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EFFECTIVENESS OF SCHOOL-BASED FLUORIDE MOUTHRINSING PROGRAMMES

B Y

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A C K N O W L E D G E M E N T S

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1. INTRODUCTION

1.1 INTRODUCTION

Dental caries continues to be the most common disease of childhood not only in the Western countries but also in many developing countries, where an increasing consumption of sucrose has been accompanied by a rise in the prevalence of caries. (Newbrun, E. - 1980).

Prevention has become the theme of modern dentistry and at a public health level has been approached in various different ways (Brandt, R.S., et al. - 1972). With the growing emphasis on prevention of dental caries, the various stages of prevention (Appendix I) and the prevention of oral diseases based upon disease level (Appendix II) ought to be given due recognition as well. However, for the purpose of this presentation 'prevention' would automatically mean 'primary prevention' unless otherwise indicated.

Studies have shown that routine dental treatment, although it may reduce the loss of teeth, does not reduce the occurrence of oral diseases (Heloe, L.A., and Konig, K.G. - 1978; Sheiham, A. - 1973). It has been shown that a milieu of abundant oral health practitioners oriented to repair the results of diseases instead of preventing them is not usually conducive to developing effective preventive programmes (Barmes, D.E. - 1979).

1.2 GENERAL USAGE OF FLUORIDES IN DENTISTRY

The most feasible way to prevent dental caries is by increasing the tooth's resistance to decay, which is considered to be the best individual and public health defence against dental caries and obtainable through proper use of fluorides (Horowitz, H.S. - 1980b, Ericsson, Y. - 1980). By the use of fluorides systemically and/or by group supervised topical applications, caries can be reduced at least to the level of 3 DMF teeth per 12 year old child (Barmes, D.E. - 1979). The effectiveness of various methods of fluoride administration have been shown in Appendix III.

Fluoridation of the public water supplies to the optimal concentration (0.7 to 1.2 parts per million) has been widely utilised with remarkably consistent results (Horowitz, A.M. - 1979; Rep.Can. D.H.S. - 1979; Ericsson, Y. - 1980; Newbrun, E. - 1980). It is effective in reducing the development of caries usually by about 50 to 60 percent in children residing in those communities with controlled water fluoridation. It is also inexpensive (Baker-Dirks et.al - 1978; Davies, 1974; Kunzel, W. - 1974; Horowitz, H.S. and Heifetz, S.B. - 1979). Concomitant with a reduction in tooth decay is a dramatic drop in tooth mortality (Newbrun, E - 1980). The only drawback with fluoridation is that it can only be implemented in areas with reticulated or central water supply. Alternatives to fluoridation do exist.

For children in areas where no central water supply exists, or where community water fluoridation has not been implemented, school water supplies can be fluoridated. The recommended concentration of fluoride is about 4.5 times the optimal level for the community in the same geographic region. Children covered by this method have been reported to have about 40% caries reduction (Horowitz, A.M. - 1979; Rep. Can. D.H.S.- 1979; Newbrun, E - 1980).

It has been shown that professional applications of solutions of 2% sodium fluoride and of 8% stannous fluoride, and either solutions or gels of acidulated phosphate fluoride containing 1.23% fluoride ion can inhibit the incidence of dental caries by about 40% in children residing in fluoride-deficient areas. (Horowitz, H.S.; and Heifetz,S.B. - 1975). Professional application of topical fluorides by the dentist or the auxilliary after thorough cleaning of the teeth is the usual procedure. It is done at least annually and preferably every six months for caries-active children (Horowitz, A.M. - 1979).

Commonly used fluoride-containing prophylaxis pastes (9% stannous fluoride - zirconium silicate, and acidulated phosphate fluoride with 1.2% fluoride - silicone dioxide) have been employed in private and public dental offices as part of the professionally-administered six-monthly checkup and topical fluoride application routine (Rep.Can. D.H.S. - 1979; Horowitz, H.S. - 1980b).

The professional application of topical fluorides is an expensive method both from the standpoint of dental manpower and cost compared with other approaches. It can be suitable for private practice settings but disadvantageous for public health programmes (Horowitz, H.S. - 1980a;Horowitz, A.M. - 1979; Rep.Can. D.H.S. - 1979; Silverstone, L.M. - 1978).

Several methods of self-application of fluorides have been developed and evaluated to overcome the drawbacks experienced with the professionally-administered procedures. Evidence exists to show that various regimens of toothbrushing with concentrated solutions or gels of fluoride about five times a year reduces dental caries by about 25% (Conchie, J.M.; et al - 1969; Horowitz, H.S.; et al - 1974).

Self-application of fluoride containing prophylaxis pastes (brush-in programmes) with the toothbrush show that this procedure is appealing because it promises efficacy, minimal frequency of application (as infrequent as once a year) and treatment of nearly unlimited numbers of children at one time. (Gunz, G.M. - 1971; Horowitz and Bixler - 1976). Semi-annual applications using 8.9% stannous fluoride with a zirconium silicate abrasive have been promising (Gish, C.W.; et al - 1975).

The daily use of concentrated fluoride gels in custom-made trays was shown to reduce the increment of dental caries by 75 to 80 percent (Englander, H.R., et al - 1967). With this method, small amounts of fluoride (0.5% concentration) is held in intimate contact with the teeth. It is expensive for public health programmes and demands much time.

Daily toothbrushing with dentifrices containing fluoride were shown to reduce the incidence of dental caries by 20 to 25 percent (Heifetz, S.B. and Horowitz, H.S. - 1975). Stannous fluoride (0.4%), sodium fluoride (0.22%) and sodium monofluorophosphate (0.76%) dentrifrices have been widely used (Horowitz, H.S. - 1980a). The use of fluoride dentifrices is most often regarded as a home-based rather than a school-based procedure.

The use of dietary fluoride supplements in school-based programmes have been adopted on large scales in U.S.A., Japan, Australia, Austria and German Democratic Republic (Binder, K., et al - 1978). Studies showing caries reduction of approximately 30-35% have been reported in school-based daily fluoride tablet programmes (Horowitz, H.S. - 1980b). For home use, dentists and pediatricians frequently prescribe fluoride supplements combined with various vitamins. Supplemented fluoride dosage schedule is tabulated in Appendix IV.

It is also possible to add fluoride to staple foods, the food most commonly used being domestic salt. Clinical trials in Colombia have shown this method to be as effective in school children as water fluoridation (Ericsson, Y. - 1980).

The use of fluoride mouthrinses has become widespread. Weekly or fortnightly fluoride mouthrinsing has, in most controlled studies, produced about 35% reductions in caries rate (Torell, P., and Ericsson, Y. - 1974; Horowitz H.S. - 1980b, Ericsson, Y. - 1980). Various aspects of fluoride mouthrinses will be appropriately dealt with in the remaining sections of this thesis.

1.3 AIM

The aim of this presentation is to review current literature of effectiveness of different methods of fluoride mouthrinsing to see which method could be considered for use in Fiji. Emphasis will be placed on school-based fluoride mouthrinsing programmes which have shown significant reductions in caries increment.

It is considered that: by reviewing the literature of effectiveness of different methods of fluoride mouthrinsing (Sections 2 and 3); by briefly studying the planning and implementation of school-based fluoride mouthrinsing programmes in the United States of America (sub-section 2.3) and by reviewing the cost-benefit/cost-effectiveness of fluoride mouthrinses and other methods of fluoride administration (Sections 1 and 4) appropriate conclusions could be drawn in order to suggest the most feasible type of fluoride mouthrinsing programme of relevance to Fiji. The contents of this thesis could be of relative value in planning a caries-preventive fluoride mouthrinsing programme for the primary schoolchildren.

2. REVIEW OF LITERATURE

Fluoride mouthrinsing programmes have been widely adopted in the Scandinavian countries (Koch, G. - 1969; Forsman, B. - 1974). In the United States, more than 8 million children are presently participating in school-based fluoride mouthrinsing programmes which rank second only to controlled water fluoridation - the largest national caries-preventive public health measure (Ripa, W.R., et al - 1981; Horowitz, A.M., and Horowitz, H.S. - 1980). Large-scale mouthrinse programme in Cuba, where children rinse 15 times a year in a school-based preventive programme has been reported (Siegel, S.R. - 1975).

2.1 RESEARCH BACKGROUND

The use of mouthrinses as a vehicle by which fluoride is applied in a self-administered preventive programme was first proposed by Bibby and co-workers (1946). Since then, a number of different fluoride solutions and different rinsing frequencies have been tested. Thus, a 0.2% neutral NaF solution has been tested once a week (Horowitz, H.S., et al - 1971) and once every two weeks (Torell, P., and Ericsson, Y - 1965), a 0.05% NaF solution has been tested once a day (Torell, P., and Ericsson, Y - 1965), and different acidulated solutions of NaF have been tested once a day (Packer, M.W., et al - 1975), twice a day (Finn, S.B., et al - 1975), and once a week (Heifetz, S.B., et al - 1973). In almost all instances significant reductions in dental caries were achieved in children who participated in the programmes for two years or longer. Indicative of the results were those of Horowitz and co-workers who reported a 16 and 44% caries reduction in first and fifth grade children respectively when rinsing was performed with a 0.2% neutral NaF solution once a week for two school years (Horowitz, H.S., et al - 1971).

The Council on Dental Therapeutics of the American Dental Association reviewed the results of 19 clinical trials in which fluoride rinsing was evaluated for at least two years. Based upon this review, the Council accepted both neutral and acidulated fluoride solutions as "effective agents" for use in reducing the incidence of dental decay (Council on Dental Therapeutics - 1975). The details of the studies conducted by various investigators using different solutions can be obtained from Table 1. Recently, a stannous fluoride rinse was also accepted by the American Dental Association (ADA News - July 1980).

Table 1 Summary of results of fluoride mouthrinse studies.

Author	Yr	Compound	Concentration (% F)	Water F	Frequency	Age (Yr)	Rinse (ml/time)	Study length	Caries reduction
Weisz	1960	NaF	0.118	No	2/day	5-9		2-10 yr	80%
Torell and Ericsson	1965	NaF	0.0225	No	1/day	11	10/2 min	2 yr	49% DMFS
		NaF	0.09	No	1/14 days	11	10/2 min	2 yr	21% DMFS
Koch	1967	NaF	0.225	No	1/14 days	10	10/2 min	3 yr	23% DMFS
		NaF	0.225	No	3-4/yr	10	10/2 min	3 yr	18% DMFS
Hagglund	1969	NaF	0.09	Yes	1/wk	8	10/2 min	5 yr	30%
Torell	1969	NaF	0.09 + MFP dentifrice	No	1/14 days	11	10/2 min	2 yr	20% DMFS in relation to F-rinses 1/14 days and F-free dentifrice
Horowitz and co-workers	1971	NaF	0.09	No	1/wk	6	10/2 min	20 mo	16% DMFS
		NaF	0.09	No	1/wk	11	10/2 min	20 mo	44% DMFS
Aasenden and co-workers	1972	APF	0.02	No	1/day	8-11	5/1 min (swallow)	3 yr	30% DMFS
		NaF	0 02	No	1/day	8-11	5/1 min (swallow)	3 yr	27% DMFS
Brandt and co-workers	1972	NaF	0.09	No	2/wk	11	10/1 min	2 yr	36% DMFS
Frankl and co-workers	1972	APF	0.02	No	1/day	14	5/1 min	2 yr	25% DMFS
Moreira and Tumang	1972	NaF	0.045	No	3/wk	7	2 x 12/30 sec	2 yr	47% DMFS
		NaF	0.045	No	1/wk	7	2 x 12/30 sec	2 yr	25% DMFS
		NaF	0.045	No	1/14 days	7	2 x 12/30 sec	2 yr	23% DMFS
Heifetz and co-workers	1973	NaF	0.3	No	1/wk	10-12	2 x 8/1 min	2 yr	38% DMFS
		APF	0.3	No	1/wk	10-12	2 x 8/1 min	2 yr	28% DMFS
Rugg-Gunn and co-workers	1973	NaF	0.0225	No	1/day	11-12	7.5/2 min	3 yr	36% DMFS
Padron and Maiwald	1973	NaF	0.09	No	1/14 days	6-7		28 mo	47% DMFS
		NaF	0.09	No	1/14 days	8-9		28 mo	32% DMFS
		NaF	0 09	No	1/14 days	10-11		28 mo	28% DMFS
		NaF	0.09	No	1/14 days	12-13		28 mo	11% DMFS
Radike and co-workers	1973	SnF_2	0.025	Yes	1/day	8-13	3 x 20/70 sec	20 mo	(1) 33% DMFS (2) 44% DMFS
Kani and co-workers	1973	APF	0.05	No	1/day	10	10/30 sec	3 yr	20%-30%
Gallagher and co-workers	1974	NaF	0.182	No	1/wk	11-13	15/1 min	2 yr	34% DMFS
Finn and co-workers*	1974	APF	0.010	No	2/day	9-19	2 x 10/1 min	26 mo	18% DMFS
		APF	0.020	No	2/day	9-19	2 x 10/1 min	26 mo	29% DMFS
Forsman	1975	NaF	0 013	No	1/wk	13	10/2 min	2 yr	Equal increments*
		NaF	0.09	No	1/wk	13	10/2 min	2 yr	
Packer and co-workers*	1975	APF	0 02	No	1/day	8-9		28 mo	27% DMFS
		APF	0.10	No	1/wk	8-9		28 mo	41% DMFS

*Comparison study. Nonsignificant trend for weaker solution.
APF, acidulated phosphate fluoride, MFP, monofluorophosphate.

