



TWENTY-EIGHTH WORLD HEALTH ASSEMBLY

Provisional agenda item 2.7

FLUORIDATION AND DENTAL HEALTH

Report by the Director-General



Summary

This Report by the Director-General is in response to a request by the Executive Board made in January, 1974.<sup>1</sup> It is based on developments which include:

- a rapid rise in the dental caries problem in developing countries,
- a widening gap between the world population and those covered by any caries-preventive fluoride programme,
- further scientific proof of the safe use of fluoride in its various forms,
- refinement and validation of several new technical procedures for use where water fluoridation is not possible in simple school-based programmes, and
- the excessive burden of professional services accruing from failure to utilize preventive procedures.

The proposed plan consists of three parts: (1) a programme for the promotion of community water fluoridation and other approved methods for the prevention of dental caries; (2) a plan for coordinated study and research into the etiology and prevention of dental caries and related problems; and (3) a plan for an information gathering and dissemination system which is expected to link the prevention and research activities together, thereby making each more effective and useful to Member States.

Clearly this plan depends on the readiness of Member States to tackle this problem, whereupon the WHO programme in dental health would respond as indicated by the three integrated activities of the plan. Action in this area by the Member States and consequent development of the programme by WHO is commended to the World Health Assembly with the long range goal of altering the trends in incidence of dental caries, which still is one of the most prevalent diseases in all developed countries, and is rapidly reaching that status in developing countries.

It is suggested that Member States organize advisory bodies to assist national health departments in planning and programming caries prevention activities. Assistance would be made available to Member States from WHO, upon request, to help them mobilize their own resources in implementing preventive programmes and in evaluating progress towards specified country objectives.

<sup>1</sup> EB53.R30, 22 January 1974.

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## 1. ORIENTATION OF THE PLAN

### 1.1 Background

In 1969, the Twenty-second World Health Assembly, after considering resolution EB43.R10 of the Executive Board and reviewing the action taken earlier by several WHO expert committees and scientific groups, recommended in resolution WHA22.30<sup>a</sup> that Member States fluoridate water supplies where practicable in order to prevent dental caries. The Twenty-second Health Assembly also recommended that Member States study other methods of using fluorides to protect dental health and requested the Director-General to encourage research into the etiology of caries and mechanisms of fluoride action at optimal concentrations.

In January 1974, the Executive Board, recalling the two resolutions referred to above which were then more than five years old, noted that dental caries is an increasingly prevalent world health problem. It also noted that many countries do not use fluoridation at all, although its value as a public health measure has been proved, or do not use it as extensively as good public health practice would suggest. Accordingly, it requested the Director-General, in resolution EB53.R30,<sup>b</sup> to (1) review the current situation on this matter; (2) develop a programme within WHO for the promotion of fluoridation of community water supplies and other approved methods for the prevention of dental caries; (3) provide continuing support for research on the etiology and prevention of dental caries; and (4) report to the Twenty-eighth World Health Assembly in accordance with resolution WHA22.30 and the above.

The report requested by the Executive Board is submitted herewith. Appropriate references are appended. No attempt has been made to provide a detailed bibliography; only summary articles and literature reviews are included.

### 1.2 New developments

There have been several relevant developments in the interval since the Twenty-second World Health Assembly endorsed fluoridation in 1969.

Much progress has been made in broadening the scientific base on which fluoridation rests. Further evidence is available on the safe use of fluorides. Two decades of experience with the fluoridation of community water supplies has brought no indication of any physiological or pathological change other than a reduction in the caries attack rates of life-long users of the water. There is a better understanding of the mechanism by which fluoride affects the carious process. It is now known that fluoride ions stimulate the formation of larger apatite crystals in the tooth structure, that they convert hydroxy-apatite to fluor-apatite within the tooth, that they promote remineralization of hard tooth structures under caries attack, that they interfere with microbial metabolism by inhibiting membrane transport of substrate into plaque micro-organisms on the teeth and by inhibiting formation of destructive acids. Each of these actions tends to interrupt the carious process.

Several new systems of fluoride distribution, which provide effective methods for making fluoride available, have been developed and tested since 1969. In general, these new systems involve the self-application of fluoride and do not require expensive professional dental personnel. Consequently, a series of practical preventive practices can now be used in countries, regions or towns which, for a variety of technical, political or sociological reasons, have not been able to benefit from community water fluoridation.

Finally, there has been a rapid increase in the magnitude of the caries problem in the developing countries as their populations begin to ingest a diet of more refined foods. This trend is specially noticeable in urban and urbanizing populations. The world's population is increasing at a faster rate than coverage by some sort of preventive fluoride programme. The widening gap in the use of these preventive measures is alarming. Recent scientific and

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<sup>a</sup> Handbook of Resolutions and Decisions, Vol. I, 1948-1972, p. 116.

