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FLUORIDATION OF PUBLIC WATER SUPPLIES

Although they lack the spectacular character of many communicable diseases, dental diseases are a major public health problem. In their two common forms -dental caries and periodontal disease- dental diseases are found almost everywhere and cause much pain and infection, thereby creating not only a public health problem but also a financial one, since treatment is expensive. The correction of dental defects calls for the skill and labor time of professional dental workers with four or more years of university training as well as costly installations, instruments, and equipment.

The dental problem in Latin America takes on dramatic proportions; in some regions just over 50 per cent of the teeth of children aged 8 are affected by dental caries; the extent of the damage continues to increase until by the time they are between the ages of 12 and 14, 13 teeth or 60 per cent of their permanent teeth are affected. In the United States about 90 per cent of the population at age 7 have one or more teeth affected; this figure increases and reaches an average of 7 teeth in children at age 16. Among the adult population of the United States of America the dental problem is extremely serious, 50 per cent of the population at age 40 having already lost 50 per cent of their teeth. It is been estimated that in the United States of America there are more than 21 million persons without a single tooth in their heads.

The annual increase in dental caries in some regions of Latin America is 1.6 teeth. In the United States the increase is 1 tooth per annum per person. There is not a single government in the world that can provide sufficient dental care, either private or official, to halt the advance of dental caries. A calculation made in 1950 for the United States confirms this statement; untreated dental defects in that year would have required an investment of 800,000,000 hours of work at a cost calculated on a basis of five dollars per clinical hour, of U.S. \$4,000,000,000.

Other causes of dental defects are: lack of understanding of what good dental health is; lack of proper health education to motivate the population to take the proper steps to prevent dental diseases; high cost of

dental care; not enough dentists to prevent the march of caries; and irregular distribution of dentists as between urban and rural areas.

Mention must be made of the very small number of professional dental workers in Latin America to meet the dental needs of the population. Although no accurate statistics about the number of dentists in Latin America are available, it is known that in Central and South America there are regions in which there is not a single dentist for 500,000 persons. Most of the dentists live and practice in urban areas and even in those areas the ration dentist population does not exceed 1:4,000. This figure should be kept well in mind, since in some countries the ideal ratio is said to be 1:1,000. In Latin America it would be impossible to meet the needs of the population by means of professional dental workers alone; hence the need for a sound preventive policy in the field of dentistry.

Since, in Latin America, the control of water supplies is usually in the hands of the governments, careful consideration should be given to the adoption of a policy for the rapid implementation of water fluoridation, which is an effective, practical, safe and inexpensive prophylactic measure against dental caries.

Efforts to prevent dental caries have taken many forms ranging from oral hygiene to stringent dietary control. However, the ideal measure is the fluoridation of public water supplies; it is the most modern, safe, and practical measure. It benefits the whole population regardless of economic, social, or educational status and does not call for efforts by the private citizen.

In 1931 fluorine in drinking water was identified as the cause of mottled enamel. Prior work by McKay, concerned with a description of the disease and the location of endemic areas, had led to the conclusion that the causative agent was in the drinking water. Subsequent studies by Dean and his colleagues clearly defined the direct and quantitative relationship between the prevalence and severity of mottling and the concentration of fluoride in drinking water. It has been fully demonstrated that the higher the concentration of fluoride in the water, the lower the incidence of dental caries. Studies have demonstrated that there is an inverse relationship between the fluoride level in the water and the incidence of dental caries. With low levels, the caries is severe but with about 1 p.p.m. fluoride children have only one-third as much caries as have those of the same age in areas where there is very little fluoride in the water. Three basic studies were carried out in the United States of America and Canada; and the effect on general health was watched. Field trials began in 1945 in Newburg, N.Y., the population of the city of Kingston being used as a control. Studies made after 10 years of fluoridation in Newburg conclusively show the benefits of fluoridation: the number of teeth free from caries was 5 times greater in the population of Newburg, than in the control population of Kingston.

Fluorine, a normal constituent of water is present in certain minerals found in rock and soil.