Source: Reports of Councils and Bureaus - JADA, 91:1251 - 1975

2.2 RECOMMENDED METHODS OF RINSING

There are two basic methods or techniques of rinsing with fluoride solutions as reported in literature:

(A) Rinse and expectorate method; and,

(B) Rinse and swallow method.

(A) Rinse and Expectorate Method:

The 'rinse and expectorate' method has been largely employed in school-based fluoride mouthrinsing programmes. While there may be differences in the concentrations of solutions used, the frequency of use, the rinse volume and the actual rinsing time for each rinsing session, the procedures have been basically same (Torell, P., and Ericsson, Y - 1965 and 1974; Horowitz, H.S. - 1973, Leske, G.S., and Ripa, L.W. - 1977; NICR - U.S. - 1977). A descriptive account of this method is presented to understand the technique of rinsing - (Adapted from Horowitz, H.S. - 1973).

The fluoride mouthrinse solution is prepared just before each rinsing session by the classroom teacher or aide. On the designated days (daily, weekly or fortnightly) school teachers dispense to participating children a paper cup containing the required volume of the solution and an absorbent paper napkin. Under the supervision of the classroom teacher the children carry out the following procedure:

(i) Starting simultaneously they 'swish' the solution around their mouths for the required duration with their lips tightly closed and their teeth in contact. When 'swishing', the solution is slowly strained back and forth through the spaces between the teeth.

(ii) When the children have rinsed for the prescribed duration, the contents of the mouth are emptied into the paper cup. Before each rinsing the children are reminded that at no time during the procedure is the

solution to be swallowed. The children are then instructed not to eat or drink for a period of 30 minutes following the rinse.

A summary of 'rinse and expectorate' techniques is presented in Table 2 (Source: Ripa, L.W. - 1981).

Table 2 ■ Summary of fluoride rinse and expectorate techniques.

Rinsing method	Program	Fluoride concentration			Type of fluoride*	Rinse frequency	Usual dose	
		% NaF	% F	ppm F			Volume	F
Low potency / high frequency	Individual home-based	.044	.0198	198	APF	daily	5 ml (1 tsp)	1 mg
		.05	.0225	225	NaF	daily	5 ml (1 tsp)	1 mg
High potency / low frequency	Group school-based	.2	.0900	900	NaF	weekly	10 ml (2 tsp)	9 mg

*APF indicates acidulated phosphate fluoride; NaF indicates sodium fluoride.

Fluoride rinsing, in which the solution is swished in the mouth and then expectorated, may involve a low potency/high frequency technique or a high potency/low frequency technique. The former uses a 0.044% or 0.05% NaF solution daily and is especially indicated for home-use by individual patients for whom, because of their caries susceptibility, self-applied topical fluoride applications are indicated. The latter technique uses a 0.2% NaF solution once a week or fortnightly and is the preferred rinse procedure for school-based programmes. Swish and expectorate rinses can be used in either fluoride-deficient or optimally-fluoridated communities (Ripa, L.W. - 1981). Table 3 shows some of the low potency rinses available in the United States.

The high potency fluoride rinse products for use in weekly or fortnightly rinsing programmes have been listed in Table 3.

(Source: Ripa, L.W. - 1981).

T a b l e 3

*High Potency Fluoride Rinse Products for Use in Weekly Rinsing Programs**

Brand	*Type of Fluoride*	*Sodium Fluoride Concentration*
NaFpak ≠	*NaF*	*0.2%*
Pacemaker Fluorinse, 0.2% #	*NaF*	*0.2%*
Point-Two Dental Rinse §	*NaF*	*0.2%*

* *All preparations accepted by American Dental Association*

≠ *Marketed in 2- and 3-gm packets of NaF. Two-gm packet should be dissolved in 1,000 ml water, 3-gm packet in 1,500 ml water. Contains additives, but additive-free packets may also be purchased (not listed by ADA in Accepted Dental Therapeutics).*

\# *Marketed in 120-ml bottles and packages of 12.10-ml unit dose trays. Contains additives.*

§ *Marketed in 120-ml bottles and 1-gal bottles with 5-ml pump dispenser. Contains additives.*

(B) Rinse and Swallow Technique:

This technique involves the use of oral fluoride rinse supplements which are dietary fluoride supplements but available as a rinse (Ripa, L.W. - 1981). The recommended procedure involves 'swishing' to produce a topical effect to the teeth already erupted and then swallowed to produce a systemic effect to the unerupted teeth (Aasenden, R., et al - 1972).

The frequency of rinsing and swallowing is on daily basis. A teaspoon provides one milligram of fluoride which is equivalent of a standard NaF tablet. Because oral rinse supplements are low potency rinses, they are listed in Table 4. (Source: Ripa, L.W. - 1981).

Table 4 ■ Low potency fluoride rinse products for use in daily rinsing programs.*

Brand	Type of fluoride	Sodium fluoride concentration	Availability
Prescription rinses			
Janar's Sodium Fluoride Rinse†	NaF	0.05%	7-ml pouches, boxes of 45
Janar's Acidulated Phosphate Fluoride Rinse†	APF	0.045%	7-ml pouches, boxes of 45
Kari Rinse	NaF	0.05%	480-ml bottle
Monoject Fluoride Mouthrinse	NaF	0.05%	480-ml bottle
NaFrinse, 0.05% Neutral	NaF	0.05%	500-ml bottle
Pacemaker Fluorinse, 0.05%	NaF	0.05%	480-ml bottle
Nonprescription rinses			
Fluoriguard	NaF	0.05%	300-ml and 480-ml bottle
Stan Care	SnF2	‡	box, 24 and 46 tablets/dispensing cups
Oral rinse supplements			
NaFrinse Acidulated Oral Rinse & Systemic Suppl.	APF	0.044%	500-ml bottle
Phos-flur Oral Rinse Suppl.	APF	0.044%	30-ml, 500-ml, and 1-gal bottle§

*All preparations accepted by American Dental Association and contain additives.
†Currently not commercially available.
‡0.1% stannous fluoride.
§Gallon bottle not for home use.

A rinse and swallow technique can be used for children between approximately 3 and 13 years of age who reside in a fluoride-deficient community. Low potency rinses may be dispensed from the dental office for home use. Recently, low potency rinses have become available to the public (in the U.S.) without prescription (Ripa, L.W. - 1981).

The need for systemic fluoride supplements and the appropriate dose are determined by the patient's age and the concentration of fluoride in the drinking water. Figure 1 shows oral rinse supplements are only indicated for children 3 years and older who reside in communities with 0.7 parts per million F or less in water. When the level of fluoride in the drinking water is less than 0.3 ppm, the patient is instructed to rinse daily and swallow one teaspoon of oral rinse supplement.

Age (years)	F in drinking water (ppm)		
	Less than 0.3	0.3-0.7	Greater than 0.7
0-2	Use another method of systematic supplementation	Systematic fluoride supplements not indicated	
2-3			
3-13	Can use oral rinse supplement. Dose: 1 teaspoon provides 1 mg F	Can use oral rinse supplement. Dose: ½ teaspoon provides ½ mg F	

Fig 1 ▪ Indications for oral rinse supplements.

Source: Ripa, L.W.- 1981

2.3 PLANNING AND DEVELOPMENT OF A RINSING PROGRAMME

In this section the guidelines for planning and developing a rinsing programme as proposed by U.S. Public Health Service (NICR - 1977) will be reviewed in addition to other contributions.

Horowitz and co-workers (1971) have summarized the most obvious advantages of a school-based fluoride mouthrinsing programme as follows:

(1) Little time is involved for the treatments.

(2) The technique of application is easy to learn.

(3) Few treatment materials are required.

(4) Non-dental personnel with minimal training can easily supervise the procedure.

(5) Frequent treatments can be administered easily with minimal interruption of a school's academic programme.

The planning and development of a rinsing programme include these factors:

(A) Identification of an appropriate population for rinsing,

(B) Estimation and securing of funds to underwrite the programme,

(C) Recruitment and training of staff to administer the programme,

(D) Programme implementation (Leske, G.S., and Ripa, L.W. - 1977).

(A) The Population:

In determining the need for a school rinsing programme the outline (Table 5) prepared by the U.S. Public Health Service is a valuable guide. Generally, a school rinsing programme is based in a community in which the fluoride in the water supply is below therapeutic levels. Since the therapeutic level is based on the estimated daily water consumption, that in turn, is related to the mean temperature, a therapeutic range rather than a single level, is usually stated.

TABLE 5

OUTLINE FOR DETERMINING THE APPROPRIATE SELF-APPLIED FLUORIDE PROGRAM FOR USE IN SCHOOLS *

Level of fluoride in water supply	Recommended Procedure		Comments
	Tablets (Daily)	Mouthrinse ** (Weekly)	
0.0 - 0.39 ppm	√ 1 mg. fluoride	√	Children who live in areas with insufficient levels of fluoride in water should receive dietary supplements (tablets) in grades K-8 and fluoride mouthrinses in grades 9-12 or, if a tablet program is not feasible, fluoride mouthrinses for all grades, K-12.
0.4 - 0.69 ppm	√ 0.5 mg. fluoride	√	See above. If fluoride level is 0.7 and above, dietary supplements (tablets) should not be provided.
Optimally fluoridated, but not for sufficient time to provide adequate protection to all children		√	Children who have not had optimally fluoridated water since birth should receive protection of fluoride rinses.
Optimally fluoridated, but schools have a high proportion of students who either have transferred from fluoride-deficient areas or who currently reside where only trace levels of fluoride exist		√	Many communities with mobile populations have initiated a fluoride rinse program to provide protection for students who have moved from non-fluoridated areas. Continuous residents are likely to benefit as well (see below).
Optimally fluoridated		?	Limited research suggests that students may benefit from the added protection of a fluoride mouthrinse.

* General guide only, the ultimate decision must be determined by a knowledgeable dentist or physician based upon local needs.
** 0.2 percent neutral sodium fluoride solution.

Source: U.S. Public Health Service

Reference: DHEW Publication No. (NIH) 77-1196 (1977)

TABLE 6

Source: U.S. Public Health Service

Reference: DHEW Publication No. (NIH) 77-1196 (1977)

EXAMPLE OF INITIATING A SAF PROGRAM ON AN INCREMENTAL BASIS

Year of Program	School Grade												
	K	1	2	3	4	5	6	7	8	9	10	11	12
1	X	X	X	X	X	X	X						
2	X	X	X	X	X	X	X	X					
3	X	X	X	X	X	X	X	X	X				
4	X	X	X	X	X	X	X	X	X	X			
5	X	X	X	X	X	X	X	X	X	X	X		
6	X	X	X	X	X	X	X	X	X	X	X	X	
7	X	X	X	X	X	X	X	X	X	X	X	X	X

Schools located in communities that have fluoridated water but have a large proportion of children who are transported from contiguous fluoride-deficient areas might also be considered for a rinsing programme.

Classroom participation usually begins in kindergarten and extend to the highest grade within the school system (Table 6). Participation beyond grammar school may be difficult for both logistical and social reasons.

After it is decided to implement a school rinsing programme the following steps may be necessary:

(1) Obtaining the cooperation and participation of school administrators, the local dental society, and local pediatricians;

(2) Preparing a proposal outlining the rinsing programme and describing the obligations and responsibilities of all parties concerned;

(3) Obtaining letters of endorsement from the local dental and pediatric societies so that the school board members, school superintendents and principals will be aware of the support of these professional groups;

(4) Soliciting additional support from local and state dental health department officials;

(5) Delineating the cooperation expected from the school;

(6) Apprising school officials that they will have to provide class rolls, aid in the distribution and collection of consent forms, and provide space to store and to mix the fluoride solution;

(7) Agreeing on the time scheduled for rinsing and describing the role of homeroom teachers and school nurses if they are to be classroom supervisors.