<sup>b</sup> Off. Rec. Wld Hlth Org., No. 215, p. 25.

technical advances, combined with the uneven acceptance and utilization of communal water fluoridation in the world and the explosion of dental caries in the least developed and developing countries, make it important that all national health organizations should review their programmes of preventive dentistry to determine if those programmes are making the best use of all available techniques and are reflecting contemporary scientific knowledge.

In that spirit, and in accordance with resolution EB53.R30, WHO has undertaken such a re-evaluation of its own efforts in preventive dentistry.

The proposals contained herein for a fluoride research and prevention programme are limited to those activities appropriately undertaken by WHO as an international health organization, in collaboration with the International Dental Federation, the only nongovernmental international dental organization in official relations with WHO. Specifically, it is proposed that these activities should include the collection and analysis of data about fluoride preventive programmes on a world-wide basis; dissemination of current information and new developments in preventive procedures and practices; promotion of fluoride programmes; provision of consultant and technical advice to Member States on request; evaluation of national dental health programmes in order to ensure that their content meets minimum standards of oral health; and training of key personnel in selected countries. Concurrently, it is proposed that a collaborative and multifaceted programme of study and research into all aspects of caries prevention should be developed and coordinated, with special emphasis on the use of fluorides.

### 1.3 Organization of report

This report is divided into three major sections: a plan for the promotion of fluoridation of community water supplies and other approved methods for the prevention of dental caries (section 2); a plan for the collection, analysis and dissemination of data and information about caries prevention programmes and the changes, over time, in the prevalence of caries by nation and by region (section 3); and a plan for coordinated study and research into the etiology and prevention of dental caries and related problems (section 4).

## 2. PROGRAMME FOR PROMOTION OF FLUORIDATION OF COMMUNITY WATER SUPPLIES AND OTHER APPROVED METHODS FOR PREVENTION OF DENTAL CARIES

### 2.1 Introduction

Dental caries remains one of mankind's most prevalent chronic diseases. The disease is present almost everywhere in developed countries. Evidence is now accumulating that it is increasing in incidence and prevalence in many of the developing countries, particularly in Africa, Asia and the Pacific Islands, which have previously reported low or minimum caries attack rates.<sup>1,2,3</sup> As these populations are exposed to urban customs and softer, caries-promoting diets, the disease inevitably increases in severity as well as in its distribution amongst the population.

The evidence is clear that these countries are experiencing an explosion in dental caries, which appears to be associated with the availability and consumption of refined foods. To give an idea of the magnitude of this increase, caries attack rates are now as much as six and sometimes even 10 or 12 times as high as those observed in the same populations prior to urbanization. Even these dramatic increases, based on a count of the actual number of teeth attacked, do not reflect the added complexity of the treatment needed, which at least doubles the effect of the increase in carious teeth.

A characteristic feature of dental caries is that, if left untreated, the lesions do not undergo remission or heal naturally. Every tooth affected by caries requires technically demanding, expensive and time-consuming professional treatment. If the carious lesions are not removed and restored they progress to severe pain, infection, possible systemic disturbances and the ultimate loss of teeth and supporting tissue.

The usual response to a rapid increase in the prevalence of dental caries in any given country has been to give high priority to the development of a skilled class of professionals and auxiliaries to restore or replace the decayed teeth and rehabilitate damaged mouths. As a main measure, rather than a support and for a mainly preventive service, this type of response

is extremely expensive, grossly inefficient and, in the light of today's scientific knowledge, socially undesirable. The work of repairing the multiple lesions in populations places a great burden on the national health care system and inevitably has exceeded the capacity of dental manpower to restore the teeth. More important, the expense of oral rehabilitation exceeds the economic resources a nation can reasonably allocate for dental care, even in countries with highly developed health care systems.<sup>4,5</sup>

Experience from all parts of the globe and in many countries with comprehensive, but different dental health service systems suggests that it is not feasible, economically, to attempt to solve the problem only by correcting carious defects after they occur. The characteristics of dental caries are such that stressing prevention of the disease is the only logical solution to the problem. This strategy is especially applicable in the least developed and developing countries which have not yet experienced a high prevalence of dental caries nor built up the sophisticated systems of professional dental education and oral health service necessary to repair damaged teeth. The alternative is large-scale deterioration in oral health in these countries, for want of simple preventive programmes.

