

Republic of the Marshall Islands: Planning and Implementation of a Dental Caries Prevention Program for an Island Nation

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Abstract:

The Republic of Marshall Islands (R.M.I.) is an island state in eastern Micronesia with a landmass of 70 square miles scattered across 750,000 square miles of the western Pacific Ocean with a national population of approximately 51,000. In a 2002 children's oral health survey, 85 percent of six year old children in the R.M.I. capital of Majuro were found to have had at least one carious tooth and 65 percent had 5 or more affected teeth. The mean caries prevalence among primary (or baby) teeth was 5.79 decayed or filled teeth (dft), a caries prevalence rate close to three times the U.S. national mean. While 12.3 percent were caries-free, 65.0 percent had experienced 5 or more affected teeth (rampant caries). Of these, less than 1 percent had received any form of dental treatment. Comparably remarkable early childhood dental disease rates were also observed on other populated islands and atolls. In response to the rampant dental disease shown to be affecting young children, the R.M.I. Ministry of Health has proposed the implementation of a strategy targeting the pre-natal / per-natal environment, young parents, pre-school and elementary school children. (PHD, 2005 Vol 12 No 1 Pages 118 - 123)

Introduction

The process of acculturation of Pacific Island peoples to western ways has resulted in dramatic increases in morbidity and mortality from infectious and chronic disease^{1,2}. Much of the increase in chronic disease has been attributed to, directly or indirectly, dietary shifts away from traditional regional diets and towards less healthy western diets. Dental caries, along with other chronic diseases including diabetes and heart disease, are more common within the region today than in the past. Increases in the use of table sugar and refined fructose syrups in manufactured foods and confections have been associated with a rise in dental caries risk and dental caries prevalence³.

Conventional strategies to reduce the impact of acculturative changes on the teeth have largely been unsuccessful. On the United States (U.S.) mainland, for example, years of investment in oral health programs have failed to effectively address persistent disparities. Similar approaches have been used in the American affiliated states and territories in the Pacific with equally poor results. Such approaches rely on conventional clinic based treatment, sometimes supported by topical fluoride application and dental sealant programs, with a focus on school-age children. Among the chronic problems faced by the Republic of the Marshall Islands (R.M.I.), as well as other Pacific-basin jurisdictions, is

the shortage of funds, supplies and trained dental health personnel. As a result, attempts have been made to have programs focused on treatment needs rather than disease prevention but these understaffed and underfunded programs have fallen short of the objective of a healthier child population. This report describes the oral health condition of young children and presents the disease prevention strategy developed for to help address the pandemic of oral disease affecting the Republic of the Marshall Islands.

Setting

The Republic of Marshall Islands is located in eastern Micronesia. Of the 1,225 islands and islets that comprise the Marshall Islands, only 5 are single islands. The remainder is grouped into 29 atolls, which run roughly north to south in two nearly parallel chains about 150 miles apart and 80 miles long. Although the land area is only 70 square miles, the Marshall Islands are scattered across 750,000 square miles of ocean. Two of these atolls are considered urban centers and the balance are viewed as outer atolls. The major atolls and islands are served by regular air service but many sites are accessible only by boat. Major population centers, including Majuro, Ebeye and Jaluit, have stable electricity but only Majuro has centralized water system. Most other sites have neither electricity nor a water system. The Majuro water system is not fluoridated and has not been tested for natural levels of fluoride. Even families and schools that have access to the central water supply use rainwater catchment systems rather than the central water system because the centralized water is considered unpalatable.

Majuro atoll is the capital of the Republic. The population of Marshall Islands now stands at 50,840 (1999 census) and more than 40 percent of the population is under 15 years of age. The population of Majuro is 26,000. Per capita income in the R.M.I. varies dramatically from Majuro to the primary subsistence based outer islands.

Organization of Oral Health Services in the R.M.I.

The constitution of R.M.I. has designated the Ministry of Health as the "State" health agency. It is the only authorized agency that provides the health care services to the people of the Marshall Islands. Dental services in R.M.I. are limited to the government hospital dental clinics on Majuro and Ebeye. In 1988, the Ministry of Health implemented a school-based sealant program on Majuro. This program was discontinued in 1994. In the recent past, preventive dental services have been delivered by periodic, though irregular, visits by an itinerant dentist to the outer islands, and volunteer teams from the U.S. mainland. Currently, the Dental Services staff includes three dentists and one dental nurse assigned to the dental department on Majuro and one dentist and one dental nurse assigned to the hospital on Ebeye. The Head Start program employs one dental nurse but has no fixed facilities for delivering dental care. There are presently three R.M.I. students studying dentistry at the Fiji School of Medicine.