After approval is obtained from the school administrators, the classroom teachers and other school health personnel are to be apprised of the proposed programme, and their participation and cooperation be secured. Only after all necessary support has been obtained can the rinsing population be truly identified.

(B) Funding:

Before funds are sought, the cost of the programme must be estimated. The overhead of each programme will vary depending upon a multiplicity of local factors, such as the number of children participating in the programme, whether one or several schools are involved, and whether the project personnel are paid or volunteers.

Expenses for the following items are to be anticipated:

(1) Office equipment

- Desk
- Chair
- Typewriter
- Filing Cabinet
- Other standard office supplies, e.g. consent forms.

(2) Other equipment (at each participating school)

- Locked storage cabinet
- Dispensing (mobile) cart.

(3) Rinsing supplies (at each participating school)

- Bottle and pumps (polythene containers with calibrated plunger)
- Fluoride
- Paper cups
- Disposal bags and ties

(4) Personnel

- Administrator-Coordinator
- Rinse monitors
- Clerk-Typist

(5) Other

- Printing
- Travel (Leske, G.S., and Ripa, L.W. - 1977)

Office equipment, personnel and other (printing and travel) need only be located at one central location.

Office costs will depend on the available equipment and supplies that can be used for the project. Likewise, the other major equipment, specifically the locked storage cabinet and the mobile dispensing cart for each school may not be necessary if a locked closet is available and if another method for dispending fluoride to the classroom can be devised. (NICR - 1977).

The costs of rinsing supplies are minimal and they can be lower if the fluoride is mixed by the programme personnel. Other costs to consider are printing costs for letters of consent and informational handouts to school personnel describing their participation in the programme. Travel to and from the school for various personnel may be a cost item. This should be estimated and computed on a per-mile basis.

For some programmes, the greatest continuing expense will be for salaries and fringe benefits of the personnel. Other programmes may rely heavily on volunteers.

After the expenses have been estimated for each programme year, a source of funding is to be sought. Potential sources of funding include voluntary, professional, or governmental agencies. Thus these programmes might be subsidised by district or state dental societies or by funds provided by a city or country health department. Contribution by parents may be possible. Other alternatives include fund-raising through school and community efforts (NICR - 1977).

(C) Staffing (NICR - 1977)

The types of personnel needed for the rinsing programme include an administrator-coordinator, one or more rinse monitors, and a clerk-typist. None of the personnel need be professional (dentist, hygienist or nurse), however it is desirable that the administrator-coordinator have some experience in the health field. The size of the programme would determine whether staff should work part-time or full-time. The programme coordinators are responsible for seeing that the following activities are accomplished:

(1) Ordering supplies

(2) Mixing and dispensing solution

(3) Supervising the mouthrinse procedure

(4) Recording procedure

Recruitment of personnel to work in the mouthrinse programme would be dependant on the availability of resource personnel in the existing school/health service. These personnel may be available:

School nurses;

School hygienists;

Teachers;

Teachers' aides;

Health aides;

Mature students;

Other faculty or staff members.

Those undertaking responsibilities in the programme are required to receive adequate training which may be accomplished through workshops which are relatively easy to conduct.

According to Leske and Ripa (1977), the responsibilities of rinse monitors and clerk-typist can be summarized as follows:

Rinse monitor -

(a) Mix and dispense fluoride at each school;

(b) Maintain local school inventory;

(c) Maintain current list of participants - receive new participants and identify dropouts;

(d) Supervise rinse sessions, unless supervision is by classroom teacher, nurse or other personnel.

Clerk-typist -

(a) Maintain central file for programme, including list of participants in the programme;

(b) Type all correspondence necessary for maintaining programme;

(c) Type all required reports to funding agencies, school board, or administrators as needed.

(D) Programme Implementation (NICR - 1977)

With the successful identification of a rinsing population, assurance of financial support, and the recruitment of staff, the programme can be initiated. Firstly, parents are to be apprised of the existence of the programme and the benefits that may accrue from their children's participation. A variety of methods may be used for publicising the programme, such as articles in local newspapers and presentations before parent-teacher organisations. Additionally, the letters of consent addressed to the parents can provide information before enrolment of the children in the rinsing programme.

In order to participate each child has to return a consent form signed by a parent or guardian. The basic elements of information necessary to such consent include:

(1) An explanation of the procedures to be followed and their purposes;

(2) A description of any attendant discomforts and risks that may occur;

(3) A description of any benefits to be expected;

(4) An offer to answer any inquiries concerning the procedures, and,

(5) A statement that the parent is free to discontinue participation in the programme at any time, without prejudice.

The actual rinsing procedures have been described in section 2.2. No more than 30 students per supervisor has been recommended.

By recording the use of mouthrinses, the information obtained can serve to measure the success of the programme in terms of the number of children participating annually and the frequency. Two types of forms have been designed:

(a) Fluoride mouthrinse programme - classroom treatment record, and,

(b) Fluoride mouthrinse treatment record - school session.

(Samples of these forms have been reproduced in Appendix V).

Monitoring of the rinse programmes has been recommended, and it is only logical to observe the actual procedures at periodic intervals. This would provide opportunity to correct any shortcomings. Periodic visits to the schools by the rinse coordinator would help ensure programme quality and indicate the importance of the programme to the students and the faculty (NICR - 1977).

Appendix VI shows examples of alternative strategies as suggested by W.H.O. (1976) in different situations.

Source: Torell and Ericsson, 1974

TABLE 7 SUMMARY OF FLUORIDE MOUTHRINSE STUDIES

Author	Year	Compound	Concentration	Water F	Frequency	AGE Years	RINSE ml/TIME	Study Length	Caries Reduction
Bibby et al	1946	NaF	0.01% F^- pH 4.0	No	2/wk	Dent. Stu.		1 yr	None
Roberts et al	1948	NaF	0.009% F^- pH 4.0	No	2/wk	12	1 min	1 yr	None
Weisz	1960	NaF	0.118 % F^-	No	2/day	5-9		2-10 yrs	80%
Torell & Siberg	1962	NaF	0.09%	No	1/mo	7	10/3 min	1 yr	ant. prox. 50-70%
		KF	0.06% F^-	No	1/mo	7	10/3 min	1 yr	ant. prox. 20-50%
Torell & Ericsson (1)	1965	NaF	0.0225 F^-	No	1/day	11	10/2 min	2 yrs	49% DMFS
		NaF	0.09 F^-	No	1/14 days	11	10/2 min	2 yrs	21% DMFS
Koch (2)	1967	NaF	0.225 % F^-	No	1/14 days	10	10/2 min	3 yrs	23% DMFS
		NaF	0.225 % F^-	No	3-4/yr	10	10/2 min	3 yrs	18% DMFS
Hagglund	1969	NaF	0.09 % F^-	Yes	1/wk	8	10/2 min	5 yrs	(30%)
Torell	1969	NaF	0.09 % F^- + MFP dentifr	No	1/14 days	11	10/2 min	2 yrs	20% DMFS in relation to F-rinses 1/14 days & F-free dentifrice
Horowitz (3)	1971	NaF	0.09 % F^-	No	1/wk	6	10/2 min	20 mos	16% DMFS
		NaF	0.09 % F^-	No	1/wk	11	10/2 min	20 mos	44% DMFS

Source: Torell and Ericsson, 1974

TABLE 8 : SUMMARY OF FLUORIDE MOUTHRINSE STUDIES

AUTHOR	YEAR	COMPOUND	CONCENTRATION	WATER F	FREQUENCY	AGE YEARS	RINSE ml/TIME	STUDY LENGTH	CARIES REDUCTION
Aasenden et al (4)	1972	APF	0.02 % F^-	No	1/day	8-11 yrs	5/1 min swallow	3 yrs	30% DMFS
		NaF	0.02 % F^-	No	1/day	8-11 yrs	5/1 min swallow	3 yrs	27% DMFS
Brandt et al (5)	1972	NaF	0.09 % F^-	No	2/wk	11 yrs	10/1 min	2 yrs	36% DMFS
Frankl et al (6)	1972	APF	0.02 % F^-	No	1/day	14 yrs	5/1 min	2 yrs	25% DMFS
Moreira & Tumang (7)	1972	NaF	0.045 % F^-	No	3/wk	7 yrs	2 x 12/ 30 sec	2 yrs	47% DMFS
		NaF	0.045 % F^-	No	1/wk	7 yrs	- " -	2 yrs	25% DMFS
		NaF	0.045 % F^-	No	1/14 days	7 yrs	- " -	2 yrs	23% DMFS
Heifetz et al (8)	1973	NaF	0.3 % F^-	No	1/wk	10-12 yrs	2 x 8/ 1 min	2 yrs	38% DMFS
		APF	0.3 %	No	1/wk	10-12 yrs	- " -	2 yrs	28% DMFS
Rugg-Gunn et al (9)	1973	NaF	0.0225	No	1/day	11-12 yrs	7.5/ 2 min	3 yrs	36% DMFS
Padron & Maiwald (10)	1973	NaF	0.09 F^-	No	1/14 days	6-7 yrs		28 mos	47% DMFS
		NaF	0.09 F^-	No	1/14 days	8-9 yrs		28 mos	32% DMFS
		NaF	0.09 F^-	No	1/14 days	10-11 yrs		28 mos	28% DMFS
		NaF	0.09 F^-	No	1/14 days	12-13 yrs		28 mos	11% DMFS

Source: Torell and Ericsson, 1974

TABLE 9 SUMMARY OF FLUORIDE MOUTHRINSE STUDIES

AUTHOR	YEAR	COMPOUND	CONCENTRATION	WATER F	FREQUENCY	AGE YEARS	RINSE ml/TIME	STUDY LENGTH	CARIES REDUCTION
Radike et al (11)	1973	SnF_2	0.025 % F^-	Yes	1/day	8-13	3 x 20/ 70 sec	20 mos	(1) 33% DMFS (2) 44% DMFS
Kani et al (12)	1973	APF	0.05 % F^-	No	1/day	10	10/30 sec	3 yrs	20-30%
Gallager et al (13)	1974	NaF	0.182 % F^-	No	1/wk	11-13	15/1 min	2 yrs	34% DMFS
Finn et al (14)	1974	APF	0.010 % F^-	No	2/day	9-19	2 x 10/ 1 min	26 mos	17% DFS
		APF	0.020 % F^-	No	2/day	9-19	- " -	26 mos	20% DFS
Forsman	1974	NaF	0.013 % F^-	No	1/wk	13	10/2 min	2 yrs	Equal Increments*
		NaF	0.09 % F^-	No	1/wk	13	10/2 min	2 yrs	

* non-significant trend for weaker solution

TABLE 10

CONCENTRATION/FREQUENCY PATTERN OF FLUORIDE RINSE STUDIES IN RELATION TO PERCENTAGE CARIES REDUCTION

FREQUENCY	ppm F^- 100	ppm F^- 200-250	ppm F^- 450-1000	ppm F^- 1800-3000
Daily at home		49 % (1)		
Daily at school	17 % (14)	27 % (4) 30 % (4)* 25 % (6)* 36 % (9) 38 % (11)** 25 % (12)* 20 % (14)*		
3/wk			47 % (7)	
2/wk			36 % (5)	
1/wk			44 % (3) 16 % (3) 25 % (7) 34 % (13)	28 % (8)* 38 % (8)
1/14 days			21 % (1) 23 % (7) 47 % (10) 32 % (10) 28 % (10) 11 % (10)	23 % (2)
3-4/yr				18 % (2)

* APF

** SnF_2

( ) numbers within brackets denote cross-reference to the studies of Tables *7, 8, 9 and 10.*

Source: Torell and Ericsson, 1974

3. CLINICAL EFFECTIVENESS

It has been demonstrated in more than 30 clinical trials that mouthrinsing fortnightly, weekly or daily with dilute solutions of fluoride reduces the incidence of dental caries by about 35% (American Dental Association - 1975; Birkland and Torell - 1978; Horowitz, H.S. - 1973; Torell, P., and Ericsson, Y. - 1974). A summary of some of the clinical trials has been presented in Table 7, 8 and 9. These studies reported reductions in incremental caries ranging from 20 to 50 percent (Torell, P., and Ericsson, Y - 1974).