There is a substantial volume of literature reporting the worldwide geographical distribution of fluoride contained in domestic water-supplies. Fluoride is also found in teeth, bones, and in many of the foods that are commonly eaten. In all scientific literature no other element has been so carefully investigated as fluorine in relation to dental health, both epidemiologically and clinically, either in regions in which it appears naturally or in regions in which it has been added to domestic water supplies. Nor has so much interest in the scientific world been devoted in the last 30 years to any other element which appears naturally in the environment and in minimum quantities in human tissue. Fluorine is one of the few elements that have been exhaustively examined in relation to human health, both its effect on animals under environmental or laboratory conditions, and its conduct in isolated systems or in artificial media and on plants and microorganisms. The rich literature on the subject comprises more than 3,000 publications at the time of writing.

The fluoride level of surface waters is usually not more than 0.3 p.p.m., except when they are contaminated by industrial waste. The fluoride level of surface waters varies according to the number of sources of fluoride and the storm waters that flow into them; the amount of fluoride is greater at the mouth of rivers and less at their sources. Ground waters have a higher fluoride level and are the most commonly used sources of public water supplies in the United States of America. Well water also contains fluorides. Once the relationship between the fluoride level of water and the occurrence and distribution of dental caries had been established, the optimum concentration had to be established. It has been determined that the optimum concentration in water in relation to environmental temperature and relative humidity is that amount of fluoride added to water or present naturally in it that affords the best protection against dental caries and the least objectionable fluorosis, that is, that fluorosis recognizable only by a properly trained dentist. Of the two factors mentioned above, temperature is the factor that most affects optimum fluoride concentration.

An analysis of public water supplies in the Americas has shown that their fluoride level is below the optimum. In the special case of Latin America, where other factors are more dramatic causes of dental caries, the addition of fluorides to public water supplies has become an urgent necessity. A careful review of the literature shows that one of the measures for the prevention of caries that must be urgently recommended is the use of fluorides. While it is true that between the discovery of a preventive measure and its practical application there is always a certain time lag, in the case of fluoridation the lapse time is becoming ever-long.

Among the literature on the fluoridation of water supplies mention must be made of the First Report of the WHO Expert Committee on Water

Fluoridation, 1/the bibliography published by the University of Cincinnati 2/ and the selection of papers published by the United States Public Health Service 3/. We are of the opinion that these three publications completely cover the question under consideration.

Since the first artificial addition of fluoride to water supplies in the United States in Newburg, N.Y. and Grand Rapids, Michigan, in 1945, the number of communities in which this measure is being applied has been continuously on the increase. To date 47 million persons, that is, approximately 36 per cent of the population of the United States, are using water to which a sufficient amount of fluoride has been added to control dental caries. The adoption of this measure by the city of New York where more than 8,000,000 persons will have water fluoridation from 1965, is well known. With the adoption of water fluoridation by New York almost all the major cities enjoy fluoridation including Baltimore, Chicago, Cleveland, Denver, Indianapolis, Louisville, Miami, Milwaukee, Minneapolis, Norfolk, Philadelphia, Pittsburgh, Rochester, St. Louis, San Francisco, Washington and Providence. In Canada 20.3 per cent of the total population (3,800,000 persons) enjoy water fluoridation; furthermore, in the same country more than 200,000 persons are living in communities in which the public water supplies contain natural fluorides.

In Latin America 60 cities in 9 countries had water fluoridation in 1961 (Table No 1); in six of these countries there was a single demonstration unit, but in the other three fluorides were being added to the public water supplies of 54 cities. A recent survey made by the Organization showed that, in 1963, nine countries were carrying out water fluoridation programs in 114 communities (Table No 1). A glance of the 114 communities concerned clearly shows that the greatest increase has been in Brazil, especially in the State of Rio Grande do Sul where a special fluoridation scheme has been continuously in operation; Mexico is also increasing water fluoridation. Table No 2 shows the percentage of population with water fluoridation in Latin America, Canada, and the United States.

This table shows that of the 44,500,000 persons with piped water service only 13.4 per cent at present benefit from water fluoridation.

Table No 3 contains a breakdown by country of the population with piped water supply and of the population benefitting from water fluoridation.

1/ Wld. Hlth. Org. Techn. Rep. Serv. 1958, 146.

2/ University of Cincinnati (1963), The role of fluoride in Public Health (The Soundness of Fluoridation of Communal Water Supplies).

3/ U.S. Public Health Service (1962) Fluoride Drinking Waters, Public Health Service Publication No 825.

