

Overview of Salt Fluoridation in the  
Region of the Americas, Part I: Strategies,  
Cost-Benefit Analysis, and legal  
mechanisms utilized in the National  
Programs of Salt Fluoridation

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The Pan American Health Organization (PAHO), Regional Office of the World Health Organization (WHO) along with the Ministries of Health in 16 countries in the Region of the Americas have developed strategies to implement programs of salt fluoridation in the Region. These include assessments and measurement of the national oral health status, development of a fluoride surveillance system, assessment of the salt industry's capacity to fluoridate salt, cost-benefit analysis of the proposed programs and the legal mechanisms that would be needed to ensure program compliance. This shows the extent of inter-and-intra-national movement of salt. The objective of the overview is to present the "essential" of these programs, detailing the levels of support, activity and effect on the local salt industry. Utilizing data from the Region, the author presents a framework and protocol for regional or national program design, implementation and management of a micronutrient program involving the salt industry. It is believed that it can serve as a model for other micronutrient programs such as salt iodination, or as yet to be thought of programs using salt as a carrier.

## 1. INTRODUCTION

At the end of the 1990's dental caries is still the most prevalent condition among school-age children, affecting 90% of them, throughout Mexico, Central and South America and the Caribbean<sup>1</sup> most commonly. Oral health status is measured by the DMFT index (Decayed, Missing, and Filled Teeth) and the extent of periodontal disease, endodontic lesions and pericoronal lesions.

It is common knowledge that if oral health conditions go untreated, they can result in tooth loss and/or costly treatment. Recent research shows a strong positive association between oral health status and systemic health involving the cardiovascular and other general body systems. The research confirms the association between periodontal infections, untreated caries, and cardiovascular diseases, respiratory diseases, diabetes, and some complications of pregnancy.<sup>2</sup>

All of this continues to underscore the importance of disease prevention as the cornerstone of PAHO's oral health policy in the Region. This policy, as outlined in PAHO's Regional Oral Health Plan, emphasizes caries prevention by ensuring that any fluoride deficiency in the population of the Region is made up by the ingestion of fluoride either through the traditional means of water or more recently salt. It is the

intention of PAHO along with its member governments to pursue national programs of salt fluoridation for the majority of the 35 member countries in the Region (exceptions are Argentina, Brazil, Canada, Chile, Puerto Rico and the United States of America, these countries are already fluoridating water). At present 16 countries have already begun a program of salt fluoridation and are at various stages in the program.

This paper describes the strategies and policies used to support these programs and the effectiveness that has been observed to date.

## 2. STRATEGIES

International organizations such as PAHO have used a regional perspective to make strategic decisions on resource allocation and country planning. A strategy-oriented typology was devised to group countries along an oral health continuum using the DMFT at age 12 as the criterion for classification. Three classifications were used: emergent, growth and consolidation. This typology served not only as a one-time classification for strategic planning purposes but also as a dynamic instrument to track each country's progress towards targeted objectives.

Table 1  
Typology table circa 1990

Emerging DMFT >5	Growth DMFT 3 to 5	Consolidation DMFT < 3
Belize	Argentina	Bahamas
Bolivia	Canada	Bermuda
Brazil	Colombia	Cuba
Chile	Ecuador	Guyana
Costa Rica	Cayman Islands	Dominica
El Salvador	Mexico	USA
Guatemala	Panama	
Haiti	Peru	
Honduras	Trinidad &	
Jamaica	Tobago	
Nicaragua	Venezuela	
Paraguay		
Dom. Rep.		
Uruguay		

The publication of this classification led to several developments. In 1994, PAHO initiated a strategy for improving the oral health status of the Region. The WHO goal of DMFT 3 or less, was to be achieved by the year 2000. The objective of technical cooperation was aimed at moving countries with high levels of disease and lacking appropriate preventive policies, towards effective policies and improved status indicators. In order to achieve that objective PAHO sought the technical means to achieving the greatest reduction in caries at the lowest cost, and in the most effective and equitable way.

The successful experiences since the early 1960's in Hungary and Switzerland (on a national scale) and in Colombia (on a research basis) demonstrated the cariostatic effects of salt fluoridation.<sup>3</sup> Water fluoridation was also considered, but requires extensive infrastructure and consequently is not feasible in most rural areas in the Region. Salt fluoridation, therefore, became the lynchpin of the PAHO strategy.