More than a dozen fluoride concentrations have been clinically tested. These range from a low of 45 ppm F (0.01% NaF), (Bibby, B.G., and Co-Workers - 1946; Roberts, Bibby and Wellock - 1948) to a high of approximately 3,000 ppm F (0.66% NaF) (Heifetz, S.B., et al - 1973). Rinse concentrations of 250 ppm F or less are considered low potency rinses; higher concentrations are called high potency rinses (Ripa, L.W. - 1981). Table 10 shows concentration/frequency patterns of fluoride rinse studies in relation to percentage caries reduction.

3.1 LOW CONCENTRATION - FREQUENT APPLICATION

The most commonly used low potency neutral NaF rinse has a 0.05% NaF concentration (225 ppm F) and the low potency APF rinse has a 0.044% NaF concentration (198 ppm F). Some evidence suggests that frequent exposure to low levels of fluoride is more cariostatic than less frequent exposure to higher concentrations, but the data are not conclusive (Torell, P., and Ericsson, Y. - 1974). Some of the studies showing anticaries clinical effectiveness are reviewed:

(1) In a comprehensive trial Torell and Ericsson (1965) showed that unsupervised daily use of an 0.05% NaF rinse over a 2-year period reduced the incidence of caries in 10 to 12 year old children by about half (50%).

(2) In 1972, Frankl, Fleisch, and Diodadi reported a two-year study with children who rinsed once daily with an APF mouthwash that contained 1 mg. fluoride ion (200 ppm F) at pH4. At the end of 2 years these children exhibited a significant decrease of 26% in the increment of decayed and filled teeth and 25% in decayed and filled surfaces - (Frankl et al - 1972) (Table 8 and 10).

(3) Aasenden, De Paola and Brudevold (1972) reported a three-year study in which participants also rinsed once daily either with a 0.02% APF rinse at pH4 or with a neutral NaF rinse of the same concentration (200 ppm F^-). A comparison of the results from this study showed that participants in the APF and neutral NaF groups had respectively 30% and 27% less decayed and filled surfaces than those in the placebo group - (Table 8 and 10). It should be noted that the solutions were kept in the mouth for one minute and then swallowed.

(4) *A clinical trial was designed to evaluate the anticaries effect of 0.1% SnF_2 rinse (250 ppm F^-) by Radike and co-workers (1973). The rinse was used by school children in a programme of mouthrinsing once each school day during two school years. The water in the area was fluoridated. Two experienced clinical investigators examined all participating children initially and at the end of the first and second years. The results from each examiner showed significant reductions in dental caries for the test group at all intervals. In the final results two examiners independently observed caries reductions of 33% and 43% in DMFS scores for the group using the SnF_2 mouthrinse. (Radike, A.W., et al - 1973).*

(5) *In an English study as reported by Rugg-Gunn and Co-workers (1973), 15 year old school children completed a 3-year double-blind clinical trial testing the daily supervised use of a mouthrinse containing 0.05% NaF. The control rinse was similar except for the omission of the fluoride. There was a difference of 3.7 DMFS between the groups (36% reduction in caries increment). The highest percentage reductions were on anterior approximal and free smooth surfaces. No adverse effects on oral soft tissues were found and ingestion of fluoride from the rinses was low (Rugg-Gunn, et al - 1973).*

3.2 HIGHER CONCENTRATION - LESS FREQUENT APPLICATION

The high potency/low frequency fluoride rinses are commonly used for school-based programmes. More than a dozen clinical trials in schools have been reported (Birkland, J.M., and Torell, P. - 1978; Ripa, L.W. et al - 1980). This method of caries prevention is accepted as effective, with a general caries inhibition of 30 to 40% after participation for two or more years in the programme. Fluoride rinsing appears effective both in fluoride-deficient and optimally fluoridated communities (Laswell, H.W., et al - 1975) (Tables 7, 8, 9, 10).

Some of the studies showing the anticaries effect of high potency/low frequency fluoride rinses will be reviewed.

(1) In a clinical trial with Swedish school children, Torell and Ericsson showed a significant reduction of dental caries (21%) with 0.2% Neutral NaF rinse after two years (Torell, P., and Ericsson, Y - 1965).

(2) The value of fluoride mouthrinsing was further established by Koch (1967) in a 3-year trial. This demonstrated a reduction in DMFS increment of 23% with the use of a fortnightly supervised 0.5% NaF mouthrinse.

(3) Horowitz, H.S., et al (1971), in a 20-month trial in the United States showed a 44% reduction in DMFS increment by weekly rinsing with a solution of 0.2% NaF. Although the percentage reduction was high in this trial, the increments were small, resulting over a 20-month period in the prevention of only one and a quarter DMF surfaces per child at the age of 10 to 12 years.

(4) *Birkeland and Co-workers (1977) evaluated the long-term effects of fluoride mouthrinsing. Fortnightly mouthrinsing with 0.2% NaF solution was performed by school children during 9 school years (about 20 times per year). The results indicate that the long-term effectiveness of a preventive programme with fluoride rinses may be about 50% lower caries increment (Birkeland, J.M. et al - 1977).*

(5) *Heifetz et al (1973) also investigated the effectiveness of neutral NaF and APF incorporated into mouthrinses used on a weekly basis. Of the three randomly selected groups, the first rinsed weekly at school (24 times per year) with an artificially sweetened neutral 0.6% solution of NaF (0.3% F). The second group used an APF solution at pH4 which also had a 0.3% fluoride concentration. The third group rinsed weekly weekly with a placebo solution. After two years the children showed caries reductions of 38% and 28% in the NaF and APF groups respectively over the control group. This study terminated in the second year because the taste of APF solution was not acceptable to the children.*

(6) *Ripa, L.W., et al (1981) reported the results of a demonstration programme after four school years of supervised weekly rinsing with 0.2% neutral NaF solution.*

The rinsing programme was implemented during rhe 1975-76 academic year (grades kindergarten through 6) of the Three Village Central School District, Long Island, New York (fluoride level in drinking water approx. 0.1 ppm). Approximately 4,000 children are involved. During four years, 109 weekly rinses were scheduled.

After four years the dental health of the children in grades 1 through 6 showed significant improvement. The reduction in caries prevalence was 36.5% (DMFT) and 37% (DMFS). Additionally, the unmet dental care of the children was reduced from 36.1% to 20.7%.

One year of rinsing in this programme did not confer reduction of dental caries. However, as the duration of rinsing continued, benefits reached a maximum of approximately 30% after three years for children in grades 4 to 7. Apparently, these children rinsed for the entire four years of the programme. However, as participation in the programme in the fourth year continued, the benefits did not increase for them. For these children rinsing provided a preferential 61.7% reduction of caries on the smooth surfaces, compared with 29.1% for occlusal and 16.9% for buccolingual surfaces.

Although the duration of the programme influences the magnitude of the results obtained the importance of the grade level, or age, when the children begin rinsing have to be considered. In this programme the children who started the programme as kindergarteners benefited most (a greater reduction in caries increment).

3.3 PERSISTENCE OF ANTICARIES EFFECT

Few studies have analysed the caries development in individuals after withdrawal of fluoride rinsing programmes, although this effect ought to be an important consideration when employing fluoride rinses as a public health measure.

(1) Koch (1969) registered the caries development following withdrawal of a three-year programme of fortnightly fluoride rinses with 0.5% NaF solutions. He found no difference in caries increment between the former fluoride rinsing group and the former control group during the two-year period following the withdrawal. The findings indicate that continuous exposure is necessary for optimal effect of fluoride rinses.

(2) In their review of fluoride mouthrinsing, Birkeland and Torell (1978) considered that the benefits of fluoride rinsing especially to teenagers, is likely to be long-lasting (Birkeland, J.M., and Torell, P - 1978). They cited a report by Malmberg in which 16 to 19 year olds, who completed a rinse programme, continued to have a low caries increment (Malmberg, E. - 1976). They noted that the teenagers probably used fluoride-containing dentifrices.

(3) Findings by other investigators (Aasenden, R., et al - 1972; Mellberg, J.R., et al - 1974) that fluoride uptake by sound enamel associated with fluoride rinses is low indicate that the benefits of this preventive method may be limited to the immediate treatment period.

It appears, therefore, that the beneficial effect of mouthrinsing with fluoride solutions can only be maintained if continued. Silverstone (1978) suggests that further studies are necessary to investigate whether benefits are maintained if the rinsing regimen is gradually phased down to less frequent applications, for example, monthly rinses. He suggested that alternatively, it may be sufficient to change to another fluoride regimen, such as annual topically applied fluorides, to maintain the benefits gained by fluoride rinsing.

In clinical and laboratory studies to evaluate the residual effects of fluoride rinsing, Leske and Co-workers (1981) indicated that fluoride rinsing may produce a residual benefit. They also considered that further investigation of post-treatment fluoride-rinsing effects and of the relation between fluoride rinsing and fluoride uptake in both sound and altered enamel is indicated (Leske, G.S., et al - 1981).

It may be necessary to continue mouthrinsing longer than three years, perhaps indefinitely, to maintain protection. Konig (in unpublished W.H.O. Document) believes that:

> *"... continued benefit may be anticipated under the influence of integrated school dental health programmes combining topical and/or tablet fluoridation with repeated instruction in toothbrushing and lessons stressing the need for life-long fluoride administration at least in the form of (fluoride) dentifrices, and the need to restrict the intake of cariogenic food throughout life."*

However, long-term data are lacking to document Professor Konig's expectations.

4. COST-BENEFIT AND COST-EFFECTIVENESS

4.1 GENERAL CONSIDERATIONS

One of the relevant conclusions of the World Health Organisation Workshop held in Singapore in 1972 indicated the need for cost-benefit analysis in planning public health programmes of topically-applied fluorides. It also emphasized that the preferred methods are those involving self-application. Methods involving application by dental personnel to individual patients are too time-consuming to be economically feasible (WHO Workshop - 1972). The direct cost savings from preventive programmes can be approximately estimated, 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 thirty-fold saving (Davies, G.N. - 1974).

For dental purposes, Davies suggested that cost-effectiveness may be expressed as the number of tooth surfaces protected from caries for each hour of time taken by dental personnel. A realistic cost-effectiveness basis would be a saving of 3 DMF surfaces per hour of dental professional time (Davies, G.N. - 1974). It was also emphasized that the cost-benefit ratios indirectly 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 (Davies, G.N. - 1974).

An outstanding example of saving in manpower on a community basis was reported from New Zealand in 1966. It proved possible to alter a long-standing standard ratio of one operator to 475 school children in a comprehensive incremental care service to 1:690 in fluoridated areas after 10 years of fluoridation (Denby, G.C., and Hollis, M.J. - 1966).

According to Heifetz (Michigan Workshop - 1978), the cost effectiveness ratio is defined as:

$$\frac{\text{Cost (dollars) of procedure/child/year}}{\text{Mean number D.M.F. surfaces saved/child/year}} \text{ OR } \frac{\text{cost/child/year}}{\text{1.0 DMF surface saved/child/year}}$$

According to Davies (1974) the following cost-benefit ratios were reported:

(1) *After 10 years' fluoridation at Hastings (N.Z), the cost-benefit ratio of 1:4.4 was achieved for children aged between 2½ to 15 years.*

(2) *Cost-benefit ratio of 1:4.1 was achieved at Newburgh (U.S.A.) for 5-6 year old children who had the benefit of fluoridation for five years.*

(3) *After 5½ years of fluoride tablets from birth a ratio of 1:5.5 was achieved in U.S.A.*

(4) *After six years of fluoride tablets from birth a cost-benefit ratio of 1:5.1 was achieved in Australia.*

(5) *A cost-benefit ratio of 1:15.4 was achieved after 8 years of school water fluoridation in the U.S.A.*

4.2 FLUORIDE MOUTHRINSES

Heifetz (1978) while assessing the cost-effectiveness of the weekly fluoride mouthrinse indicated that because of wide variation in clinical results it is difficult to make an exact estimate of the effectiveness. He took a conservative stand and assumed a caries reduction of 25%, a level close to the lower boundary of efficacy. Cost for materials were based on a 36-week per year programme. It was also assumed that school personnel administered and supervised the programme, and therefore, no estimation of salary costs were involved (Heifetz, S.B. - 1978). His estimation of cost-effectiveness of supervised weekly mouthrinsing with a 0.2% NaF solution is presented in Table 11. It shows total costs, which amount to the cost of materials alone or $1.50 per child. The low cost of fluoride mouthrinsing, therefore, mainly accounts for its highly favourable cost-effectiveness of $1.00 per surface saved. Heifetz considered that even if payment is made for supervision, cost-effectiveness is still only $1.60 per surface saved.