Table No 4 shows the Latin American countries in which at least one city has a water fluoridation scheme.

The Pan American Sanitary Bureau study of Latin American countries shows that water fluoridation is advancing slowly. There are a number of reasons for this slow advance in Latin America, including financial, professional, and technical reasons, and public opinion.

Although most Latin American communities do not have public water supplies, there are 44,500,000 persons with piped water supplies, of which only 13.4 per cent enjoy water fluoridation. It would therefore be easy to draw a national water fluoridation plan. No engineering problems would be involved in installing it, since fluoridation is nothing but the addition of yet another element to the many already found naturally in water in order to prevent dental caries. It is enough to bear in mind that, in more than 20,000 public water supply systems, millions of pounds of other chemical ingredients are added to billions of gallons of water; some of these chemical elements are solid, liquid, or gaseous under high pressures, and all play an important part in water treatment; and the methods used to apply them necessitate daily control.

As for financial reasons, the same reasons that justify water supplies apply to fluoridation; if it is accepted that communities should pay for their water supplies, then the additional cost of water fluoridation would be too insignificant to cause any increase in water rates. As a matter of fact, water fluoridation is one of the cheapest procedures in the whole process.

As for public opinion, it can be said that water fluoridation is not a sufficiently attractive issue to cause public opinion to bring pressure on politicians to undertake nation-wide programs. It is to be noted that most of the anti-water fluoridation movements in the United States stem from other than political reasons. However, in Latin America the experience gained with other public health measures makes it certain that this will not occur. This is confirmed by the complete absence of political interference in water supply systems that have implemented fluoridation.

As for professional reasons it is true that, traditionally, that is in the promotion of water fluoridation in the United States and Canada, dentists have taken the initiative and have led the movement for this measure, and sanitary engineers have been responsible for implementing it. When the dental profession has succeeded in gaining approval of the addition of fluorides to water supply systems, sanitary engineers have given full collaboration in designing the necessary devices for water fluoridation.

An analysis of these four factors shows that the basic cause for the slow advance of water fluoridation in Latin America is the absence of a policy in which sanitary engineers and dentists assume joint responsibility

for promoting it. Sanitary engineers should not take part not only in the execution and control of water supplies but also in promotional activities in the various ministries and water authorities. In most Latin American countries the administration of water systems is in the hands of ministries of public works and not of ministries of health, and the slow advance of fluoridation is due to the fact that sanitary engineers do not take a greater responsibility for promoting it.

Dentists in Latin America have centered their efforts for the promotion of water fluoridation in the ministries of health. If the area of responsibility for promotion it was expanded, and sanitary engineers included in it, then water fluoridation would become a reality.

All that needs to be done is for sanitary engineers to recognize water fluoridation for what it is: an integral part of a suitable system and to treat it as such and include it in the standard designs for new systems or for systems which are to be modified.

New approach to the Promotion of Fluoridation of Public Water Supplies

It is now almost universally recognized that the fluoridation of public water supplies is one of the most effective ways of preventing dental caries. The number of official and private associations, both national and international which support and promote water fluoridation shows that it is not necessary to pass more resolutions about the subject, but rather to formulate a definite plan of immediate action to enable the Americas to benefit from this measure within the shortest possible time.

An examination of the work done by sanitary engineers in the promotion of public water supplies in the Americas, and the present plans to provide suitable water systems to 70 per cent of the urban population and 50 per cent of the rural population, shows how important it is to have this profession assume joint responsibility with dentists for the rapid promotion and implementation of water fluoridation.

The Pan American Sanitary Bureau has submitted the following proposal to the organizers of the forthcoming Sanitary Engineering Congress, which will meet in Bogota in July of this year.

a. To adopt fluoridation as a policy and as a procedure that must be incorporated into water supply systems already constructed or to be constructed, wherever the addition of fluorides is called for.

b. To recommend that schools of ~~dentistry~~ ^{dentistry} provide instruction in the technical procedures necessary for implementing this policy. For the purposes of this training it is necessary to prepare special manuals in English, Spanish, and Portuguese, both for sanitary engineering students and for their teachers. Revisions of these manuals should be prepared from time to time in order to ensure that teaching about fluoridation is kept up to date.

c. To recommend that training is given to sanitary engineers in the Americas at present serving water supply undertakings in Government bodies or in international health organizations or credit institutions. This training will both be for the promotion of water fluoridation and in the technical aspects of its design and execution.