As a result of the Compact of Free Association with the U.S., some R.M.I. educational and public health programs receive U.S. federal government financial support. Through federal support, Head Start programs in the region are able to receive funds to support oral disease prevention and dental treatment programs where the local health delivery system is deficient. There are 47 Head Start centers in the R.M.I. Of these, 6 are located on Majuro (600 children enrolled), 1 on Ebeye (200 children enrolled), and the remaining 40 centers are located on outer islands (400 children enrolled).

There are 20 elementary schools on Majuro, 4 on Ebeye and 80 on the outer islands.

Prior to this project, the extent of the oral disease problem, though apparent to all working with young families, had not been effectively documented. Through a collaboration between the R.M.I. Ministry of Health with the Hawa State Department of Health and the University of Washington School of Dentistry, oral status baselines were developed which will serve as a means of examining the impact of future disease prevention programs.

Oral Health Status Findings

During the 2001-2002 school year, all 243 six year old children (118 boys and 125 girls) present in the elementary schools on Majuro were examined. These children represent 46.4 percent of all children in this age cohort and are typical in terms of socioeconomic status of all children in the urban and rural areas of the R.M.I. The remaining children within this age cohort were either still enrolled in Head Start or were absent from school. These children represented about 20 percent of all six year old children in the R.M.I. The school sites included facilities in the heavily urbanized areas of the Capital as well in the outreach sites. Six year old children were chosen for evaluation because they still retain the majority of their primary dentition and were easily accessible.

Visual examinations were conducted by a single trained examiner using a mirror and explorer and portable dental light (Aseptico - Direct A-Beam ALU 27). Clinical evaluations did not include radiographic information or trans-illumination. Examinations followed the WHO procedures. An assistant recorded the results while the dentist examined. Copies of student dental charts were sent to the Hawai'i State Department of Health Dental Health Division (Honolulu) and entered to create a computerized multivariable database. The database

Table 1 Caries Experience of 6 Year Old Children on Majuro, 2001

	Sample Size	dft ^a	95% C.I.	DMFT ^b	95% C.I.	Percent With Unmet Treatment	% d ^c	%D ^d	% Caries-free ^e	Percent with Rampant Caries ^f
Majuro	243	5.794	5.315, 6.274	0.671	0.522, 0.820	85.6	97.4	99.4	13.2	60.5
Boys	118	6.008	5.298, 6.719	0.568	0.356, 0.779	83.9	96.9	100.0	12.7	62.7
Girls	125	5.592	4.944, 6.240	0.768	0.559, 0.977	87.2	98.0	99.0	13.6	58.4
Hawaii^g	6,152	4.165	4.065, 4.265	0.106	0.094, 0.119	35.8	28.7	36.9	30.1	44.7
U.S.^h	*	1.773	1.640, 1.906	0.100	0.076, 0.124	na	38.7	47.1	na	Na

a. dft = caries prevalence in the primary dentition

b. DMFT = caries prevalence in the secondary dentition

c. %d = d/dfx 100 = percentage of primary teeth actively carious

d. %D = D/DMFx100 = percentage of secondary teeth actively carious

e. Caries-free (primary dentition)

f. Rampant Caries = 5 or more carious primary teeth

g. Hawai'i, Statewide School Oral Health Assessment, 1999

h. NHANES III, 1986-1987

* dft, n=3,978 DMFT, n=3,413

was analyzed utilizing a statistical program written for this purpose.

The dental health status of the children examined is detailed in Table 1. Each of the oral health / oral disease indicators examined reflect that young children on Majuro, as represented by 6 year olds, have a problem with severe dental disease by comparison with children of the same age in Hawai'i and the mainland U.S. Although the variance is not statistically significant ($p > 0.05$), the caries rate among primary teeth was found to be higher among the boys than the girls and the caries rate among secondary teeth was higher among the girls than the boys. This pattern is a typical finding and is attributable to known gender variance in the eruption of primary and secondary teeth. Also use of dental services usually follows this typical girl-boy pattern. However, contrary to U.S. national survey findings, which demonstrate higher dental care utilization and lower unmet treatment needs in girls. We found only a slight and inconsistent difference in Majuro. More girls than boys were found to have untreated dental caries, though they appear to have slightly lower risk of having rampant tooth decay and a marginally higher chance of being caries-free. As proxy indicators of "oral health", measures of oral disease prevalence give an indication of the "relative dental wellness" of a community. Likewise, data for a single age group, six year old children, gives a relative view of the dental disease experience of children in adjacent age groups. Dental caries, as with most dental disease, is an insidious and progressive disorder, and is generally rooted in early childhood. A high rate of dental caries in 6 year olds is representative of problems, which may be preventable with intervention, which needs to occur among infant and toddlers.

