using sealants for prophylactic purposes could be highly cost effective.

4.5 In developed countries the relationship between changes in population consumption of sugar and caries is not obvious and there is no basis for estimating a quantitative relationship. The effectiveness of campaigns to reduce sugar consumption is also uncertain. A switch away from sugar consumption might lead to greater fat consumption with associated increased risk of Coronary Heart Disease. The current dietary advice to replace sugar consumption with starch and fruits is unlikely to bring about any significant change in dental status.

4.6 On the evidence available, fluoridation of water supplies is almost certainly the most cost-effective strategy open to Government. If this is rejected because of the arguments relating to risks of unknown effects of mass medication, then the hierarchy of cost-effectiveness among alternative policies cannot be calculated. The same logic which rejects fluoridation should reject dietary change, at least until the effect of reduced sugar on dietary fat intake is known. Widespread fissure sealing and related procedures offer some prospect of being effective, and their application would not be very expensive. Some research is needed urgently on the organisation and quantitative impact of campaigns to change dental health attitudes and behaviour.

The arguments relating to the various areas are summarised in Table 3.

APPENDIX A

Setting Targets for Dental Health

The best-known target for dental health is that set by the World Health Organisation of a global goal of an average DMFT of 3 or less for 12 year olds by the year 2000. This target was established in 1980 as part of the WHO Oral Health Programme for the period 1980 to 2000. It has been achieved by the UK as a whole [6], although some areas have scores which are considerably above this target - for example, several districts in North Western Region and parts of Scotland.

The Health of the Nation consultative document [57] proposed an average DMFT of 1.5 for 12 year olds by 2003. This target can be criticised on two grounds:

i) DMFT scores for 12 year olds can be misleading since their permanent dentition is not long established, and a target for 14 year olds (whose average DMFT scores tend to be about 0.8 higher, according to recent data from Yorkshire Region [7]) may be more appropriate;

ii) by focusing on an average score it fails to take account of those children who experience considerably higher DMFT scores, and who would therefore benefit most from improved dental status (ie. it ignores any equity issues).

Therefore a secondary target which specifies maximum dmft/DMFT scores (eg. of 3.5 at 5 years and 5.0 at 14 years) should be considered as well as an average index.

In addition, a target for adults (eg. 95% of adults retaining 80% of their own teeth) would focus on the importance of lifetime dental care and oral hygiene to prevent gum diseases in later life. Such an objective will take many years to achieve, given that DMFT scores cannot be reversed and many adults bear the legacy of poor dental care as children, but adult dental health will continue to improve as the current cohorts of children and adolescents reach adulthood.

It is important to achieve a balance when setting dental targets. If achieving the target(s) does not require changing the dental status of those who would benefit most then there is a danger of increasing existing inequalities in dental status. Thus targets must be sufficiently challenging. However, targets must be explicit and quantifiable so that it is clear whether or not they are being achieved. The Secretary of Health, Education and Welfare in the USA established a series of 200 health objectives in 1979 to be achieved by 1990, which included 12 dental objectives for adults and children [58, 59]. Unfortunately, due to their wording, it was impossible to collect data on some of these, and a few of them seemed unrealistic. These points should be borne in mind when setting targets for dental health in the UK.

APPENDIX B

Item of Service Treatments

Tables B.1, B.2, B.3, B.4 and B.5

Table B.1: Item of Service Treatment for Adult Patients

ITEM OF SERVICE FOR ADULT PATIENTS	1989/90		1990/91		1991/92		CHANGE ON PREVIOUS YEAR %
	£000s	%	£000s	%	£000s	%	
Examination and diagnosis	90,972	11.4	95,478	11.4	107,835	11.7	12.9
Non-surgical periodontal treatment	107,724	13.5	114,223	13.7	128,567	13.9	12.6
Fillings	176,508	22.1	178,320	21.3	186,358	20.2	4.5
Root fillings	38,623	4.8	40,557	4.9	42,441	4.6	4.6
Crowns, inlays, porcelain veneers and bridges	193,298	24.2	206,016	24.7	234,958	25.4	14.0
Extractions, surgical extractions, general anaesthesia and relative analgesia	28,554	3.6	30,047	3.6	34,212	3.7	13.9
Dentures	118,699	14.9	119,410	14.3	128,837	13.9	7.9
Domiciliary visits	5,968	0.7	7,024	0.8	8,475	0.9	20.7
Recalled attendance	2,739	0.3	4,247	0.5	9,136	1.0	115.1
Other	35,217	4.4	39,951	4.8	43,742	4.7	9.5
TOTAL	**798,302**	**100.0**	**835,273**	**100.0**	**924,560**	**100.0**	**10.7**