To gain insight into specific cost-benefit and cost-effectiveness of mouthrinsing programmes, some of the studies will be briefly reviewed and in view of the fact that cost data for fluoride mouthrinse programmes are sparce:

(1) In a study concluded by Rugg-Gunn et al (1973), the cost assessment of a 3-year trial of mouthrinses (0.05% NaF, daily) resulted in a saving of 1.25 surfaces per child per year at a cost of 2 newpence (U.K.) per rinse.

(2) In 1971 the cost per child per year was estimated at $0.31 (Horowitz et al 1971), for weekly oral rinsing with a 0.2% neutral NaF solution in a school dental programme. By mid-1977 the cost per child per year had increased to $0.42

(Leske, G.W., and Ripa, L.W. - 1977); and by late 1977 it had increased to $0.45 (Ripa, L.W., et al - 1977). These figures refer only to the cost of materials and supplies.

(3) In 1975, 17 standardised school-based programmes were initiated for children in different locations of Guam and U.S. for a three-year period to evaluate the effectiveness and economic feasibility of weekly fluoride mouthrinsing. Information on the cost of supplies, equipment, personnel and school overhead was collected for each school year. The mean cost of supplies and equipment for the first two years ranged from 20 cents to 82 cents. The average of 17 sites was 50 cents per child per year. When the salary of paid personnel (if any) is included, the costs range from $0.28 to $8.78 with a mean of $3.49 over all studies. Differences in cost are mainly attributable to different methods of delivering the rinse and different numbers and levels of supervisory personnel. Estimates of cost-benefit based on two years of experience indicate that the procedure is highly cost-effective in a variety of settings (Brunelle, J.A., and Miller, A.J. - 1978).

In an overview, Horowitz (1980b) assumed that if supervision is done by volunteers, weekly fluoride mouthrinsing can be carried out for as little as 21 pence per child per year.

TABLE 11

Cost-effectiveness of supervised weekly mouthrinsing with a 0.2% NaF solution

Cost

No. of classroom treatments:

8000 childr. /yr. x 36 treatms./year x 3 years =
864,000 child-treatments

$$\frac{\text{864,000 child-treatms.}}{\text{30 childr./class}} = \text{28,800 class-treatms.}$$

Time required:

28,800 class-treatms. x 5 min/class-treatm.
= 2,400 hrs

Salaries: = N/C

existing school personnel

Materials:

.50/child/yr x 3 years = $1.50/child

Total cost: = $1.50/child

Effectiveness

6 DMFS/child x 25% reduction = 1.5 DMFS/child

Cost-effectiveness

$$\frac{\text{\$1.50/child}}{\text{1.5 DMFS/child}} = \frac{\text{\$1.00}}{\text{1 surface saved}}$$

SOURCE: *Heifetz, S.B. - Cost-effectiveness of topically applied fluorides: In "Relative Efficiency of Methods of Caries prevention in dental public health" - Workshop Proceedings, University of Michigan, June 5-8, 1978 (pp 69 - 104).*

(4) *According to Horowitz, et al (1971) the cost benefit ratio for weekly mouthrinsing with a 0.2% NaF solution in the U.S.A. was 1:16.4. The cost of paper cups, paper napkins, and fluoride solutions was US$0.31 per child per year or US$0.62 in two years. They considered that no additional charges be included for salaries, since the programme was administered in schools by schoolteachers. Their estimates are briefly shown below:-*

The savings in DMFS per child in 2 years = 1.27

Savings in cost of fillings in US$8 per saved surface = US$10.16

$$\text{Cost-benefit} = \frac{\text{Cost of implementation}}{\text{Savings in cost of treatment}}$$

$$= \frac{0.62}{10.16}$$

$$= \underline{1:16.4}$$

(5) *A fortnightly mouthrinsing programme in Gothenburg, Sweden was evaluated by Torell (Torell, P. - 1965) and the estimates showed a cost-benefit ratio of 1:10.6. The programme was initiated in 1960 using 0.2% NaF solution. The costs of the programme have been detailed by Torell (1965), as follows:-*

Cost of implementation (Swedish kronor)

1 dentist at 10 hours/week	=	*14 600*
1 head dental nurse	=	*33 600*
10 dental nurses	=	*363 600*
Paper cups and fluoride tablets	=	*14 600*
Travelling costs	=	*6 600*
	Sw. kr	*433 000*

Savings in costs of fillings

Decrease in number of fillings per child per year	=	*2.3*
Number of children	=	*40 000*
Total decrease in fillings	=	*92 000*
Cost per filling	= Sw. kr	*50*
Total savings	= Sw. kr	*4 600 000*

$$\text{Cost-benefit ratio} = \frac{\text{Cost of implementation}}{\text{Savings in cost of treatment}}$$

$$= \frac{433\ 000}{4\ 600\ 000}$$

$$= 1:10.6$$

TABLE 12. REDUCTIONS IN DENTAL CARIES RESULTING FROM FLUORIDE MOUTHWASHES IN SCHOOLS

Authors	Initial age (years)	Length of study (years)	Agent	Frequency	Absolute reductions per person			
					DMFT		DMFS	
					(Mean)	(%)	(Mean)	(%)
Torell & Ericsson	10	2	0.5% NaF	Once a day			4.92	49
	10	2	0.2% NaF	Once a fortnight			2.15	21
De Paola et al.	6-8	3	1.0% NaF (APF) 0.25% NaF (APF)	Three times a year	0.02	1	0.58	13
Gerdin & Torell	10-11[a]	4	0.2% KF + $MnCl_2$	2 min per week	2.44	21	-	-
	10-11[a]	4	0.2% NaF + $MnCl_2$	2 min per week	0.26	2	-	-
Koch	10	3	0.5% NaF	Once a fortnight	0.93	11	4.36	22
	10	5	0.5% NaF	Once a fortnight for 3 years only	0.93	8	3.75	11
Swerdlow & Shannon	11-15	1/2	0.1% SnF_2	Once a day	0.19	33[b]	0.26	31[b]
Horowitz et al.	6	2	0.2% NaF	Once a week	0.18	25[b]	0.21	16[b]
	10	2	0.2% NaF	Once a week	0.84	15	1.27	43

[a] Comparisons with 0.2% NaF as Control.

[b] Not significant.

Source: Davies, G.N. - Cost and Benefit of fluoride in the prevention of dental caries - Geneva, W.H.O. Offset publication No. 9, 1974.

From the data in Table 12, a summary of conclusions drawn by Davies (Davies, G.N. - 1974) is presented below:

(a) Substantial benefits can be obtained by children aged 10 years and over, and the extent of the benefit appears to be related more to the frequency of rinsing than to the strength of the solution. Daily rinsing with 0.05% NaF solution by 10 year-olds gave a reduction of 4.92 DMFS (49%) in two years; weekly rinsing with 0.2% NaF solution by 10 year olds gave a reduction of 1.27 DMFS (43%) in two years; fortnightly rinsing with 0.2% NaF by 10 year olds gave a reduction of 2.15 DMFS (21%) in two years; and fortnightly rinsing with 0.5% NaF by 10-year olds gave a reduction of 4.36 DMFS (22%) in three years.

(b) The beneficial effects of mouthrinsing are gradually lost after mouthrinsing is discontinued.

(d) A combination of $MnCl_2$ and KF appears to be more effective than either NaF or a combination of $MnCl_2$ and NaF. Further confirmatory work is required before the evidence can be accepted as conclusive.

According to Birkeland and Torell (1978) with daily, weekly, or fortnightly NaF, the benefits are better shown by long-term use of these rinses:

(1) The caries prevalence is reduced by 50%, the increment by 60-70% and the need for fillings by about 70%.

(2) The treatment is simpler and the fillings last longer.

(3) The cariostatic effect improves by combination of rinses and other fluoride regimen.

(4) The benefits in teenagers are likely to give a long-lasting low caries prevalence.

(5) *Following long-term use of rinses, the expenses for treatment are reduced, and treatment time is saved.*

(6) *Fluoride-mouthrinsing procedure has been shown to be a valuable caries-preventive alternative to fluoride - containing drinking water.*

RANKING OF TOPICAL FLUORIDE PROCEDURES

In assessing the relative efficiency of various methods of topical fluoride application in dental public health, Heifetz (Michigan Workshop - 1978), ranked their cost-effectiveness as shown in Table 13. The estimates indicate that some methods are able to protect teeth against caries at decidedly less cost than others. It could be seen that weekly fluoride mouthrinsing is the most economical procedure.

In terms of public health, professional manpower and money are usually scarce in many countries. Of the various methods listed in Table 13, weekly NaF rinsing appears to best accommodate these constraints. According to Heifetz when comparison is drawn between, for example, the self-administered rinsing and the professionally-administered Knutson's technique (although mouthrinse confers less cariostatic effect on a per child basis) implementation of the most cost-effective procedure will result in the largest total number of surfaces saved on a population basis for every dollar spent (Heifetz, S.B. - Michigan Workshop 1978). However, since these assessments were based on conservative assumptions there is a need for more realistic approach when dealing with cost-effectiveness of different procedures.

TABLE 13

Ranking of estimated cost-effectiveness of alternative topical fluoride procedures

Procedure	Estimated percent reduction	$ Cost per 1.0 DMFS saved	Rank
Weekly mouthrinse 0.2% NaF solution	25	$1.00	1
Semiannual "brush-in" 9% SnF Zircate paste	25	$2.50	2 (tie)
Prof.-applic. 2.0% NaF sol. multiple-chair method	40	$2.60	2 (tie)
Annual prof.-applic. APF gel (1.23% F) in preformed trays	40	$4.40	4
Toothbrushing 5 x yr APF sol (0.6% F)	20	$5.60	5
Toothbrushing at home 0.1% fluoride dentifrice	20	$10.00	6
Annual prof.-applic. 8.0% SnF	20	$21.00	7 (tie)
Daily self-applic. APF gel (0.5% F) in custom trays	80	$21.30	7 (tie)

SOURCE: Heifetz, S.B. - Cost-effectiveness of topically applied fluorides: In "Relative Efficiency of methods of Caries Prevention in dental public health" - Workshop Proceedings, University of Michigan, June 5-8, 1978 (pp 69 - 104).

At an international workshop (Maryland - 1974) on fluorides Wei concluded that "the cost-benefit ratios of professionally-applied topical fluoride agents are extremely poor for the U.S.A. due to the high cost of dental personnel manhours".

The cost-benefit ratios of self-applied topical fluorides appear to be favourable, especially in public health programmes.

The cost-benefit ratios of various methods of topical fluoride application by dentists are listed below (Davies - 1974):-

(1) One application of stannous fluoride for two years by dentists was 1 : 2.3 in U.S.A. and 1 : 5.2 in Sweden;

(2) Professional application of NaF by Swejda's method was 1 : 2.4 in the U.S.A. and 1 : 3.3 in Sweden;

(3) One application of APF for two years was 1 : 1.1 in the U.S.A. and 1 : 2.5 in Sweden;

(4) Three agent method for three years (three applications) was 1 : 1.1 in U.S.A. and 1 : 2.5 in Sweden;

Cost-benefit ratios for self-applied fluorides are listed below (Davies - 1974):

(1) Cost-benefit ratios for fluoride brushing programme conducted four times a year in Norway was 1 : 3.9.

(2) After eight years of brushing with fluoride solution was 1 : 13.9 to 1 : 4.6 in Switzerland.

FIJI SHOWING HEALTH, ROADING & PINE SCHEME PROJECTS, 1975.