Unfortunately, experience has shown that, once faced with a caries explosion, developing countries do as other countries have done, and attempt to correct dental defects by heroic efforts at rehabilitation. The exorbitant cost of these efforts upsets national health programme priorities, frequently to the point where scarce resources are devoted, unnecessarily, to the treatment of a disease that can be largely controlled by prevention.

The economic advantages of preventing oral disease before it occurs are clear and unmistakable. Not only is the direct cost of restoration and rehabilitation avoided, but the indirect cost to society of developing complex systems of professional education and oral health care delivery is reduced sharply.

## 2.2 Cost/benefit ratios

The direct cost savings from preventive programmes can be determined with reasonable accuracy, though indirect costs cannot even be estimated. Data from several cost/benefit analyses (cost of implementing a preventive programme divided by the potential cost of treating caries in the absence of prevention) indicate that community water fluoridation, for example, can result in a more than thirtyfold saving.<sup>6</sup>

Cost/benefit ratios were determined by a formula which included the per capita cost of water fluoridation divided by the per capita cost of treating teeth that would have been expected to become carious if the fluoride in the water had not prevented the disease from occurring.

It is clear that the saving to a community (or nation) in terms of a reduction in the cost of dental services alone is a very significant financial benefit. Not only are fewer teeth attacked by dental caries, but the intensity of the attack in each affected tooth is lessened. Thus, cost reduction goes even further than that calculated in terms of fewer restorations needed and includes a significant factor of reduced complexity.

An outstanding example of saving in manpower on a community basis was reported from New Zealand<sup>7</sup> in 1966. It proved possible to alter a long-standing standard ratio of one operator to 475 schoolchildren in a comprehensive incremental care service to 1:690 in fluoridated areas after 10 years of fluoridation.

It should be emphasized that the cost/benefit ratios directly reflect the efficacy of the particular system in preventing caries as well as the cost of conducting the programme. The cost/benefit ratios in programmes for dispensing fluorides by means other than water fluoridation, and for other caries prevention methods, are not as dramatic as they are for water fluoridation but they are significant enough to warrant utilization where water fluoridation is not possible.<sup>a</sup>

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<sup>a</sup> It should be noted that fluoridation trials have been assessed by cross-sectional (prevalence) studies, whereas evaluations of other methods of using fluoride have resulted from longitudinal (incidence) studies. For these and other reasons<sup>6</sup> comparisons should be made with caution, in the realization that more cost/benefit data are needed.

### 2.3 A five-year plan for promoting use of fluoride in caries control programmes

WHO will encourage each Member State to formulate its own national plan for implementing a caries prevention programme as soon as possible and will provide assistance in reaching that goal, on request, within the limits of its resources. It is recommended that each national health department or ministry appoint a group of professional advisers to assist in the planning of the fluoride preventive programme. The dental/stomatological profession in each country will be ready to participate in such groups and to support the national planning effort for caries prevention. The assistance of the International Dental Federation can be invaluable in locating qualified professional advisers within each country and the cooperation of the country representatives of that organization might be sought. In developing its national plan each Member State should identify the resources it has or will require to implement the preventive programme and then establish specific goals on a year-by-year basis.

While it is anticipated that WHO will take an active part in promoting the use of fluorides in all countries, according to this plan, the specific geographic and programme areas selected for emphasis in each country will depend on many factors; the interest and concern about dental caries as a public health problem, the resources of Member States to participate in the programme, the availability of local expertise, and the extent of dental caries in the country.

It is proposed that WHO, after obtaining advice from health authorities in Member States, members of its expert advisory panels and other experts, should develop a more detailed five-year plan for the promotion of the use of fluoride in its various forms. The plan will provide for the phased development of fluoridation programmes in a specific number of Member States in each WHO Region each year. In all its activities, the promotion programme will draw upon information from the global data collection and dissemination system (section 3), and will be coordinated with the fluoride research programme (section 4) and the other activities of WHO's dental health programme.

As indicated above, the vehicle of choice for applying fluoride in each State, region or community will depend upon many factors. Some of the more important technical and scientific aspects to be considered when Member States are selecting a course of action are outlined below.

### 2.4 Rationale for use of various methods of fluoride application: general considerations

Fluoride provided at optimal levels in drinking-water throughout the whole lifespan of the individual is the most effective known means of preventing caries. Because of its clear advantages, fluoridation of communal water supplies, where feasible, should be the cornerstone of any national programme of dental caries prevention. It is an ideal public health measure since its benefits are conferred to everyone regardless of socioeconomic level or availability of dental services. In addition, it is effective without the need for active participation by the individual.<sup>8</sup>

Unless there are overriding technical reasons, no nation can continue to afford the luxury of not fluoridating every central water supply system containing less than the optimum concentrations of fluoride.