The basic elements of this strategy were as follows:

- Regular measurement national DMFT, in order to determine program effectiveness and resource prioritization
- Technical cooperation centered around oral epidemiology, biological and chemical fluoride measurement and mapping, and salt fluoridation technology
- Development of strategic alliances with ministries of health, philanthropic foundations and the salt industry

## 3. PROGRAM COMPONENTS

From the overall strategies national salt fluoridation programs were developed and implemented. Although tailored to the specifics of each country adopting such plans, the major components include the following steps:

- (1) Country baseline studies to assess DMFT and exposure to fluoride
- (2) Salt fluoridation cost-benefit analysis
- (3) Epidemiological surveillance systems for salt fluoridation, including biological and chemical monitoring of all fluorides, and quality control
- (4) Salt Industry assessments
- (5) Evaluation and tracking systems to determine effectiveness of national fluoridation programs
- (6) Regular monitoring of fluoridation programs to prevent the risk of developing fluorosis

PAHO's technical cooperation has centered on providing technical expertise to countries to guide and carry out, these program components. Taking a team approach, PAHO assembled various consultants who specialized in a particular component of the program.

Local expertise in each country was identified and developed such that each country of sub-region would become self-sufficient.

### 3.1 National Oral Health Status

The country fluoridation plans called for the measurement of baseline oral health status. Over the interval of the last 10 years PAHO in association with the Ministries of Health of the Region has completed 17 surveys. The most recent results of these surveys for 14 countries along with the status of their salt fluoridation program is shown in Table 2.

Table 2  
DMFT-12 Indicators and Status of Salt Fluoridation

Country	DMFT-12 (yr.) Survey results	National Salt F. Program
Belize	In progress (99)	In progress
Bolivia	4.67 (95)	Yes
Colombia	4.80 (80)	Yes
Costa Rica	4.90 (92)	Yes
Cuba	2.90 (89)	In progress
Dom Rep	4.40 (97)	In progress
Ecuador	2.94 (96)	Yes
Grenada	5.52 (91)	Projected
Guatemala	In progress (99)	In progress
Guyana	1.33 (95)	Projected
Honduras	3.7 (97)	In progress
Jamaica	1.08 (95)	Yes
Mexico	Pend (99)	Yes
Nicaragua	2.81 (97)	In progress
Panama	3.61 (97)	Yes
Paraguay	In progress (99)	Yes
Peru	3.09 (90)	Yes
Uruguay	4.10 (92)	Yes
Venezuela	2.12 (97)	Yes

Source: PAHO, September 1999

### 3.2 Salt Industry Assessments

An important program component was the assessment of the capability and willingness of the salt industry to manufacture a fluoridated salt

product. Although this is relatively simple from a technological point of view, the monitoring, and surveillance components of a quality program, and the distribution and marketing of fluoridated salt required commitment from the owners and managers of salt processing facilities. The program wanted to avoid the pitfalls of previous salt iodization programs that did not maintain commitment and relationships with the salt producers, thereby contributing to periodic lapses in the quality of the program.

Since 1995 visits and assessments have been made to over 130 producers/processors in all 16 countries. This has formed the basis of a long term relationship with the salt industry.

### 3.3 Legal Mechanisms

Legal and regulatory procedures are considered important to cement the success of the salt fluoridation program. Normally legislation on salt fluoridation addresses a number of issues. These issues include the concentration of fluoride ion in the salt, the areas where fluoridated salt may or may not be sold, the labeling and packaging of fluoridated salt, the importation or prohibition of external non-fluoridated salt, and the types of salt, which may be fluoridated.

The legislation for salt fluoridation in the Americas is either obligatory or voluntary. Obligatory salt fluoridation forces the health authorities as well as the salt industry to fluoridate. Most countries in the Americas have obligatory salt fluoridation programs, except for Uruguay, where salt fluoridation is voluntary.

In most countries, the pull of consumer demand is lacking and voluntary fortification of salt with fluoride has less chance of being sustained, as there is no incentive for companies to take the risk and expense to fluoridate.

Mandatory salt fluoridation is recommended by PAHO because most health ministries put little priority in motivating private industry. The preferred regulatory option requires fortification, and gives industry incentives to comply.

From the experience in the region PAHO has been able to develop a model framework for legislation and regulation which has sufficient flexibility for practical, timely and smooth implementation.