Source: Dental Practice Board Annual Report 1991-1992

Table B.2: Item of Service Treatments for Children and Adolescents: 1989/90

ITEM OF SERVICE FOR CHILDREN AND ADOLESCENTS	0-4 YEAR OLDS		5-9 YEAR OLDS		10-14 YEAR OLDS		15 YEAR OLDS	
	£000s	%	£000s	%	£000s	%	£000s	%
Examination, X-ray and report	6,443	53.2	16,265	34.0	17,025	23.2	3,196	25.9
Periodontal treatment	104	0.9	333	0.7	256	0.3	56	0.5
Fillings	10	0.1	4,358	9.1	12,020	16.4	3,727	30.3
Root treatment	0.4	0.003	72	0.2	779	1.1	389	3.2
Crowns, inlays, veneers and bridges			84	0.2	1,125	1.5	801	6.5
Extractions, surgery and anaesthetics	716	5.9	5,284	11.0	5,773	7.9	494	4.0
Dentures	3	0.03	26	0.05	139	0.2	70	0.6
Conservation of deciduous teeth	2,069	17.1	10,247	21.4	1,934	2.6	22	0.2
Scaling and gum treatment, application of topical fluoride or fissure sealants	2,556	21.1	8,018	16.8	7,947	10.8	1,502	12.2
Orthodontic treatment	0.7	0.1	2,738	5.7	25,810	35.2	1,913	15.5
Other	202	1.7	434	0.9	475	0.6	148	1.2
TOTAL	**12,104**	**100.0**	**47,859**	**100.0**	**73,282**	**100.0**	**12,318**	**100.0**

Source: Dental Practice Board Annual Report 1989/90

Table B.3: Caries and Non-Caries Related Treatments for Adults

TREATMENT TYPE	1989/90		1990/91		1991/92	
	£'000s	%	£000s	%	£000s	%
Caries related*	555,618	69.6	574,668	68.8	626,852	67.8
Non-caries related**	242,684	30.4	260,605	31.2	297,708	32.2
TOTAL	798,302	100.0	835,273	100.0	924,560	100.0

* Caries related: Fillings, root fillings, crowns, etc, extractions, etc, and dentures
** Non-caries related: All other treatments

Source: Table B.1

Table B.4: Caries and Non-Caries Related Treatments for Children and Adolescents

TREATMENT TYPE	0-4		5-9		10-14		15		ALL	
	£000s	%	£000s	%	£000s	%	£000s	%	£000s	%
Caries related*	5,338	44.1	28,093	58.7	29,826	40.7	7,009	56.9	70,266	48.3
Non-caries related**	6,766	55.9	19,766	41.3	43,456	59.3	5,309	43.1	75,297	51.7
TOTAL	12,104	100.0	47,859	100.0	73,282	100.0	12,318	100.0	145,563	100.0

* Caries related: Fillings, root fillings, crowns, etc, extractions, etc, and dentures
** Non-caries related: All other treatments

Source: Table B.2

Table B.5: Summary of Caries and Non-Caries Related Treatments: 1989/90

TREATMENT TYPE	CHILDREN AND ADOLESCENTS		ADULTS		TOTAL	
	£000s	%	£000s	%	£000s	%
Caries related	70,266	48.3	555,618	69.6	625,884	66.3
Non-caries related	75,297	51.7	242,684	30.4	317,981	33.7
TOTAL	145,563	100.0	798,302	100.0	943,865	100.0

Source: Tables B.3 and B.4

APPENDIX C

North West Regional Health Authority's 1990/91 Dental Health Campaign

1 Background

In the 1988 White Paper "Promoting Better Health" the Government described the need to launch further initiatives to promote dental awareness and regular attendance at the dentist, especially among the young and those in deprived areas, and announced the intention of carrying this forward in conjunction with the Health Education Authority (HEA) and a number of other bodies. For this purpose the HEA was allocated £¼million in 1988/89 with the possibility of a similar amount being available in 1989/90. This was to be spent on a pilot project in an NHS Region preferably not bordering on the West Midlands where a separate initiative was planned.

The North Western Region was selected. On the one hand its population suffer poor general and dental health, with caries levels in children the highest among the English Regions: this reflects high levels of social deprivation, including relatively high proportions of ethnic minorities, social class IV and V families and very young mothers. On the other hand there has always been close co-operation between the Regional Health Authority, the Dental School and the Community Dental Services who have strong traditions of health promotion, health services research and health education respectively.