Among significant findings were:

- A mean caries rate among primary teeth (dft) of 5.79, a caries prevalence rate close to three times the U.S. national average.
- Almost 88 percent of children examined had experienced at least one decayed tooth (primary or permanent).
- While 12.3 percent were caries-free, 65.0 percent had experienced 5 or more decayed teeth (rampant caries).
- Rampant caries was also found among permanent (or secondary) molar teeth, with 21 percent of all 6 year olds found to have experienced two or more carious permanent molars. Striking, considering that permanent molars typically first erupt at approximately 6 years of age.

More girls than boys were found to have untreated dental caries, though they appear to have slightly lower risk of having rampant tooth decay

- In regards to unmet treatment needs, R.M.I. children had 97.4 percent of the decayed primary teeth observed were actively decayed and in need of treatment, by contrast with 38.7 percent of decayed primary teeth in the U.S. In addition, 85.6 percent of children had untreated tooth decay.

Improvement Plan

Given the dramatic level of caries among young R.M.I. children, a plan was developed to reduce the prevalence and severity of dental caries on the community. Children and pregnant women and new mothers are targeted in order to emphasize prevention and life long oral health. The goals of the plan are as follows:

- To incorporate good dental health practices into prenatal care for all women.
- To incorporate preventive oral health activities into well baby (child) care.
- To establish preventive oral health activities within Head Start program and kindergartens.
- To re-establish preventive oral health within the elementary schools.

Prenatal Care

There are approximately 1,056 births on Majuro and 361 births at the Ebeye Hospital annually. At both sites, prenatal care is available to all women at no cost. There are an additional 290 births outside of these two hospitals, with prenatal care provided by health assistants in outreach dispensaries.

Because mothers are the source of both the infectious bacteria for dental caries and the diet of the child, it was decided to target this population.

The prenatal environment was also targeted because recent research has suggested that poor oral health may lead to poor birth outcomes. Also, many of these new mothers have previously had little access to regular preventive dental care.

The goal established was that all pregnant women attending prenatal clinics on Majuro and Ebeye will receive a dental examination on the first prenatal visit. Cost is a barrier to most women returning for further treatment and a future goal for this program is to gain governmental acceptance of a subsidized treatment program to help assure that pregnant women are dentally fit. At the first visit, mothers to be will also receive information about the importance of the teeth of the new child and the significance of proper diet and daily hygiene.

Current Status

- 100 percent of women in prenatal clinic on Majuro currently receive a dental exam.
- Approximately 25 percent of women who receive an initial visit during prenatal care return for needed treatment.
- On Ebeye, there is little integration of oral health into prenatal care and only those with symptomatic teeth are seen in the dental clinic. A future goal is to gain acceptance of preventive dental activities for all pregnant women on Ebeye.

Well Baby and Child Care

Because early childhood caries is of such high prevalence, efforts to combat the disease must begin early in childhood⁷. The objective is that all children will be seen by a dentist or dental nurse within 6 months of the eruption of the first tooth⁹. This objective is consistent with the recommendations of the American Academy of Pediatric Dentistry. Beginning at this period, and continuing every 2 months, the child will receive topical applications of either Betadine (10 percent povidone-iodine) or fluoride varnish^{10,11}. In addition, mothers will receive free toothbrushes and fluoridated toothpaste for their children. Instructional materials will be developed in Marshallese to guide mothers regarding cleaning baby teeth and appropriate diet to prevent caries.

There are dental clinics only on Majuro and Ebeye. Until recently, these clinics were not oriented toward seeing very young children and no dental staff were assigned to work with maternal and child health clinics. Currently, pre-Head Start age children (before age 5) are seen one day per week without appointments and without payment for preventive care at the dental clinic on Majuro. No preventive activities for very young children have been developed for the outer islands except when the dentists visit.

Current Status

- Approximately 200 of the estimated 3,400 (6 percent) pre-Head Start age children on Majuro are currently receiving topical treatments.
- 100 percent of those children who have been seen in the dental clinic on Majuro are receiving fluoridated toothpaste and toothbrushes.
- None of the children attending well child clinics on Ebeye are currently receiving fluoridated toothpaste or

toothbrushes.