#### 4. THE ECONOMICS AND COST-EFFECTIVENESS OF SALT FLUORIDATION

A key question in evaluating the merits of any public health intervention has to do with “what difference does it make.” Salt fluoridation improves health outcomes as intended. An efficient intervention achieves good results with the least amount of resources. Economics and effectiveness are therefore inextricably linked especially in public health interventions; especially in developing countries where resources are more scarce and decisions are inevitably more pointed.

##### 4.1 Preventive-Effectiveness of Salt Fluoridation

Apart from its low cost, the experience of salt fluoridation is showing that it is as effective in preventing caries as water fluoridation. Data collected from the various national programs are showing high rates of prevention of caries.

Despite potential methodological differences in the implementation of salt fluoridation programs as well as in the assessment of effectiveness outcomes, it is clear that salt fluoridation has achieved dramatic preventive results. This has been recognized in Europe for the last three decades. Select data collected in the Americas corroborate those findings. It is expected that, as oral health surveillance studies are completed in more than 16 countries in the Americas, more evidence will become available.

Table 3 summarizes data related to the effectiveness of salt fluoridation. Effectiveness, in this context, is assessed by the reduction in caries between baseline and follows-up observations.

Table 3  
DMFT Reduction Due to Salt Fluoridation

Country	Baseline Studies		Follow up Studies		% Caries Reduction
	Yr	DMFT	Yr	DMFT	
	12	12	12	12	
Colombia	64	6.7	72	3.5	48
Costa Rica	88	8.4	96	4.8	49
Jamaica	84	6.7	95	1.1	83
Hungary	66	8.2	82	3.3	60
Mexico	84	2.32	99	1.39	40
Switzerland	75	7.5	83	3.4	51

\* Mexico Reports DMFT 10

For Example, in Jamaica, caries were reduced by 83% after eight years of program implementation. In 1987, a comprehensive salt fluoridation program was initiated. In 1995, a survey of Jamaican children was conducted to assess the effectiveness and risk of salt fluoridation. Dental examinations of 1,200 children ages 6 to 8, 12, and 15 showed a mean DMFT prevalence for 12-year-olds of 1.08, compared with the corresponding score of 6.7 DMFT for children of the same age at the baseline Examinations in 1984. The main percentage of sound permanent teeth in all age groups was 95%.<sup>4</sup>

##### 4.2 Cost-Effectiveness of Salt Fluoridation

The economics of salt fluoridation in the Americas is beginning to be understood. As more experience with the programs is accrued across countries, more information on this matter will become available. In any case, it is possible to indicate here that production costs of fluoridated salt are generally modest. In Switzerland, for example, production costs are between \$ 0.2-\$0.04 per kilogram of salt to serve approximately 6 million people. In the Americas, most completed studies have to do with the economic feasibility of programs using estimated costs.

Cost-benefit analyses conducted by PAHO in various countries use very conservative assumptions: dental service coverage to approximately 50% of the population at an average of \$10 per dental visit. A summary of result of these studies is shown in Table 4.

Table 4  
Cost-benefit calculations for selected countries

Country	Program Cost US\$ (000)	Caries Prevented (000)	Cost-Benefit Ratio
Belize	187	115	1:126
Bolivia	785	10,650	1:136
Dom. Rep.	520	12,500	1:203
Honduras	527	8,340	1:122
Panama	424	4,133	1:146
Paraguay	360	5,303	1:123
Total	2,803	41,041	

Estimates reveal that the cost-benefit ratio ranges from 1:122 to 1:203. This means that in the case of

Bolivia at a cost-benefit ratio of 1: 136, for every dollar invested in salt fluoridation programs, the country will save \$136 dollars in curative dental care that is avoided. Salt fluoridation is proving to be one of the most effective interventions in modern public health.

#### **4.3 Equity considerations**

The population groups who potentially will benefit most are those in low socio-economic status, especially children. In addition to its excellent anticipated cost-benefit ratio, this aspect demonstrates that a fluoridation program is socially highly equitable.

### **5. STRATEGIC ALLIANCES**

PAHO's work and technical cooperation in the six years has been dedicated to assisting countries in each of the salt fluoridation program components. These have included feasibility studies, DMFT survey design, training of surveyors, data analysis, development of surveillance systems for biological and chemical monitoring of fluorides, the quality assurance of salt fluoridation as well as the review of the legal framework and legislative actions needed to ensure compliance and regulatory standards for these programs.