FIGURE 2

FIJI ISLANDS

MILES 10 0 10 20 30 40 50

KILOMETRES 10 0 10 20 30 40 50 60 70 80

REFERENCE

Divisional Boundaries

Provincial Boundaries

E180°W

CIKOBIA

NORTHERN DIVISION

VETAUUA

QELE LEVU

Udu Pt

KAVEWA

DRUA DRUA

TUTU

KIA

MALI

NUKUBASAGA

NUKUBALATE

MACUATA-I-WAI

LABA

VANUA LEVU

COBIA

YAVU

YANUCA

RABI

YAQAQA

Natewa Bay

BUCA

KIOA

YALEWA KALOU

BLIGH WATER

YADUA

BUA

LEKUBI

Savusavu Bay

SAVUSAVU

WAIYEVO

LAUCALA

QAMEA

TAVEUNI

NABOUWALU

Wainunu Bay

NANUKU PASSAGE

WAILAGI LALA

GROUP

YASAWA

TAVEWA

NACULA

MATACAWA LEVU

YAQETA

NAITAUBA

VIWA

NAVITI

YASAWA

MALIMA

AVEA

SOVU

NAMENA

VANUA BALAVU

WAYA

NUKUTOLU

YACATA

KAIBU

KANACEA

CIKOBIA-I-LAU

WAYA LAILAI

VITI LEVU

NANANU-I-RA

MALAKE

VATU-I-RA

NANANU-I-CAKE

VATU-I-CAKE

KORO

SUSUI

MUNIA

VOMO

MAKOOROGA

MAKOGAI

VATU VARA

MAGO

KATAFAGA

YANUYA

TAVUA

MAMANUCA

MANA

NAIGANI

OVALAU

WAKAYA

LEVUKA

LOMAIVITI

TUVUCA

MALOLO

BATIKI

NAIRAI

CICIA

LAU

AROUA

GROUP

NADI

MOTURIKI

LELEUVIA

KOROVOU

GROUP

NAVULA

LATE-I-VITI

LATE-I-TOGA

18°S

BAU

MABULAU

GAU

SEA

NAYAU

PASSAGE

VANUA MASI

18°S

SIGATOKA

LAUTOKA

SUSORI

Sigatoka River

NUKULAU

SUVA

EASTERN DIVISION

LAKEBA PASSAGE

LAKEBA

KOROLEVU

NAVUA

AIWA

VANUA VATU

GROUP

ONEATA

INSET ROTUMA

177°E

AHAU

12°30'S

SAME SCALE

ONEATA PASSAGE

CENTRAL DIVISION

YANUCA

BEQA

WESTERN DIVISION

MOALA

OLORUA

MOCE

KOMO

KARONI

TAVU-NA SICI

BOUNTY BOAT PASSAGE

VATULELE

KADAVU PASSAGE

SOLO

VUAQAVA

NAMUKA-I-LAU

DRAVUNI

BULIA

ONO

INSET

178°30'W

VATOA

20°S

MILES 0 10 20 30 40

KILOMETRES 0 20 40 60

TOTOYA

KABARA

NAVUTU-I-RA

YAGASA LEVU

NAVUTU-I-LOMA

MARABO

VUNISEA

SOUTH PACIFIC OCEAN

KADAVU

ONO-I-LAU

TUVANA-I-COLO

TUVANA-I-RA

MATANUKU

MATUKU

FULAGA

OGEA LEVU

OGEA DRIKI

E180°W

KEY

	EXISTING	PLANNED*
Hospital	■	
Health Centre	●	
Nursing Station	▲	△
Pine Scheme	▒	
Roads	———	·····

* NOT NECESSARILY FOR COMPLETION DURING THE SEVENTH PLAN PERIOD

MINISTRY OF LANDS & MINERAL RESOURCES, FIJI.

J. NARAYAN, M.N.Z.I.D., H. V. JOGIA & K. MASIKERE.

5. ORAL HEALTH STATUS AND SCHOOL DENTAL SERVICES IN FIJI

5.1 ORAL HEALTH STATUS

Reports of oral health surveys conducted in Fiji since 1965 (Wong - 1965; Speake, J.D., et al - 1978; Speake, J.D. and McKegg, R.N. - 1980) indicate that dental caries prevalence amongst the school children has gradually changed from a 'low' in 1965 to a 'moderate' status in 1980. This is based on World Health Organisation's classification (WHO - 1980) - low: 1.2 - 2.6 DMFT; and moderate: 2.7 - 4.4 DMFT. Preliminary analysis of the 1980 survey data on dental caries and oral hygiene status indicates that average caries rate range from 0.2 DMFT at 6 years of age to 4.7 DMFT at 14 years and that the average modified oral hygiene index is 1.5 at 12 years of age.

The increasing trend in caries prevalence was largely attributed to growth in urbanization of the population and the concomitant dietary changes. The domestic per capita annual sugar consumption between 1970 and 1976 was estimated at 41.57 kilograms (Speake et al - 1978). The endemic periodontal diseases, the early signs of which are already manifest in the young age groups have no doubt created additional problems. Table 14 shows a summary of the various dental surveys:

TABLE 14: ORAL HEALTH STATUS - FIJI

Age (yrs)	1965 - (Wong) Mean DMFT	1978 - (Speake et al) Mean DMFT	1980 - (Speake & McKegg) Mean DMFT*	Mean OHI **
7-8	0.5	1.0	0.8	1.2
10	0.9	1.7	1.8	1.5
12	1.6	3.0	4.0	1.5
14	2.5	4.0	4.7	1.9
	Urban & Rural	Urban	Urban & Suburban	

Table 14 (cont'd)

*Average dmft rates (1980)		** Oral Hygiene (1980)
5 yrs.	4.0 dmft	generally poor
6 "	6.1 "	calculus affected 50% of the children
7 "	6.1 "	
8 "	4.7 "	85%-90% affected by soft deposits
9 "	3.7 "	
10 "	2.4 "	
11 "	0.9 "	
12 "	0.5 "	

Furthermore, studies indicated that the levels of fluoride incorporated in the teeth of the children were higher in Suva (water supply fluoridated since 1969) than in non-fluoridated areas (Speake, et al - 1979). Assessments showed that the non-fluoridated communities had approximately twice the caries rates in comparison to that prevalent in the capital city. Generally, it was evident that natural occurrence of fluoride in drinking waters of Fiji was very much lower than the optimal concentration needed for maximal effect against dental caries. The current level of fluoride in Suva's water supply is approximately 0.8 ppm (Speake, et al - 1978).

5.2 SCHOOL DENTAL SERVICE

Fiji's School Dental Service is organised and financed by the Government. Free and comprehensive dental care is provided to all children under the age of 15 years.

There are some 648 primary schools (total enrolment - approx. 130,000) and 134 secondary schools (total enrolment - approx. 35,000) situated in 55 different islands within Fiji (Ministry of Education, Fiji - 1981).

The Government has been responsible for training dental personnel at the Fiji School of Medicine since the end of Second World War. Dental Officers, dental therapists (operating auxilliaries of the New Cross type), dental technicians and chaiside assistants are employed in the Government service. Private practitioners operate in most major towns and are mainly responsible for service to the more affluent sections of the community. The Government dental service provides service to the priority groups and the less fortunate section of the community apart from the emergency dental services for all attending.

The School Dental Service constitutes a distinctive feature of the national dental care delivery system. The dental therapists and the chairside assistants form the bulk of the school dental service workforce. They work under the direction of the dental officers. The manpower ratio for the school dental service in 1978 was (Speake et al - 1978):

- *Operator : patient ratio = 1 : 7,000 for primary schoolchildren*
- *Operator : patient ratio = 1 : 8,000 for all school children*

The attached map (Figure 2) shows distribution of health services within Fiji. Most health centres and hospitals have dental clinics operated by dental officers and/or therapists, and who are also responsible for the delivery of dental care to the schoolchildren in their districts.

TREATMENT PROGRAMME

Dental teams visit schools using mobile clinics or portable equipment to provide emergency dental treatment for relief of pain and control of infection, restorative services and periodontal treatments on an annual basis. However, children who need orthodontic treatment are referred to the nearest private practitioner when orthondontic services are not available in the Government dental centre of the district.

The oral health survey conducted in 1978 concluded that the curative and restorative services available were not keeping up with treatment needs. This was evident as permanent teeth had to be extracted for reasons of pain and infection from 8 years (age of child) onwards and the need for conservative treatment was high. The results of the survey indicated that -

- dental care index F/DMF of 0.13 was low
- at 6 years of age, 11.4% of the children in primary schools did not need treatment for deciduous teeth
- at 14 years of age, only one in five children did not require any fillings.

In view of the prevailing unfavourable economic climate finance for personnel, equipment, materials,premises and transport which constitute a formidable barrier, Speake and Associates (1978) foresaw the need for greater emphasis on primary prevention to be effective in controlling dental diseases rather than relying heavily on preventive and curative services that are directed towards treatment of the sequelae of dental diseases.

PREVENTIVE PROGRAMMES

The preventive programmes have been designed and implemented as part of an integrated preventive, oral health education and treatment programmes.

Toothbrushing in Primary Schools

The toothbrushing scheme in primary schools is a combined effort of the Ministries of Health and Education and has been in operation since 1957. The toothbrushes are supplied to the schools at a nominal cost (9 cents each) through the Controller of Government Supplies (Singh, D. 1978). These brushes are used in toothbrush drill after lunch daily under the supervision of the teachers. There is, however, inadequate evidence to substantiate that toothbrushing prevents dental caries (Horowitz, A.M. - 1979). Nevertheless, according to current status quo and based on the firm knowledge that bacterial plaque on the teeth is the direct cause of periodontal disease, and that in the absence of plaque, caries will not develop, one practical approach to controlling both diseases simultaneously is to prevent bacterial plaque from forming, or to remove plaque at regular intervals (Loe, H.- 1979). Professor Loe also emphasised that today, toothbrushing and other mechanical cleansing procedures are the most reliable means of controlling dental plaque provided the cleansing is sufficiently thorough and performed regularly. One of the most effective tools in oral hygiene is the toothbrush.

About 75% of the primary schools in Fiji are voluntarily participating in the toothbrushing scheme (Singh, D. - 1978). The daily toothbrushing exercises are performed after lunch, under the supervision of teachers and active participation by the children ensures that long-term regular toothbrushing habit will be formed. To assist teachers in this scheme, they are supplied with suitable and adequate charts and booklets. The brushing technique used was originally roll method, but changing gradually to vibratory method. One of the conclusions of the Oral Hygiene Symposium held in Sweden in 1971, was: "... it is possible to motivate children to carry out more effective brushing by instructing them in toothbrushing techniques...".

ORAL HEALTH EDUCATION

Oral health education talks, including dietary advice and toothbrush instructions are given annually either before or after treatment services in primary schools by the dental officers and the auxilliaries.

Oral hygiene education is principally designed and directed towards the children by the transmission of information about prevention of dental disease through effective oral hygiene in such a way that they will apply it in their daily life. Apart from oral hygiene practices, oral health talks place emphasis on dietary controls, including the need for reduced sugar intake and less frequent consumption of sucrose containing foods, especially the between meal snacks. In addition, lectures are given to the school teachers on canteen operation and profitability with the immediate aim of restricting the sale of cariogenic foods and promoting the utilization of healthful diets (with nutritional value) in the school environment.

Organised national dental health week on an annual basis has been initiated since 1973. Dental health talks are also given to the second year students at the Nasinu Teachers' Training College, with the aim of equipping them with basic knowledge of the school oral health programme. With the view to educating the expectant and nursing mothers in oral hygiene practices both for themselves and their offspring, lectures and practical instruction are given to the public health nurses as well as final year medical students.

The most important gaol for oral health education is to increase the percentage of population who have changed their oral hygiene practices or their behaviour towards utilization of dental health services (WHO - 1980).

USE OF FLUORIDES

Fluoridation of the public water supply in Suva is the only large-scale public health programme of long-standing importance. Since the beginning of 1980, there has been an increasing emphasis on the use of topical fluorides in non-fluoridated areas. With the co-ordinated efforts of the World Health Organisation, the South Pacific Commission and the Fiji Government, three types of pilot projects involving the use of topical fluorides has been initiated in the districts of Nausori and Lautoka with a participation of over 5,000 schoolchildren in the primary schools (Speake, J. and McKegg, R.N. - 1980).

(a) The first group of schools participate in a rinsing programme using 0.2% NaF solution at fortnightly intervals during the school term - time under the supervision of dental service personnel - about 20 applications per year.

(b) In the second group of schools the "brush-in" method is being employed six times annually. 10% stannous fluoride paste is applied for a period of approximately three minutes during each session under the supervision of dental personnel and volunteer mothers.

(c) The third group employs a double "brush-in" technique, involves brushing first with a 1.23% acidulated phosphate fluoride gel, then followed by 10% stannous fluoride paste three times a year under the supervision of dental service personnel and volunteer mothers.

After one year age specific longitudinal comparisons showed a reduction in caries rates for the three groups as follows (Speake, J.D.- Personal communication):

SnF_2 x 6/yr	SnF_2 + APF x 3/yr	NaF x 18/yr
- 34%	- 41%	- 33%

Generally, the overall results are encouraging but it must be emphasized that at this early stage no definitive statements could be made. However, the programme administrators have expanded the project with the inclusion of more schools during 1981.

Finally, it would be appropriate to mention that most dentifrices available in Fiji include fluoride and are generally used by majority of the population and therefore some benefit could be expected with this anticaries measure. The expected range of reduction in caries increment from these preparations has been stated to be between 20 and 30% (Horowitz, H.S., 1980b).

6. DISCUSSION

6.1 GENERAL

Implementation of well-planned, properly executed, objectively evaluated economically and clinically feasible primary preventive programmes would ensure adequate measure of success in the prevention and control of dental caries.