- Children in the outer islands are seen by a visiting dentist where topical Betadine is being applied at no cost. Health assistants have been trained to continue application of Betadine every two months. No data are available on the performance of the health assistants in these settings at present.

- The distribution of toothbrushes and fluoridated toothpaste on the outer islands is irregular.

Head Start and Private Kindergarten

Head Start is a one year program of early childhood education aimed at increasing readiness to enter school. Ninety percent of all five year old children in the R.M.I. are enrolled in Head Start. Head Start programs address health and nutrition as essential to preparing students to learn. U.S. federal guidelines for Head Start grants require that children receive health screenings

and appropriate treatment. The isolation of the islands and the lack of manpower had resulted in frequent failure to be in compliance with Head Start guidelines. In the past, agreements had been made between the R.M.I. Head Start program (Ministry of Education)

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and the Ministry of Health to implement an oral disease prevention program for all Head Start enrollees. However, little effort was made to actually implement the agreement and no children received effective preventive care. Some children received episodic care without follow-up. Many children enrolled in Head Start brush their teeth with fluoridated toothpaste at school.

The goal of this aspect of the oral health improvement plan is that all children enrolled in Head Start will receive a dental examination, appropriate referral, treatment and follow-up care. In addition, all children enrolled in Head Start will receive topical fluoride varnish applications every two months. Current guidelines include the use of dietary fluoride supplement tablets, however, these have not been followed and are expensive. All children enrolled in Head Start will receive free fluoridated toothpaste and a toothbrush, both for school and for home. All children will receive a home visit, where oral disease prevention is reviewed by a Head Start teacher, including the importance of daily oral hygiene and appropriate snacking. This visit is aimed at encouraging self-reliance and personal responsibility and dispelling the idea that no preventive efforts are needed at home because they are carried out at school. In addition, all Head Start programs will review current dietary guidance

in order to minimize cariogenic meals.

Contributing to the development of a prevention strategy, in Fall 2002, a Head Start Oral Health Forum was held for the first time, bringing together representatives of the Ministries of Health and Education as well as parents and local government officials. Through his forum, supported through a grant of the Association of State & Territorial Dental Directors (U.S.), collaborative relationships were strengthened and plans were made by attendees associated with specific strategies targeting Head Start families.

Three hundred children attend private, usually church-related kindergartens. Because there is no private dental service available in R.M.I., State services extend to children enrolled in private kindergartens. These services are identical to those provided for Head Start enrollees.

Current Status

- Approximately 50 percent of children enrolled in Head Start on Majuro now receive a dental exam and appropriate treatment.

- Very few children enrolled in Head Start on Ebeye or the outer islands now receive a dental exam and appropriate treatment.

- Approximately 50 percent of children enrolled in Head Start on Majuro now receive periodic topical fluoride treatment.

- No children enrolled in Head Start on Ebeye or the outer islands now receive a periodic topical fluoride treatment.

- 100 percent of children enrolled in Head Start on Majuro, Ebeye and the outer islands now receive free toothpaste and toothbrush.

Elementary School Program

The objective of the program is that children enrolled in public and private elementary schools nationwide will participate in weekly fluoride mouth rinse programs and children in grades 1 through 3 will receive free toothbrushes and toothpaste. Dental educational materials will be available in Marshallese or English as appropriate and presentations will be made to all children in grade 1 in all schools throughout R.M.I. Children in grades 1 to 3 will brush their teeth at school. A further goal is to distribute fluoridated toothpaste for the children to use at home. It is also an objective to provide dental sealants for permanent molars in all

schools in R.M.I. All children in need of care will receive a referral for dental treatment at the Majuro or Ebeye clinics at a dental treatment visit cost of \$5 (U.S.). In order to monitor progress toward these objectives, we will establish an on-going oral health surveillance program. Initially all children in grade 1 will receive at least 1 dental examination during the school year.

Current status

- 100 percent of all children on Majuro grade 1 received a toothbrush.

- 100 percent of all children on Majuro grade 1 received a dental examination last year.

- Approximately 80 percent of all children on Majuro grade 1 received a referral for treatment.

- Currently, there are no data documenting these activities on Ebeye and in the outer islands but the rate is apparently very low.