Other approaches, although less desirable and reported to be considerably less effective in controlling caries, now constitute practical public health possibilities. These alternative fluoridation approaches are based on a number of different vehicles and methods of fluoride administration, sometimes in combination, and usually can be self-applied by children under the general supervision of a school teacher.<sup>5,9,10</sup>

For example, it is now possible to administer fluoride systemically in school water supplies, and in tablets, salt, or milk. The more effective topical fluoridating agents, such as gels, mouth rinses, solutions, specially prepared pastes and lozenges, provide a localized method of exposing tooth tissue to fluoride ions. It is now clear that the cariostatic effect of different systems of fluoride administration tends to be additive. Thus

combinations of some of these fluoridation alternatives have been shown to be almost as effective as water fluoridation. The cost of these alternatives, however, requires close scrutiny and is discussed later.

These alternative approaches to fluoridation are best administered to children in primary or secondary school programmes where proper supervision can be given and the fluoride vehicle can be made available on a routine basis. Obviously school personnel, particularly teachers, will play a most important role when these alternative fluoride delivery systems are used. The choice of alternatives will vary by nation or local region according to prevailing technical conditions and/or preferences related to the particular caries problem.

## 2.5 Programme for fluoridating community water supplies

Each Member State will be encouraged to formulate a national plan for fluoridating its drinking-water supplies and to implement that plan as soon as possible.

It is recommended that each Member State establish a special advisory board or committee to advise the national health administration on a programme for community water fluoridation, to review and follow scientific progress in fluoridation and to provide for the dissemination of information on fluoridation to the medical, dental and water engineering professions and the general public. The assistance of the International Dental Federation is relevant to this aspect of the programme.

At an early stage in the formulation of its national plan, each Member State should collect baseline information on its water supplies and the administrative structure of its water industry, including relationships with any local authorities concerned with the local implementation of the fluoridation plans.

Also at an early stage, each country should review its legislation on the management of its water supplies in order to determine whether new legislation is necessary or advisable. When new laws are required each State should determine the form of legislation most suitable for its individual circumstances. If it has had difficulty in developing the use of community water fluoridation, it should review its entire national situation in the hope of developing a plan designed to overcome its particular problems.

It is anticipated that the Organization will make arrangements to ensure that there is, at the request of national health administrations, an adequate consultative service available either from WHO itself or from other sources, especially the International Dental Federation.

For those concerned in the least developed and developing countries, it is expected that WHO will provide guidelines to determine how much the caries problem in an area may be expected to be reduced by fluoridation, or held static, as will usually be the case in the least developed countries. Many of these countries may have technical problems in fluoridating water supplies. In cooperation with other interested international organizations, WHO will make technical advice available to augment local expertise. The technical advice will include information on combined operational procedures for filtration, chlorination and fluoridation or defluoridation (depending on initial fluoride content of the water) to achieve optimal fluoride levels. Training and instruction will be offered in operating the equipment. Description of these combined operational procedures will be incorporated in WHO's forthcoming "Guide on Information Systems for the Planning and Evaluation of Community Water Supply and Wastewater Disposal Programmes in Developing Countries".<sup>11</sup>

### 2.5.1 Promotion of fluoridation in national or regional organizations

Much progress has been made since 1969 in the implementation of water fluoridation programmes in a number of Member States, notably Australia, Canada, New Zealand, USSR, the United States of America and certain Latin American countries. Even so, it is noteworthy that the U.S. Public Health Service recently recommended that fluoridating the remaining unfluoridated water supplies should have high priority amongst government health programmes for 1975.

Unfortunately, in other developed regions, such as in parts of Europe, Member States have not been very successful in responding to the recommendations of the Twenty-second World Health Assembly. The draft recommendations submitted by a working party of the Public Health Committee of the Council of Europe on "Problems of Implementation of Drinking Water Fluoridation in Europe" have neither been endorsed nor accepted by that Committee.

In regions where progress has been uneven or non-existent, it is expected that the WHO programme for promotion of water fluoridation will concentrate on assisting in developing national plans to implement fluoridation programmes.

To facilitate the supply of information to national and regional bodies with new or already established oral health programmes, it is essential that WHO organize channels of communication with pertinent organizations in all countries. It is proposed that, through these channels, WHO will disseminate information on fluoride use to dental, medical and other related professions in all Member States. New discoveries and improvements are being made constantly through research and it is essential to update health information periodically. Dentists and physicians, especially those assigned to school systems, health educators, nurses and dental hygienists should be the principle focus of attention. Professional medical and dental organizations should also be made aware of new information. Schools of dentistry, medicine, nutrition, nursing and dental auxiliaries should be kept abreast of new concepts and approaches for fluoride use.