In the review of literature on the effectiveness of fluoride mouthrinses (in clinical trials and demonstration programmes) it was shown that daily, weekly and fortnightly rinsing with fluoride solutions were effective in reducing the increment of dental caries by about 35% in children who had participated in such programmes for two or more years.

Daily (frequent) rinsing with 0.05% NaF solutions appeared to be more cariostatic than 0.2% NaF solutions used on weekly or fortnightly (less frequently). Although the daily rinses have been used in school programmes they are not particularly feasible for use in schools.

On the other hand, the weekly and fortnightly rinsing frequencies have been considered to cause less disruption to school curriculum, require little motivation and are more acceptable to the teachers and the children. In most clinical trials supervised compliance was necessary for achieving greater participation and thus contributing towards ultimate success of the programmes.

The major costs involved in a rinsing programme would include expenses on rinsing materials, transportation, office equipment and stationery and remuneration in terms of salaries paid to the rinse co-ordinator (if employed).

6.2 MOST EFFECTIVE METHODS OF RELEVANCE TO FIJI

In Fiji, the government is the main organisation responsible for the delivery of dental care to the school children. With the limited resources available it can only achieve the goal of reducing the incidence of dental caries by adopting proven primary preventive measures which are inexpensive and provide significant anticaries effect. The caries rate amongst schoolchildren (with the exception of those residing in Suva which has fluoridated central water system since 1969), is increasing despite the introduction of oral health education and toothbrushing schemes since 1957. According to Professor Loe (1970 and 1979) toothbrushing schemes in the schools can prevent or control periodontal disease, in particular gingivitis amongst schoolchildren to a large extent and may provide partial control of dental caries.

The World Health Organisation and South Pacific Commission in collaboration with the Government of Fiji have, through farsightedness initiated self-applied topical fluoride pilot projects in a number of schools. The results after one year are encouraging but it is too early to draw any definite conclusions yet. The "brush-in" and "mouthrinsing" projects are expected to be the major caries-preventive efforts in non-fluoridated areas. Fortnightly 0.2% NaF rinse is being used.

The most effective methods of relevance to Fiji are considered to be of high potency/low frequency rinses (0.2% NaF weekly or fortnightly).

Cost of Rinsing Materials

In terms of costs, since materials used are few (NaF powder or tablet, plastic containers, calibrated pumps, plastic cups and paper napkins), it has been shown to be inexpensive in other countries.

Horowitz (1980b) estimated that if supervision is done by volunteers weekly fluoride mouthrinsing can be carried out for as little as 21 pence per child per year. Daily rinsing with 0.05% NaF appears no more efficacious than the weekly or fortnightly rinsing with 0.2% NaF, and is clearly more expensive and less practical.

Supervision:

In considering the cost of supervising the rinsing programmes it is generally accepted that no direct cost is incurred if school teachers, teachers aides or volunteers are used for the supervision of rinsing procedures carried out. The cooperation of school teachers is necessary. School nurses or non-operating medical and dental auxilliaries could also supervise where teachers and volunteers are not used. The actual application of rinse solutions is done by the children themselves, and therefore there is no need for professional manpower (dentists and operating auxilliaries) in order to apply fluoride solutions.

However, when rinse co-ordinators are employed it would involve costs. In Fiji, the district dental officers (or therapists) could act as rinse co-ordinator-administrators and therefore the need for employing one does not arise.

Transport

Fiji's schools are geographically scattered over 55 different islands. Transportation costs would be high if dental service personnel are used for the purpose of supervising rinsing procedures. In order to avoid this, supervision by schoolteachers would be necessary in the absence of volunteers and school health service personnel. However, some transport costs are inevitable as the programme administrators would be required to visit the schools at infrequent intervals to ensure all is well. Government transport is not readily available and therefore transport problems can be expected.

The use of dental service personnel for supervisory role in rinsing programmes would definitely mean higher costs in terms of transport to supervise the rinse procedure if the programme is to reach every primary school child in the country. As has been the problem with current pilot topical fluoride projects, by the use of Government vehicles and dental service personnel there is a tendency to incur high costs if long-term programmes which confer greater benefits are to be implemented. The supervision of rinse procedures essentially by teachers would be a far-sighted approach towards minimizing costs. The only overall administrative personnel, the rinse-coordinator will have to liaise with the rinse supervisors and in particular the schoolteachers to obtain full cooperation and ensure that the programme is carried out as scheduled and the recommended techniques applied.

Practicality

(1) *The efficiency of the rinsing methods in reducing dental caries has been demonstrated in numerous clinical trials. Caries increments can be reduced by about 35% after two or more years of participation.*

(2) *Few materials are required and the cost is low.*

(3) *Little time is involved per session so that frequent treatments (weekly or fortnightly) can be accomplished with minimum disruption of classroom time. The average time is about five minutes per classroom rinse.*

(4) *Non-dental personnel with minimum training can easily supervise the procedure. The program can use classroom teachers who, with minimum training act as rinse supervisors. One supervisor could supervise about 30 children who are required to rinse simultaneously.*

(5) *The technique of administration is easy. The procedure involves swishing with 10 ml. of the rinse solution for one minute and then expectorate under the direction of the supervisor. For kindergarteners, however, a 5 ml. rinse volume would be suitable.*

(6) *No side effects have been attributed to the unintentional swallowing of the rinse solution.*

(7) *Flavoured rinse products (powder and tablet) are available and the taste would be acceptable.*

For practical purposes some aspects of the school-based mouthrinsing pilot project initiated in 1980 will be considered and related to unmet dental treatment needs.

(a) *During 1980, approximately 2600 schoolchildren participated in fortnightly mouthrinsing (0.2% NaF solution) programme in Nausori district of Fiji. Supervision and monitoring of the rinsing procedures was carried out by dental service personnel (at least two dental officers and three dental therapists on each rinse day). The use of Government vehicle was necessary to travel from one school to another (nine schools in all). At each school the dental staff prepared the solution, distributed the plastic cups, dispensed the solution, instructed the children during procedure and collected information on the number of absentees for the particular rinse session. It was*

possible to supervise rinsing by all 2,600 children in one day (eight official hours and which includes travelling time). Altogether 20 rinse sessions were completed during the year.

Time spent by dental staff during pilot fluoride mouthrinsing project in Nausori district:

Time spent by dental staff during one rinse session

= 5 x 1 staff x 8 hours/rinse day/2 weeks

For 20 rinse sessions during the year

= 800 manhours/year (required for supervising 2,600 schoolchildren in nine different schools).

(b) *The use of dental staff (clinical operators) to supervise rinsing sessions would affect the treatment programme, especially conservative treatments. According to the 1978 oral health survey (Speake, J.D., et al - 1978), the need for conservative treatment and the manpower for schoolchildren are summarized:-*

- *The dental care index $\frac{F}{DMF}$ of 0.13 was low;*
- *At six years of age, 88.4% of the children needed treatment for caries in primary teeth and at 14 years of age four out of five children needed fillings;*
- *For primary schools, the operator : patient ratio was 1 : 7,000.*

These conditions indicate the need for conservative treatment is high and dental service utilization is low. Therefore, the use of operating dental service personnel in supervising mouthrinsing programmes would lead to deterioration in dental health of the schoolchildren. It is assumed that if teachers, non-operating medical and dental auxilliaries and volunteers were available

for supervising, the use of a minimum number of dental operators (2) in the rinsing programme, especially for the purpose of organisation and management would have been sufficient. Moreover, the remaining three dental operators would have been released for clinical duties to treat the sequelae of dental diseases (secondary and tertiary prevention).

If these three dental staff provided conservative treatments to the schoolchildren (a total of 480 manhours would have been available) secondary prevention would have been possible in order to avoid the loss of teeth (especially permanent teeth).

Assuming it takes 20 minutes for an operator to complete one one-surface filling in the school, for 480 manhours the number of treatments done by the three operators is computed to be 1440 fillings/year. The backlog of treatment needs could be reduced if manpower is available. The manpower ratio suggested by the World Health Organisation (Barmes, D.E. - 1979) while estimating the number of dental personnel if preventive programmes are implemented in a developing country (such as Fiji with a caries rate of 3 DMFT), an operator to schoolchildren ratio of 1 : 2700 would be capable of providing comprehensive care. The manpower ratio for Fiji's schools is not favourable.

(c) *Assuming that teachers supervised rinsing procedures in all the nine schools once a fortnight and a conservative time (10 minutes per rinse session for 20 rinse days) is taken a minimum number of hours is spent by each teacher*

on supervision per year - 10 min x 20 sessions/teacher/year

= 200 min/teacher/year

= 3 hours 20 min/teacher/year.

Therefore, non-dental personnel such as teachers and volunteer workers could play an important role in implementation of fluoride mouthrinsing programmes. The support of the Ministry of Education (Fiji) and the teaching profession have to be solicited. Convincing them that prevention does work and that the use of fluoride mouthrinses in schools is feasible would have to be the top-level discussion. Incorporating rinsing sessions (five minutes/week) into routine school activities would no doubt ensure a high degree of participation. However, the need for training elementary schoolteachers through seminars and workshops on "fluoride mouthrinsing" would be a definite advantage for ensuring efficiency and success of the programme.

Weekly Mouthrinsing Programme:

Once the weekly mouthrinsing programme has been instituted the cooperation of the teachers through periodic school visit by dental staff as coordinator-administrators would further the importance of the programme and encourage the supervisors for continued activity. Dental therapists and assistants could also act as advisors and supervisors when they visit schools to provide dental service (treatments and dental health education). Continued support from the teachers can be obtained through follow-up visits by dental personnel.

A weekly mouthrinsing session would mean more frequent application of the fluoride solutions and the teachers are more likely to follow the programme as a routine. The fortnightly rinsing frequency if not followed on one occasion (scheduled day for rinsing) it would mean a "no rinse" period of one month until the next scheduled date. Therefore, a weekly rinsing programme is thought to be more advantageous in this respect, and as well as being more effective clinically in reducing dental caries increment. (Horowitz, H.S. et al - 1971).

An alternative way of achieving better cost-effectivenss and cost benefit ratios would be the training of more non-operating dental auxilliaries who could be permanently involved in the self-applied topical fluoride programmes, thus avoiding the need for clinical dental staff (operating) to perform non-operative duties.

7. S U M M A R Y

The use of fluorides in the prevention of dental caries is the most effective way of controlling the dental disease.

Communal water fluoridation continues to be the cornerstone of an ideal caries prevention programme. An effective method of providing the benefits of systemic fluoride in geographic areas that lack central water systems is by fluoride tablet supplementation.

Fluoride solutions, gels or prophylactic pastes can be professionally-applied but it is an expensive method both from the standpoint of dental manpower and cost compared to other approaches and, therefore, are more suitable for private practice settings.

Self-applied fluorides, such as tablets, mouthrinses, pastes, gels and solutions are particularly suitable for use in school settings. Fluoride dentifrices are available for home use.

The use of fluoride mouthrinses in school programmes have been shown to reduce dental caries increment in children by about 20 to 50 per cent. Investigators in more than 35 clinical trials, mostly in the United States and Scandinavian countries have evaluated different methods of rinsing under a variety of conditions. The results of these trials have led to the acceptance of the following methods of rinsing:-

(1) *Low potency/high frequency rinses (0.05% NaF, 0.44% APF, 0.1% SnF_2) have been recommended for daily home-use by persons highly susceptible to caries. Involves a rinse and expectorate technique (5 ml. of solution swished for one minute). Have been shown to reduce dental caries increment in school children by about 40% when used for more than two years. However, they are not particularly suitable for school-based programmes.*

(2) *Rinse and swallow methods using low potency/high frequency solutions (0.05% NaF, 0.044% APF) on daily basis. This technique involves the use of fluoride rinse supplements which are dietary fluoride supplements but available as a rinse. Suitable for children between three and 13 years. The appropriate dosage is determined by patient's age and fluoride concentration in drinking water. Suitable for home-use.*

(3) *High potency/low frequency rinses (0.2% NaF solutions) have been recommended for weekly and fortnightly school-based programmes. The technique involves rinsing with 5-10 ml. of the solution for one minute and then expectorating (under supervision). Effective in reducing dental caries increment in children by about 35%.*

Most investigators have concluded that the beneficial effect of mouthrinsing with fluoride solutions can only be maintained if continued. The use of less frequent fluoride mouthrinses and pastes or daily use of dentifrices containing fluoride have been suggested once the children have completed primary school education.

Conservative estimates show that weekly or fortnightly rinsing with 0.2% NaF solution can be cost-effective (45 cents/child/year in the U.S. in 1977) and the cost-benefit ratios are impressive (1:16.4 for weekly rinsing in the U.S. in 1971 and 1:10.6 for fortnightly rinsing in Sweden in 1965).