Ministry Support

The plan described addresses primarily process goals. Clearly it is believed that the application of these steps will reduce disease prevalence and severity. The plan is a living document and will be modified as new approaches are considered and can be adapted to suit local needs. However, at this time the plan serves to

guide the dental disease prevention program and inform policy makers as to resource requirements needed to achieve better health for the children of R.M.I.

Ministry support has increased since 2001. In 2002, a dentist has been assigned for dental disease prevention programs for

the Republic, including Head Start and a vehicle was provided. The preventive services dentist was sent to the 2002 Scientific Session of the American Association of Public Health Dentistry (U.S. National Oral Health Conference) to present a poster session on the "Prevalence of Early Childhood Caries on Majuro". She also collaborated with dental public health specialists in Hawai'i on community health status monitoring models and attended meetings with the Pacific Islands Faculty at the University of Washington School of Dentistry to discuss preventive programs in R.M.I.

Table 2 contrasts current program support with resource requirements needed to move towards the implementation of the prevention strategy.

Table 2 Estimated Budgetary Needs for Dental Disease Prevention Plan Program Implementation for the Republic of the Marshall Islands, 2003 (U.S. Dollars

The goal of this aspect of the oral health improvement plan is that all children enrolled in Head Start will receive a dental examination, appropriate referral, treatment and follow-up care.

Program Area	Current dentist	FTE	Current annual non personnel expenditures for preventive program (US \$)	FTE required to fully implement program	Annual non personnel expenditures required fully implement program
Prenatal	0.1		\$2,500	0.4	\$4,000
Well Baby/Child	0.2		\$1,600	0.4	\$26,000
Head Start	0.1		\$5,000	2.0	\$10,000
Elementary Schools	0.4		\$10,000	2.0	\$20,000

Non-personnel expenditures do not include the cost of air/boat transport or per diem payments to personnel.

Discussion

The oral health indicators for Majuro six year olds reflect the need for the implementation of systematic dental caries prevention. This dental caries prevention program will require a team approach and community investment in primary, secondary prevention and tertiary care. Plans also include the gradual substitution of new personnel into the school program as it becomes well established on Majuro, so that the preventive services dentist's efforts can be focused on implementing other aspects of the overall plan. In the long run, an investment in primary prevention will be more effective and cost-efficient than treatment (disease control) programs, which are expensive and manpower intensive. Community health and hygiene education, early screening (with dental examinations as early as 6 months of age) and the maintenance of fluoride supplement and topical application programs will set the stage for a healthier tomorrow. Targeting efforts on the peri-natal environment, young families and pre-school age children is anticipated to lower the caries risk in the incoming generation and disrupt the cycle of dental disease, which is initiated at a young age.

Other strategies are also being explored. Fluoride varnish treatments at Head Start are being implemented and consideration is being given to adding xylitol-containing foods or snacks to Head Start diets.

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References

1. Feasley JC, Lawrence RS (eds). Pac for health: *Charting a new course*. Institute of Medicine. Washington, DC: National Academies Press, 1998
2. Yamada S, Palafox N. On the biopsychosocial model: the example of political economic causes of diabetes in the Marshall Islands. *Fam Med* 2001;33(9):702-4
3. Newbrun E. *Cariology*. Baltimore: Williams and Wilkins, 1983
4. Republic of the Marshall Islands, Office of Planning and Statistics. *Census of Population and Housing Final Report*, Majuro, 1999
5. *Oral Health Surveys Basic Methods*. 4th ed: WHO
6. Oral Health of United States Children: The National Survey of Dental Caries in U.S. Children: 1986-1987; Epidemiology and Oral Disease Prevention Program, *National Institute of Dental Research, N Publication No. 89-2247*, September, 1989
7. Milgrom P, Weinstein P. Early childhood caries: A team approach to prevention and treatment. Seattle: *Continuing Education*, University of Washington School of Dentistry, 1999
8. Offenbacher S, Lief S, Boggess KA, et al. Maternal periodontitis and prematurity. Part I: Obstetric outcome of prematurity and growth restriction. *Ann Periodontol* 2001 ;6(10):164-74
9. Sanchez O, Childers N. Anticipatory Guidance in Infant Oral Health: Rational and Recommendations; *American Family Physician* Jan, 2001
10. Lopex L, Berkowitz R. et al Topical antimicrobial therapy in the prevention of ECC. *Pediatric Dentistry*. 21:1, 1999.
11. M.J. Kanellis. Fluoride Varnish, Prevention of Dental Disease. *Pediatric Dentistry: Infancy Through Adolescence*, 3rd ed.