#### 2.5.2 Cost/benefit ratio for water fluoridation

The actual costs of water fluoridation are well documented, including the cost of amortization of capital expenditure, personnel and materials. While these costs vary widely, as do treatment costs, both between and within countries, it is possible to determine the savings resulting from the prevention of caries by estimating the cost of treating the lesions by professional personnel had they not been prevented by fluoridation.

Cost/benefit studies have varied widely in methods and results, but the ratios for water fluoridation have been, on average, the most advantageous of the several methods of fluoride distribution studied, as pointed out in section 2.2.

#### 2.6 Fluoride administration in school dental health programmes

Where fluoridation of community water supplies is not possible, fluoride administration in various school programmes is the next best approach and each Member State is encouraged to develop a plan for alternate fluoride use in those instances. One of several systems can be utilized in school programmes. A combination of the fluoride systems described below is the most effective way of reducing the caries attack rate in a child population when fluoridation of public water supplies is not practicable.

Any school-based programme in preventive dentistry should be an integral component of the national caries control programmes described in section 2.3.

##### 2.6.1 School water fluoridation

Evidence is now available that significant dental benefits accrue to children who consume fluoridated water at school.<sup>10</sup> Therefore, since fluoridation of the school water supply, where feasible, is such a simple process, it should be considered the method of choice for a school programme. It is recognized, however, that in many schools there is no central water supply to which fluoride can be added.

The principle of school water fluoridation is very similar to that of the fluoridation of community water supplies, except that the children's exposure to fluoride is limited to school terms and hours. Consequently, in temperate climates it is recommended that school supplies contain a fluoride level 4.5 to 7.0 times the optimum level used for a community water supply.

There is a difference in the effectiveness of school water fluoridation according to time of tooth eruption, most benefit being gained from fluoridating primary school water supplies. When feasible, however, the water supplies of secondary and advanced schools should be fluoridated in order to continue the exposure of teeth to fluoride for as long as possible.

No insurmountable engineering or technical problems are associated with school fluoridation programmes. It is proposed that expert advice should be available from WHO upon request.

#### 2.6.1.1 Cost/benefit ratio for school water fluoridation

The cost/benefit ratio for school water fluoridation programmes has been estimated to be as high as 1:15.

#### 2.6.2 Topical rinses, solutions, gels and pastes

The primary school systems in most countries are ideal settings for the administration of several fluoride-containing vehicles which, singly or in combination, will provide children's teeth with localized exposure to fluoride ions.<sup>5</sup> The application of one or more of this group of preventive procedures can form a most effective school programme if fluoridation of the school water supply is not feasible. The procedures may also be used in addition to school water fluoridation. However, the applications require the time of both children and school personnel which has to be taken from the already busy school schedule. Thus methods requiring the least time on the part of staff and school are advantageous provided they are effective. The fluoride applications should be periodic and frequent, and usually can be made by the children themselves under the supervision of a teacher or auxiliary dental personnel.

In general, the effectiveness of the procedures varies with the frequency of exposure. For example, daily application of a fluoride gel in a specially constructed mouthpiece has been shown to provide, under rigorously controlled conditions, almost complete protection against caries, but the daily, time-consuming routine is not likely to be acceptable to school administrators or teachers. The frequency of the applications must be determined by balancing the extent of the caries problem with the intensity of the school schedule.

Self-applied fluorides in school programmes have been reported to be approximately half as effective as water fluoridation in preventing dental caries. These results have been obtained by a fairly frequent (every two weeks, for example) application of the vehicle containing the fluoride and also by as few as four to five applications annually.

The self-application procedures considered simple and practical include:

- (1) mouth rinsing with fluoride solutions;
- (2) tooth brushing with specially prepared high fluoride pastes;
- (3) tooth brushing with fluoride solutions and gels.

Teachers will need to be suitably trained through short courses and lectures to conduct these kinds of prevention programmes. They should have professional support and advice from local dentists, dental auxiliaries and physicians.

It is proposed that WHO staff should be available to advise Member States on the respective merits, requirements and benefits of the individual self-application procedures.

#### 2.6.2.1 Cost/benefit ratio for self-applied fluorides

Using the same general methodology as was used for the fluoridation of water supplies, data have been developed that show that the cost/benefit ratio of self-applied fluoride agents may vary from 1:4 to as much as 1:16.<sup>5</sup> However, the cost data on procedures other than water fluoridation are very crude. Because of the range of cost/benefit ratios reported, straightforward comparisons between the cost of community or school water fluoridation and any alternative method of providing fluoride therapy should be carefully evaluated.