At the present time sanitary engineers support fluoridation as an effective method of preventing dental caries, intervene in technical problems involved in its incorporation into a water service, but they do not assume primary responsibility for promoting it, mainly because of the lack of special motivation for doing so. Public health dentists, in turn, have worked hard but with meager results, to have the persons in charge of water treatment stations implement this measure. As water fluoridation is not considered to be an integral part of the water supply system, action by the public health bodies is taken subsequent to design and construction; and involves an excessive amount of time and energy. Some services do not agree to it because they regard it as a public health program and therefore the responsibility of ministries of health. Others hold the view that the financial aspects of fluoridation are the responsibility of the Ministry of Health. This makes it necessary for the two professions of dentistry and sanitary engineering to join forces so as to ensure that the fluoridation of public water supplies in Latin America does not suffer further setbacks and becomes a reality in the very near future.

At the meeting of the Task Force on Health at the Ministerial Level in April 1963 environmental sanitation programs, in particular water supplies were strongly recommended (recommendation AG-1). The XIV Meeting of the Directing Council of the Pan American Health Organization adopted as the general policy of the Organization (Resolution No XXXII) all the recommendations adopted by the Meeting of the Task Force on Health.

In Section IV of the Final Report of that meeting, entitled "Criteria for Establishing Priorities in Health Problems" it is stated that:

"An order of priority among health problems clearly cannot be established unless the problems themselves, both their magnitude and their social, cultural and economic repercussions, are fully known. This background information will make it possible to decide which problems should be dealt with first, so that health, as a social function, may make the contribution needed for the balanced development of the country.

Criteria for establishing priorities include the nature and extent of the problems, their present or potential danger, measured in terms of mortality and morbidity, and their bearing on development. This approach emphasizes the social impact of each problem.

Attention must likewise be given to the scientific knowledge available for preventing or reducing the seriousness of each problem. This knowledge can be applied through techniques that are reliable, relatively simple to use, and inexpensive when compared with the financial consequences the problem has for the community. This approach is closely linked to the one mentioned earlier."

The problem of dental caries as it presents itself in the Americas satisfies the above-mentioned criteria, and fluoridation is exactly in accordance with the recommendations on the use of mass preventive measures.

Furthermore, since fluoridation is a means of supplementing the natural fluorine content of water, that is, in other words, an integral part of a suitable system, it should be possible to rapidly implement this measure in the Americas by means of a plan in which both dentists and sanitary engineers assume primary responsibility for its promotion at the national and international level.

Stages in the Promotion of Fluoridation

The World Health Organization has given special attention to the fluoridation of public water supplies. In order to meet the many requests of health agencies in the various countries WHO convoked a Committee of Experts which made a thorough study of the fluoridation of water supplies and published a report on it.

The stages of this plan would be as follows:

- a. To obtain an agreement that fluoridation is to be considered an integral part of the water system, when the natural fluoride level is below the normal optimum concentration.
- b. The enactment of laws which establishes that fluoridation is an integral part of water systems.
- c. The rapid training of senior engineers of national and international administrations.
- d. Technical advisory services, both national and international.
- e. The fluoridation of existing water supplies or water supplies which are to be constructed.

TABLE 1

NUMBER OF LATIN AMERICAN CITIES WITH WATER FLUORIDATION IN
1961 and 1963

Country	Number of cities with water fluoridation	
	1961	1963
Brazil	23	69
Chile	24	27
Colombia	7	7
El Salvador	1	1
Guatemala	1	1
Mexico	-	5
Panama	1	2
Paraguay	1	1
Peru	1	1
Venezuela	1	-
TOTAL	60	114

TABLE 2

PERCENTAGE OF POPULATION WITH FLUORIDE DRINKING WATER
IN LATIN AMERICA, CANADA, AND THE UNITED STATES

	1963			Eight Latin American countries with fluoridation
	Latin America **	Canada	Unites States of America	
Total population	143,619,000	18,928,000	188,616,000	82,472,000
With fluoride drinking water (*)	4.2	20.3	22.5	7.2
Urban population	72,323,000	13,061,000	...	39,194,000
With water service	61.6	76.4	...	62.7
With fluoride drinking water	8.2	29.5	...	15.2
Urban population with water service	44,556,000	9,966,000	...	24,575,000
With fluoride drinking water	13.4	38.6	...	24.3

(*) In addition, persons whose water supply naturally contains 1 mg/l fluoride number 7,300,000 in the United States of America and 241,656 in Canada.