The benefits of daily, weekly or fortnightly rinsing, according to Birkeland and Torell (1978) can be summarized as follows:

(1) *The caries prevalence is reduced by 50%, the increment by 60-70% and the need for fillings by about 70%.*

(2) *The treatment is simpler and the fillings last longer.*

(3) *The cariostatic effect improves by combination of rinses and other fluoride regimen.*

(4) The benefits in teenagers are likely to give a long-lasting low caries prevalence.

In planning and developing a rinsing programme there is need for identification of an appropriate population for rinsing, estimation and securing of funds to underwrite the programme, recruitment and training of staff to administer the programme and implementing the programme through supervision, monitoring and follow-up, thus ensuring maximum participation.

The discussion was based on the choice of most effective methods of relevance to Fiji. The use of high potency/low frequency rinses (0.2 NaF solutions either weekly or fortnightly under supervision) in schools in non-fluoridated areas in Fiji were considered in terms of costs, supervision and practicality in order to achieve maximum reduction in caries increment.

The use of professional dental manpower in the pilot dental projects in Fiji (1980) and the possibility of using non-dental personnel, especially the school teachers was also discussed. It was considered that school teachers would be the most appropriate personnel for supervising of rinsing procedures and that the professional dental staff time could be saved for secondary prevention. Finally, it was suggested that a weekly mouthrinsing frequency would be more advantageous than the fortnightly rinses.

8. CONCLUSION

Fluoride mouthrinses have gained importance in the caries-preventive armamentarium of public health dentistry. With the current increasing trend in dental caries prevalence amongst schoolchildren in Fiji and the stringent economical measures being exercised in the Government Dental Health Service, it is necessary to adopt a preventive approach to dental services and it would seem most reasonable to implement fluoride mouthrinsing programmes in the schools.

The method of choice would be the use of a high potency/low frequency fluoride regimen. It is considered that weekly rinsing with 0.2% neutral NaF solution would be more advantageous than the fortnightly frequency currently being used in the pilot preventive project in Fiji. Both from the clinical point of view that frequency of application is more important than concentration and from practical standpoint that schoolteachers are more likely to follow it as a weekly routine,this method appears to be more promising.

The method involves weekly rinsing with 0.2% NaF solution using the 'rinse and expectorate' technique. Under the supervision of the classroom teacher the children 'swish' with 10 ml. of the solution for a duration of one minute and then expectorate into a paper cup. The younger children could use a rinse volume of 5ml. for practical reasons. In this way about 30 children could rinse simultaneously under one supervisor keeping the 'rinse session time' to a minimum (about 5 minutes).

The clinical effectiveness of weekly fluoride mouthrinses have been well-documented. Children participating in long-term (two or more years) rinsing programmes can expect 35% reductions in dental caries increments. The benefits are better the longer the programme continues and therefore, long-term programmes would be needed to confer maximum benefits.

Estimates of cost-benefit based on long-term programmes indicate that the procedure is highly cost-effective in a variety of settings. The cost of rinsing materials is minimal. In Fiji, the costs could be further lowered if the Government Pharmacy stocks all necessary materials. To ensure continuity of the programme the NaF tablets/powder may be supplied to the schools without costs. However, it is possible to encourage schools to raise funds for purchasing the other rinse materials (plastic containers, calibrated pumps, paper/plastic cups, paper napkins) and storage facilities (cabinets).

The supervision of the rinsing procedures is an important aspect of the programme. It is considered that the schoolteachers could be the most appropriate personnel for supervision. Non-operating dental auxilliaries and volunteers could also be suitable. Adequate training is required for them to efficiently carry out the supervision.

It is also considered that dental officers and dental therapists could best serve as rinse co-ordinator-administrators. They could ensure continued participation by visiting each school once a month, thus reducing the need for the use of Government transport which is not always readily available. Moreover, these clinical operators would be largely involved in the treatment programmes in the light of the mounting backlog of unmet dental treatment needs and the unfavourable manpower ratio for schoolchildren (1 : 7,000; caries rate : 3 DMFT).

This method of fluoride application would seem to be a promising public health measure when adopted in conjunction with the oral health education, toothbrushing schemes and treatment programmes in the schools and thus could provide an effective means of preventing and controlling dental caries prevalence amongst schoolchildren, especially those residing in the non-fluoridated areas of Fiji.

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A P P E N D I X I

Prevention:

1. *Primary Prevention:*

   Steps taken to ensure that disease does not occur.

2. *Secondary Prevention:*

   Detection of incipient disease and halting its progression by simple repair or remedial measures. Sometimes at this stage there may be 'reversal' to the normal (as in gingivitis).

3. *Tertiary Prevention:*

   Treatment of well-established disease in order to minimize or eliminate the gross destructive effects, to restore healthy function and to resist further attacks of the disease process.

Dentists have in general, started their disease control at stage 2 above. Their training equipped them to search carefully for early caries, and dealing with this was thought to be the best approach possible. The result was a mouth with numerous small fillings in the pits and fissures. At stage 3 above or later the presence of periodontal disease was noted but all too often this awareness came too late.

(The different stages of prevention as relating to the approach to disease control).

SOURCE: Forrest, J.O., Editor - Preventive Dentistry: Dental Practitioner Handbook No. 22, John Wright & Sons Limited, Bristol, 1976.

APPENDIX II

PREVENTION OF ORAL DISEASES BASED UPON DISEASE LEVEL

DISEASE LEVEL	TREND	PREVENTIVE APPROACH
Very low to low	Stable	. None (surveillance);
	Increasing	. Dental health education;
		. Improvement of oral hygiene;
		. Dietary counselling.
Moderate	Decreasing	. Dental health education;
		. Improvement of oral hygiene;
	Stable	. Dietary counselling;
		. Community programs;
	Increasing	. School programs.
High to Very High	Decreasing	. Reinforcement or supplementation of existing preventive programs.
	Stable	. Dental health education;
		. Improvement of oral hygiene;
	Increasing	. Dietary counselling;
		. Community programs;
		. School programs;
		. Individual approach;
		. Combination programs.

SOURCE: Moller I.J. (1979) -

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Int. Dent. J., 29.3, 208-214 (September)

A P P E N D I X . I I I

EFFECTIVENESS OF VARIOUS METHODS OF ADMINISTERING FLUORIDES

METHOD	CONCENTRATION OR DOSE	% REDUCTIONS IN DENTAL CARIES
Community water fluoridation	0.7 - 1.2 ppm	50-65
School water fluoridation	4.5 x's optimum	40
Dietary Fluoride supplements	Depends on age of child and F concentration of water.	
• Home	2.2 mg NaF (daily)	50-65
• School		30-35
Mouthrinses	0.05%* NaF (daily) 0.20% NaF (weekly)	20-50
Dentifrices	0.40% SnF_2 0.76% MFP 0.22% NaF	20-30
Professionally applied applications	2.0% NaF 8.0% SnF_2 APF (1.2%F)	30-40

SOURCE: Horowitz, H. - 1980
Established methods of prevention.
Brit. Dent. J., 149:11, 311-317 (2 Dec.) 1980.

A P P E N D I X I V

SUPPLEMENTAL FLUORIDE DOSAGE SCHEDULE

It should be emphasized that fluoride tablet administration is strictly supplemental: it is intended to increase fluoride intake to approximately the amount that would be obtained from ingestion of liquids in optimally fluoridated communities. A practical dosage schedule (below) has been proposed which allows for differences in age and in fluoride concentration of the community water supplies, and has been accepted by the Committee on Nutrition of the American Academy of Pediatrics. This schedule is relatively simple, and can be implemented by using either the fluoride drops or the 0.25, 0.5 and 1.0mg fluoride tablets that are now commercially available. For infants who are unable to chew and swallow a tablet, a fluoride solution dispensed with an appropriate dropper is recommended; the implementation should start before six months of age.

Supplemental Fluoride dosage schedule (in mg F/day) According to fluoride concentration of drinking water*

	Concentration of fluoride in water (ppm)		
Age (yr)	*Less than 0.3*	*0.3 to 0.7*	*Greater than 0.7*
Birth to 2	*0.25*	*0*	*0*
2 - 3	*0.50*	*0.25*	*0*
3 to 14	*1.00*	*0.50*	*0*

**Adjusted allowance in milligrams of fluoride per day; 2.2 mg of sodium fluoride contains 1 mg of fluoride.*

SOURCE: *Newbrun, E., Dietary Fluoride Supplementation for the Prevention of Caries. Pediatrics 62: 733, 1978.*

A P P E N D I X V (Part 1)

FLUORIDE MOUTHRINSE PROGRAM
CLASSROOM TREATMENT RECORD

TEACHER _____ GRADE _____ SCHOOL _____ COUNTY _____

AUGUST, 19__ - JUNE, 19__

NAME	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN

FLUORIDE MOUTHRINSE TREATMENT RECORD

19__ - 19__ SCHOOL SESSION

School_____ Teacher_____ Grade _____

Participants — Rinsed? Yes (+) No (—) — School Week

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
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SOURCE: Dept. of Health, Education and Welfare
U.S. Public Health Service: DHEW Publ. (No. NIH) 77-1196, Washington, Government Printing Office.

A P P E N D I X V I

EXAMPLES OF ALTERNATIVE STRATEGIES - W.H.O. (1976)

"An example is useful in order to illustrate the nature of the process employed in the formulation of alternative strategies. We are considering a country or province that has a predominantly rural population, though urbanization is proceeding at a rapid rate. There is a central oral health planning group and the opportunity to coordinate all elements of the oral health services available or likely to be available. The prevalence of caries is extremely low, but increasing to moderate in urban areas. The prevalence of periodontal diseases is uniformly high, and the demand for services is low except in the urban areas and for emergencies. There is 1 dentist per 100 000 population and an equal but more rapidly increasing number of operating dental auxiliaries. There are both time and cost constraints on the more rapid production of professional man-power. Alternative strategies are available both between types of services, e.g., the concentration on preventive or restorative care provided in structured (systematic) or unstructured (demand) services and within a type of service, e.g. different preventive and health education approaches and different programmes of systematic care. Moreover, relevance of these strategies will differ between the urban and rural populations.

Objectives were defined in relation to 12-year-old children, to achieve:

(1) at least no further increase in dental caries prevalence in urban and urban-fringe schoolchildren and perhaps a reduction in the number of DMF teeth per child of 1/2 to 1 tooth,

(2) maintenance of the low prevalence of dental caries in rural children, and

(3) elimination of loss of teeth in urban and urban-fringe school-children.

The possible alternative strategies were (1) the selection of professionally or self-applied topical application methods for fluorides, or systematic administration, (2) the choice of applying prevention to all children or to a group selected on the basis of an indicator such as DMF measurements of population sectors, where the disease showed signs of increasing, or (3) the selection of a systematic care procedure from several patterns of regular selective care.

For each of these strategies there were cost-effectiveness considerations, and logistic constraints. With regard to prevention, the unsuitability and general lack of public water supplies virtually ruled out fluoridation of water as an option, the possibility of greater effectiveness of professionally applied topical fluoride application had to be weighed against the low cost of supervised self-applied methods, and all methods had to be considered in terms of the possible effects on the generally low caries prevalence. As regards systematic care, the dental manpower requirements for the options considered ranged from 1 : 1200 to 1 : 3300 depending on the comprehensiveness of the service provided.

It should be noted that while cost-effectiveness is a very powerful factor in making choices in such situations, there are many other factors to be considered. The important point is that for a number of situations very clearly defined alternatives can be provided as the basis for planning in the oral health sector.

Many other similar examples could be quoted of problem situations that illustrate the various considerations necessary at the time of formulation and analysis of alternative strategies. It is most important, at this stage of the planning process, that those with this responsibility demonstrate awareness of the various options available and are creative with regard to their formulation and analysis. Each alternative strategy needs to be examined carefully as regards its feasibility - technical, social, political, institutional, and economic.

Given the constraints that are found in any country, an appropriate decision might be sequentially to implement increasingly comprehensive strategies. For example, it is often necessary to begin with emergency dental services for the entire population, if possible including preventive and health educational components, followed by care and special preventive measures for selected target populations, and then by comprehensive programmes implemented in an incremental fashion for various groups until the entire population is covered both preventively and curatively. At each stage of this sequence, appropriate manpower production must be planned and evaluation must be envisaged for the programme as a whole. Allowance must also be made in calculations for the achievement of the objectives."

Source: Planning and evaluation of public dental health services. (Report of a W.H.O. Expert Committee, Technical Report Series, 589, W.H.O. Geneva, 1976. p. 21-23).