## 2.7 Dietary supplements

### 2.7.1 Fluoride tablets

Public health programmes in which fluoride tablets are used on prescription or are distributed to families for use by children at home have not been successful on a population basis. To be most effective, fluoride tablets should be consumed from shortly after birth up to the age of 18-20 years. Children and parents apparently find it difficult to follow the necessarily strict regimen for the long period required to provide protection against caries.

However, school-based programmes of tablet distribution have been shown to have some effect in preventing dental caries.<sup>5</sup> Children should receive the tablets daily on all school days and the tablets should be chewed or dissolved in the mouth.

It is necessary for a teacher or other adult to supervise the distribution and consumption of the tablets in order to ensure that the tablets are used properly. Although the amount of fluoride ingested in tablets, ideally, should be varied with the size and weight of the child, exact individual adaptation is impractical in a school programme. However, adequate adjustment can be achieved in terms of the number of tablets administered at various ages.

#### 2.7.1.1 Cost/benefit ratios for fluoride tablets

The estimates for this method vary in different parts of the world. However, in children who have taken tablets from birth the cost/benefit ratio has been reported to range from 1:5 to 1:10. In Switzerland, after eight years of tablet consumption in school, a cost/benefit ratio of 1:20 has been reported.<sup>6</sup>

### 2.7.2 Fluoridated milk, salt and flour

Commonly used and widely available foodstuffs, including salt, milk and flour, have been suggested as carriers for fluoride. The addition of fluoride to these substances has been shown to reduce the incidence of dental caries. However, there is limited experience of determining the level of fluoride that is ingested in these vehicles and even less experience in the administration of any organized fluoride distribution system.

Theoretically, salt would appear to be a useful distributive vehicle in some countries. Therefore, several studies are being conducted on fluoridated salt.<sup>2</sup> Findings thus far, at relatively low fluoride levels (90 mg F per kg of salt), have in fact shown some caries reduction. Based on comparisons of the urinary excretion of fluoride from persons consuming optimally fluoridated water and salt fluoridated at 90 mg per kg, it has been recommended that the fluoride concentration in salt be increased to 250-300 mg per kg. Studies using these higher concentrations of fluoride in salt are continuing in Colombia, Hungary and Switzerland.

At the present time there is little scientific evidence on the use of milk as a vehicle for the distribution of fluoride in a public health programme. Although the findings of the limited studies to date suggest positive caries prevention and indicate that further study is merited, more clinical data are needed before fluoridation of milk can be recommended as a public health based caries prevention programme. Even less is known about the use of flour as a vehicle.

While it is interesting to speculate about the use of substances such as salt, milk and flour as fluoride dispensing agents, these foodstuffs do not at present lend themselves to use in comprehensive preventive programmes, on either a community or a school-wide basis. The substances are generally available only through commercial channels, and their use is variable and subject to economic and personal factors. Technical difficulties and problems of distribution of fluoride in selected foodstuffs are likely to continue to be serious inherent disadvantages in a public health programme aimed at preventing a disease as widely prevalent as dental caries in all but very special circumstances.

However, in areas where water fluoridation or school fluoridation programmes are not feasible, the alternative use of salt or milk should be borne in mind as a theoretical possibility.

Further study of the use of these agents in public health programmes is covered under the general areas for research outlined in section 4 of this document.

#### 2.7.2.1 Cost/benefit ratio for fluoridated foodstuffs

There are as yet no estimates of cost/benefit ratios for these methods, because of the lack of cost data.

### 2.8 Promotion of other preventive methods

#### 2.8.1 Health education

Health education is an important aspect of any dental caries preventive programme. Comprehensive health education material should be developed for use by pre-school and school teachers so that children can gain an early understanding of the value of health, especially before they adopt unfavourable patterns of behaviour. Health education, including oral health, should start early in life, preferably during the pre-school years, and should involve parents.

The general purpose of health education should be to stimulate the transfer of knowledge to children from all relevant fields (nutrition and health, hygiene, including dental hygiene, environmental health, consumer health, and special topics such as drugs, abuse of alcohol and smoking). This comprehensive approach should provide a firm foundation for the development of, or change to, sound health habits and behaviour in children.

Each Member State is encouraged to undertake studies to ascertain the priority age-groups within its population that are most likely to benefit from health education. If this step is taken these efforts will be more effective in changing attitudes and habit patterns that are detrimental to oral health.