The aim of the campaign was to improve the dental health of young people in the North Western Region by focusing on young parents and their children, on health professionals who are in a position to contact and influence this target group, and on the availability of dental services in deprived areas.

The objectives included:

i) increasing dental health self-care and uptake of dental treatment among young mothers and their children up to 11 years of age;

ii) increasing the involvement of appropriate professionals, including general dental practitioners, nurses, health visitors and nursery nurses, occupational health nurses, teachers and retail pharmacists.

It was proposed that a range of health education techniques should be used, combining community-based activities and mass media work and adopting a multi-disciplinary approach.

The four projects proposed were: dissemination of a school-based dhe/treatment programme for 9-11 year olds and a development of this, looking at transfer of patients to the GDS; a study of new dental practices in inner city areas; promotion of the Brush Up Your Smile

(BUYS) programme in workplaces, and a campaign aimed at young mothers and their children working through appropriate professionals such as Health Visitors.

A full time campaign co-ordinator, a senior nurse tutor, was appointed and four District Dental officers were invited to manage individual programmes. A campaign co-ordinator was also appointed. All were responsible to the Regional Dental Officer, Mike Lennon, who had initiated the campaign and maintained a close interest.

2 The Mothers and Young Children Programme

This was the largest component, and has been fully described by Fuller [24]. It fell into three phases.

The first phase included educating health visitors via a series of workshops, working with general dental practitioners and their staff, developing and sending material to health visitors and general dental practitioners, and working with health promotion officers (with whom the campaign was never popular).

Much of the work of the second phase, which occurred during 1989-90, was devolved to District level, and also involved a wider target group of professionals. These included midwives, school nurses and pre-school staff.

This phase also included a media advertising campaign. This was both expensive and extremely controversial. The campaign included three posters which were designed to be shocking - all three focused on sugar as the cause of dental decay, and two included a baby. The Health Promotion Officers considered the posters to be victim blaming, and the Sugar Bureau brought political pressure to bear in an attempt to have the posters withdrawn. The poster campaign was evaluated and suggested that there was very little change in dental health knowledge or reported behaviour as a result of it.

Other aspects of the media were also used, such as local newspapers. It is worth noting that Fuller [24] states that:

In order to effect the complex behaviour changes sought by dental health campaigns, individual advice or counselling is necessary, supported by appropriate literature. The media can only support these strategies by raising awareness of the issue.

The third and final phase centred on encouraging mothers of young children to register their children with general dental practitioners. This campaign and its evaluation was financed directly from the Department of Health. It required considerable support from and co-operation by health visitors. This phase of the campaign appeared to have limited success at best, partly because some parents thought their children were registered when in fact they were not. About 70% of dentists thought that the campaign had made no difference to the number of children attending their practice, but this was perhaps not surprising considering the small numbers of children referred to most individual practices. Bentley [25] provides a more detailed evaluation of this programme.

3 School-Based Programme for Occasional Dental Attenders

Epidemiological studies conducted within the North Western Region suggested that approximately 20% of children of school age receive irregular or no dental care; although the actual reasons why this 'core' of children, found in selected schools in each Health District, give dentistry such a low priority in their lives are complex. In addition, there was evidence of improving dental health in the child population as a whole, thus a programme targetted at that part of the school population who appeared not to be moving with the trend, would be valuable in improving overall dental health. It was also recognised that the Community Dental Service should concentrate resources on groups in the child population not receiving treatment from General Dental Practitioners; and should use these resources, particularly access to schools and mobile units, to foster the idea of regular dental care within a community.

These factors indicated the need to design a programme to overcome some of the 'barriers' to dental care that certain children experience. Brown [26] describes a programme targetted at the 9-11 year old age group, which comprised a series of dental health education lessons, combined with the offer of dental treatment within school. This treatment was carried out using portable dental equipment set up in a medical room or spare classroom. Combining treatment together with health education allowed the correct behavioural approach so as to encourage these children to accept dental care.

Results from programmes run within the North Western Health Region showed that simple operative treatment can be satisfactorily provided on school premises, and, by removing many barriers to dental care, be considered appropriate in circumstances where there is a 'core' of children not receiving such care. The programme was also found to be acceptable to participating school staff. Therefore the study suggests that the Community Dental Service has an important role to play with regard to providing treatment and advice to at-risk children.

APPENDIX D

Water Fluoridation Cost-Effectiveness Model

Researchers at York Health Economics Consortium have designed a model to determine the cost-effectiveness of fluoridating water treatment works in Yorkshire [7]. The model has been run for a number of hypothetical populations, and the results are presented below.