Date: End of 1961 for the United States of America and 1962 for Canada.

Sources: Manual of Water Fluorudation Practice by Franz J. Maier and personal communication from the Health League of Canada.

(**) Excluding Brazil, Jamaica, Trinidad and Tobago, and territories.

TABLE 3

POPULATION WITH FLUORIDATION IN LATIN AMERICA IN 1963

Country	Population in 1963 (In thousands)				Population with water %	Population with fluoridation			Communities with fluoridation	
	Total	Urban		Total Population		Urban Population	Urban Population with water	No	Population (thousands)	
		Total	With water service							With fluoridation
Argentina	21762	16017	10459	-	65.3	-	-	-	-	-
Bolivia	3596	1365	762	-	55.8	-	-	-	-	-
Brazil	77521	34962	19124	...	54.7	...	...	69	...	...
Chile	8181	5438	4002	2415	73.6	29.5	44.4	27	3756	...
Colombia	15098	6616	5213	2401	78.8	15.9	36.3	7	2955	...
Costa Rica	1338	461	451	-	97.9	-	-	-	-	-
Cuba	7203	3980	2253	-	56.6	-	-	-	-	-
Dominican Republic	3334	976	553	-	56.7	-	-	-	-	-
Ecuador	4726	1331	775	-	58.2	-	-	-	-	-
El Salvador	2721	882	516	70	58.5	2.6	7.9	1	76	...
Guatemala	4095	1019	393	240	38.6	5.9	23.6	1	437	...
Haiti	4448	436	111	-	25.4	-	-	-	-	-
Honduras	2008	623	214	-	34.3	-	-	-	-	-
Jamaica	1687	...	...	-	...	-	-	-	-	-
Mexico	38416	19476	10673	340	54.8	0.9	1.7	5	340	...
Nicaragua	1633	611	232	-	37.9	-	-	-	-	-
Panamá	1177	556	468	370	84.2	31.4	66.5	2	370	...
Paraguay	1903	671	185	100	27.6	5.3	14.9	1	300	...
Peru	10881	4536	3125	25	68.9	0.2	0.6	1	25	...
Trinidad and Tobago	921	...	...	-	...	...	-	-	-	-
Uruguay	2955	2182	1608	-	73.7	-	-	-	-	-
Venezuela	8144	5147	2563	-	49.8	-	-	-	-	-
TOTAL	223748	...	...	...	...	...	...	...	...	...
Total excluding Brazil, Jamaica and Trinidad	143619	72323	44556	5961	61.6	4.2	8.2	114	8259	...

TABLE 4

TOTAL POPULATION AND PERCENTAGE OF POPULATION WITH FLUORIDE DRINKING WATER
IN LATIN AMERICAN COUNTRIES WITH AT LEAST ONE CITY WITH FLUORIDATION

Country	Communities with fluoridation	Population of communities			Percentage with fluoridation		
		Total	With Fluoridation		Total Population of the country	Urban Population	Urban population With water service
			Number	%			
Brazil	69	.....	... ..	....	...
Colombia	7	2,955,000	2,401,000	81.3	15.9	36.3	46.1
Chile	27	3,756,000	2,415,000	64.3	29.5	44.4	60.3
El Salvador	1	76,000	70,000	92.1	2.6	7.9	13.6
Guatemala	1	437,000	240,000	54.9	5.9	23.6	61.1
Mexico	5	340,000	340,000	100.0	0.9	1.7	3.2
Panama	2	370,000	370,000	100.0	31.4	66.5	79.1
Paraguay	1	300,000	100,000	33.3	5.3	14.9	54.1
Peru	1	25,000	25,000	100.0	0.2	0.6	0.8
Total	114
Total excluding Brazil	45	8,259,000	5,961,000	72.2	7.2	15.2	24.3



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CORRIGENDUM TO ENGLISH TEXT ONLY

On page 6 of Document CD15/29 last paragraph, first line, delete the word "dentistry" and substitute for "engineering".