#### 2.8.2 Nutrition and dietary counselling

Although the use of fluoride in various distribution systems remains pre-eminent as a method of caries prevention, there are sound scientific reasons for including other preventive methods in an oral health programme.

Unquestionably, the increased frequency of consumption of snacks containing sugar between meals poses a serious threat to the oral health of populations in both developing and developed areas. Refined carbohydrate foods and too-frequent intake of sugar-containing foods lead to the formation of microbial plaque which is a direct etiological factor in dental caries and periodontal disease.

Nutritional and dietary counselling should be an important component of any oral disease prevention programme. It is essential that children and parents be informed of the role of foods and diet in dental caries so that they can, if properly motivated, take preventive action.

In countries where starvation or malnutrition is a problem, remedial national policies on food distribution and utilization can have a very direct effect on tooth development and dental caries. These policies should be reviewed to be certain that, when a choice of dietary supplement or change is made, it does not unnecessarily promote dental caries in populations where prevalence of the disease has been low.

#### 2.8.3 Oral hygiene

Cariogenic organisms lodge in the matrix of the plaque formed on the teeth. Therefore, oral hygiene procedures designed to disorganize plaque and break up and remove food debris should be promoted actively.

In most cultures various forms of oral hygiene are practised which should be evaluated in terms of efficiency of plaque removal. Efforts should be made either to improve or to supplement such practices with other procedures to increase their effectiveness. Organized daily toothbrushing programmes supplemented by comprehensive use of dental floss between the teeth

can be effective in disorganizing plaque and preventing its formation. An outstanding example of such a programme exists in the Singapore school dental service.

#### 2.8.4 Cost/benefit ratios for health education, nutrition counselling and oral hygiene

There are no data available to indicate the relationship between the cost of these general kinds of preventive oral health procedures and the extent to which caries are prevented.

#### 2.9 Training

There need not be a major emphasis on training in the caries preventive programme. Generally, the programmes do not include any very complicated procedures that require highly specialized knowledge or skill. However, some training of local personnel may be required in two particular areas. Therefore, WHO should be prepared, as part of its fluoride promotion programme, to arrange courses for personnel in training centres already established in countries that need assistance.

It is anticipated that waterworks personnel in some Member States may require training in the application of fluoride compounds and appropriate surveillance and maintenance of equipment. WHO should be prepared to give this training until such time as Member States can themselves provide it.

In addition, dental nurses, dental therapists and other operating auxiliary personnel may need to attend short courses in the utilization of locally applied fluoride rinses, gels, pastes and other fluoride vehicles. Teachers also may need brief training in order to provide proper supervision for programmes of fluoride therapy based in the school classroom. Personnel in schools of dentistry, schools of public health, schools for training operating dental auxiliaries and other training centres can be given the necessary guidance through the WHO programme in order to provide the necessary training.

### 3. COLLECTION, STORAGE, RETRIEVAL AND DISSEMINATION OF INFORMATION

The success of the programme outlined in this document can be facilitated by the development of a comprehensive, world-wide system for the exchange of information to encourage the implementation of the most effective combination of preventive measures in each of the Member States.

It is proposed that pertinent information about caries preventive programmes should be collected by WHO, studied, collated for appropriate retrieval, and used for counselling in method selection. The information requested by the Organization would be limited to data essential to initiate, monitor or improve national or local programmes around the world. This limitation is to ensure that participating countries waste no effort on unnecessary reporting, and that data are not accumulated in the system for no specific purpose.

Examples of information to be collected are national or regional policies involving the use of fluoride, new developments in health, food and drug legislation affecting oral health services, attitudinal data about water fluoridation and other preventive measures, health education programmes (including oral health), and community dental health programmes with extensive education components.

The new data would be coordinated with data already being acquired by WHO in its continuing study of the epidemiology of dental caries, thus permitting world-wide evaluation of progress in combating the disease. This would provide a unique opportunity to assess the international impact of the proposed programme.

Information needed by WHO would be requested from participating countries only as the need arises, and after careful consideration of its usefulness to the success of the programme.

### 3.1 Periodicity and channels of information

The flow of information would be facilitated if the International Dental Federation participates in the collection of data through its regional and national organizations. One person might be requested by the International Dental Federation in each country to assist in the preparation of an initial baseline report covering the caries preventive programmes in the country, and in the subsequent periodic reporting. The Regional Offices should be involved directly in the development of the communications network and should participate actively in it.

The information system would be based primarily on a combination of questionnaire and narrative report. The frequency of updating information after the collection of baseline data will be determined to a great extent by the rapidity of change within a country or region. For some information a definite reporting period can be specified; in other instances data would be reported when available.