PAHO's oral health strategy could not be implemented without a team and the development of strategic alliances between the private and public sector. The Oral Health Program operates with core funds from the regular budget to strengthen technical cooperation and promote the mobilization of extrabudgetary funds. A significant part of the work in salt fluoridation in the Region was initiated by PAHO with strong support from the W.K. Kellogg Foundation, and additional support from

ministries of health, and salt producers, and the Rotary Foundation.

### **6. SALT FLUORIDATION AS A MODEL FOR OTHER MICRONUTRIENT PROGRAMS**

The systematic approach described above can be used as a model for projects and developments in countries throughout the world. Support and guidance of PAHO has played a key role in these improvements. Programmatically, in order to implement salt fluoridation programs, the model proposes three stages of implementation (Table 5).

Phase I - Baseline studies: several baseline studies are essential including cost-benefit studies and prevalence baseline of caries and dental fluorosis. The studies are recommended because they provide the economic and technical rationale for program implementation. Prevalence baseline studies provide information on the disease the program pretends to address, so that later the effectiveness can be evaluated.

Phase II - First Evaluation: this is recommended seven years after the implementation of salt fluoridation. After this interval, early erupting teeth exposed to salt fluoridation throughout their development can be assessed for reduced caries and for the prevalence of fluorosis. The long-term effects ascertained after 14 years will subsequently measure the maximal caries preventive effects and dental fluorosis in both early and later erupting teeth.

Phase III - Long term evaluation: countries that have successfully moved along the oral health development continuum and have an established fluoridated salt program, have reached the consolidation stage. These activities provide information on program progress, effectiveness, and sustainability, which are important for generating continued support for the program.

Table 5  
Program Stages of Implementation for Salt Fluoridation

Phase I Feasibility Assessment and Program Implementation	Phase II First Evaluation	Phase III Long-term Evaluation Consolidation
Baseline Fluoride in drinking water	Periodic analysis of Fluoride in water	Continued analysis of Fluoride in water
Baseline study on marketing and use of products with Fluoride	Monitoring of Fluoride- containing products in the market	Continued periodic monitoring of Fluoride-containing products
Development of monitoring guidelines for Fluoride concentration in salt	Monitoring Fluoride concentration in salt	Continued monitoring of Fluoride concentrations in salt
Baseline DMFT fluorosis surveys in 6-8, 12, and 15-year-old	DMFT and dental fluorosis surveys 7 years after	DMFT and dental fluorosis surveys fourteen years after
Initial assessment of Fluoride concentration in urine in 3-5 year-old children	Periodic evaluation of Fluoride concentration in urine	Periodic evaluation of Fluoride concentration in urine

## 7. CONCLUSIONS

Given the knowledge and scientific evidence on the effectiveness of salt fluoridation accumulated for decades, in Europe and the Region of the Americas, we know that it is increasingly possible to prevent dental caries, and to minimize the negative sequelae of this condition. Much of the oral health effort in the future will have to overcome barriers, mostly in the integration of preventive approaches to health care. Salt fluoridation is an effective intervention to prevent and reduce the overall burden of dental caries. Technical implementation of salt fluoridation programs is generally feasible; it requires small financial investments; and anticipated benefits greatly exceed initial or maintenance costs. Unlike many other public health interventions, salt fluoridation has the potential to become self-sustaining in the short term, and the benefits of salt fluoridation are for a life-time.

## REFERENCES

- <sup>1</sup> Health in the Americas. *Pan American Health Organization*. Scientific Publication: 569. Vol 1, page 192-200, 1998.
- <sup>2</sup> Genco, RJ: *Overview of Risk Factors for Periodontal Disease and Implications for Diabetes and Cardiovascular Disease*. Compendium/Special Issue. MWC Publication. Fall 1999.
- <sup>3</sup> Marthaler T.M. Mejia R., Toth K. and Vines J.J. *Caries-preventive Salt Fluoridation*. *Caries Res.*, 12 (suppl 1): 15-21, 1978.
- <sup>4</sup> Estupiñán S, Baez R, Sutherland B, et al *Impact of salt fluoridation in preventing caries in Jamaica* (abstract). *J Dent Res* 1996 75 (Spec Issue): 142.