Table D.1 relates to a programme for a treatment plant serving 50,000 people. The costs and benefits in the model are calculated over a 14 year period, and capture the savings in dmft/DMFT scores of children born post-fluoridation. The per capita costs are presented for the population covered, who will also enjoy some oral benefits from the fluoridated water. The annual equivalent cost includes both initial capital and annual revenue costs, and is shown as 88p per person. The annual revenue cost per person of 38p relates only to the running costs. The net annual equivalent cost (aec) is calculated after assigning a 'value' of £10 to every dmft/DMFT prevented. The benefits will depend upon the percentage of the population at high risk of caries, and Table D.1 shows that the net aec per person falls as the percentage of high risk children increases.

Tables D.2, D.3 and D.4 relate to populations of 100,000, 200,000 and 400,000 respectively. The annual revenue costs per person fall as the size of the population covered increases. Table D.4 shows that the net aec becomes negative (ie. it becomes an annual equivalent saving) with a large population and a high percentage of children at risk. Figure D.1 shows how the net aec per person falls with population size for a 20% at risk population and a value of £10 per dmft/DMFT prevented.

TABLE D1: ANNUAL EQUIVALENT COSTS OF A 14 YEAR WATER FLUORIDATION PROGRAMME FOR A TREATMENT PLANT SERVING 50,000 PEOPLE

% OF CHILDREN IN HIGH CARIES-RISK CATEGORY	ANNUAL EQUIVALENT COST	NET ANNUAL EQUIVALENT COST	AEC PER PERSON	NET AEC PER PERSON	REVENUE COSTS PER PERSON
0%	£44,047	£31,227	88p	62p	38p
5%	£44,047	£30,196	88p	60p	38p
10%	£44,047	£29,165	88p	58p	38p
15%	£44,047	£28,134	88p	56p	38p
20%	£44,047	£27,103	88p	54p	38p

Note

Revenue costs £19,000 per annum
Capital costs £170,000

TABLE D.2: ANNUAL EQUIVALENT COSTS OF A 14 YEAR WATER FLUORIDATION PROGRAMME FOR A TREATMENT PLANT SERVING 100,000 PEOPLE

% OF CHILDREN IN HIGH CARIES-RISK CATEGORY	ANNUAL EQUIVALENT COST	NET ANNUAL EQUIVALENT COST	AEC PER PERSON	NET AEC PER PERSON	REVENUE COSTS PER PERSON
0%	£54,957	£29,318	55p	29p	26p
5%	£54,957	£27,256	55p	28p	26p
10%	£54,957	£25,194	55p	25p	26p
15%	£54,957	£23,131	55p	23p	26p
20%	£54,957	£21,609	55p	21p	26p

Note

Revenue costs £26,000 per annum
Capital costs £180,000

TABLE D3: ANNUAL EQUIVALENT COSTS OF A 14 YEAR WATER FLUORIDATION PROGRAMME FOR A TREATMENT PLANT SERVING 200,000 PEOPLE

% OF CHILDREN IN HIGH CARIES-RISK CATEGORY	ANNUAL EQUIVALENT COST	NET ANNUAL EQUIVALENT COST	AEC PER PERSON	NET AEC PER PERSON	REVENUE COSTS PER PERSON
0%	£76,273	£24,995	38p	12p	20p
5%	£76,273	£20,870	38p	10p	20p
10%	£76,273	£16,746	38p	8p	20p
15%	£76,273	£12,622	38p	6p	20p
20%	£76,273	£8,497	38p	4p	20p

Note

Revenue costs £40,000 per annum
Capital costs £195,000

TABLE D.4: ANNUAL EQUIVALENT COSTS OF A 14 YEAR WATER FLUORIDATION PROGRAMME FOR A TREATMENT PLANT SERVING 400,000 PEOPLE

% OF CHILDREN IN HIGH CARIES-RISK CATEGORY	ANNUAL EQUIVALENT COST	NET ANNUAL EQUIVALENT COST*	AEC PER PERSON	NET AEC PER PERSON *	REVENUE COSTS PER PERSON
0%	£116,885	£14,328	29p	4p	17p
5%	£116,885	£6,079	29p	2p	17p
10%	£116,885	(£2,169)	29p	(1p)	17p
15%	£116,885	(£10,418)	29p	(3p)	17p
20%	£116,885	(£18,667)	29p	(5p)	17p

Note

Revenue costs £68,000 per annum
Capital costs £205,000

* Scheme provides Net Annual Equivalent saving

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