## 4. RESEARCH PROGRAMME FOR DENTAL CARIES PREVENTION

### 4.1 Introduction

In resolution EB53.R30, the Executive Board requested the Director-General to provide continuing support for research on the etiology and prevention of dental caries.

WHO is in a unique position to stimulate and coordinate research in caries prevention. With its world-wide perspective it can review progress in national, regional and international research programmes in dental caries and caries prevention. It can then develop a research strategy to promote and coordinate collaborative studies, strengthen the focus of research and training centres on areas in caries research that need emphasis through bilateral and multi-national arrangements, and disseminate new information to research personnel and institutions. It has had and continues to accumulate experience in these functions and can also be instrumental in reducing unnecessary duplication in research effort.

It is equally important that there be a direct flow of information between the research and promotion components of the proposed programme. If the preventive programme is to be effective it must be based on current scientific fact. Science is undergoing rapid expansion at present and the application of newly acquired knowledge in practical disease control programmes in the Member States calls for close interaction between the research and prevention programmes. This interaction will be an objective of the research programme.

### 4.2 Nature of the research plan

It is expected that the research programme in dental caries prevention will be developed in three ways: (1) by the establishment of a WHO dental research task force; (2) by the establishment of a network of collaborative research centres and institutes where research on dental caries is in progress; and (3) by the support of research projects financed from sources other than the regular budget.

#### 4.2.1 WHO dental research task force

The functions of the WHO dental research task force are expected to be as follows:

- (1) to plan the general scope of the caries research programme;
- (2) to advise on priorities for research projects within the programme;
- (3) to screen outside projects and working group programmes with the objective of modification and integration into the WHO caries prevention research programme;
- (4) to advise on the scientific merit and programme relevance of applications for support of projects to be financed through WHO by voluntary funds;

(5) to advise on the utilization of specific preventive procedures in programmes of Member States;

(6) to prepare an annual report on the progress of activities, conclusions and consequences of new research findings.

It is expected that the task force would be composed of a small group of dental and related scientists representing a spectrum of interests and technical competence. Due consideration would be given to the representative composition of the task force, particularly with reference to geographical distribution and connexion with collaborating research institutes. Members would be appointed for specific terms on a rotational basis.

#### 4.2.2 Collaborating research centres

Many scientific centres around the world are already engaged in a wide range of fundamental and applied research in dental caries and its clinical application in individual and community prevention programmes. By involving these centres of excellence in a global effort to control dental caries in both developing and developed countries the necessary expertise would be available for an advance towards the now reachable goal of caries control. Early benefits should be derived from improved cooperation and communication between the network of research centres.<sup>12</sup> Long range benefits will result as WHO is able to mobilize funds and resources to support international studies and training in caries research.

#### 4.2.3 Support for research projects

There is a variety of governmental, voluntary and commercial agencies throughout the world concerned in various ways with dental health. Some of these agencies now support dental research projects related to dental caries, or would do so if properly approached. Certain agencies have already expressed interest in providing WHO with funds for this purpose.

It is anticipated that an annual assignment of funds would be available to WHO for the support of projects it finds appropriate. As noted earlier, the proposed WHO dental research task force would act as a scientific review body, advising the Director-General on the scientific merit of research proposals submitted to it by investigators throughout the world.

#### 4.3 Areas of research emphasis

The main gaps in scientific knowledge of dental caries and its prevention change with time as new evidence is accumulated. In the solution of one problem new questions are raised that need answers. Consequently, no listing of areas in which research is needed is ever completely current or complete.

However, at the present time a collaborative and multifaceted project in dental caries research should probably explore the following general areas of activity:

(a) studies of optimal levels of F ingestion: population studies involving variable ingestion of fluoride from all sources; studies of fluoride balance in humans and animals; studies of defluoridation systems;

(b) studies using alternative fluoride distribution systems (other than water fluoridation), including levels of caries reduction, personnel requirements, costs and logistics;

(c) studies of increased fluoride intake after permanent tooth eruption as a means of improving the quality of the skeleton;

(d) studies of pre-eruptive and post-eruptive effects of nutrition and dietary factors; studies of the role of malnutrition in susceptibility to caries during tooth development; studies on organoleptic and compositional factors in foods that affect their cariogenicity; studies of the role of minerals and trace elements in food and water;

(e) studies of prevention and control of plaque formation: evaluation and testing of specific mechanical and chemotherapeutic antiplaque agents; studies of immunological factors involved in plaque and the metabolic activity of cariogenic bacteria;

(f) studies of health education systems and motivational factors that improve the effectiveness of health information.

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