CASE 16
Preventing Dental Caries in Jamaica

Geographic Area: Jamaica

Health Condition: In the early 1980s, dental caries in Jamaica was widespread. On average, children had 6.7 decayed, missing, or filled teeth, and fewer than 3 in every 100 children were free of caries.

Global Importance of Health Condition Today: Dental caries, or tooth decay, is one of the most common chronic health problems of children. Untreated caries is painful and may affect diet, school attendance, and sleep.

Intervention or Program: In 1987, at the encouragement of a dentist from the country's Ministry of Health, Jamaica's only salt producer began producing and selling fluoridated salt. The Ministry of Health and the Jamaican Parliament completed the necessary legal and regulatory framework, and the government provided biological and chemical monitoring of the salt.

Cost and Cost-Effectiveness: Salt fluoridation costs only 6 cents per person annually. Cost savings from the program are extraordinary: For each $1 spent on salt fluoridation, $250 will be saved in reducing the need for future dental treatment.

Impact: By 1995, the health of children's teeth in Jamaica had improved dramatically. In both 6-year-olds and 12-year-olds, the index of the severity of caries had fallen by more than 80 percent.

Some public health programs attract wide financial and political support because the health conditions they address are seen as severe, even life threatening. Others are out of the public view because they tackle smaller problems, albeit concerns that may profoundly affect quality of life. Donors rarely line up to fund such programs, and politicians make little effort to lead the charge. However, such modest initiatives—exemplified by Jamaica's successful effort to reduce the incidence and severity of dental problems among children—can demonstrate how small amounts of money, applied intelligently, can quietly and steadily raise the health status of populations.

Problem of Dental Caries

Dental caries is the progressive loss of tooth mineral and the invasion of the demineralized tooth by bacteria. It develops when bacteria stick to the surface of the tooth, forming plaque. When a person eats food containing simple sugars, the bacteria use the sugars for their own metabolic needs and produce acids as by-products.

Caries is common among children worldwide, and, though declining, remains a persistent problem in many regions (WHO 2003). Poor oral health can add significantly to the disadvantages a child faces, in terms of both personal health and life chances. Untreated caries is painful and may affect diet, school attendance, and sleep. Unresolved oral health problems can affect a child's speech and language, as well as appearance, self-image, and even social functioning. Long-standing untreated caries is often associated with gum disease.

In many populations, a disadvantaged minority of children suffer a much higher burden of caries than their more affluent peers and also are less likely to have received treatment. In the United States, for

The first draft of this case was prepared by Phyllida Brown.

example, almost 37 percent of children aged 2 to 9 years living below the poverty level have at least one untreated carious tooth, compared with 17.3 percent of nonpoor children in this age group. A similar pattern is evident in other countries (WHO 2003).

Prevention of Dental Caries with Fluoride

Dental treatment is expensive, and the costs of treating caries mount with the progression of the disease. In many developing countries, treatment is not available because of a shortage of dentists (WHO 2003).

Since the mid-20th century, researchers have discovered that much dental caries can be prevented. In countries and areas where fluoridated water, toothpaste, or salt has been made available, the prevalence of caries has fallen sharply, despite the fact that people continue to consume large amounts of sugar.

In 1945, the town of Grand Rapids, Michigan, became the first to deliberately add fluoride to its water. The levels of caries in the town's children were then compared over a period of years with those of children in a "control" town, Muskegon, where water was not fluoridated. In Grand Rapids, dental caries declined significantly. Several other studies in other cities followed, each showing similar results. In a review of 95 studies conducted between 1945 and 1978, Murray et al. (1991) reported that water fluoridation reduced caries by around 40 to 50 percent in primary teeth and 50 to 60 percent in permanent teeth (US Department of Health and Human Services 2000).

Since that time, parts of the developing world in which dental caries poses a serious problem for both children and adults have sought to adapt the approach of fluoridation to local circumstances.

Jamaica's Intervention Takes Shape

In the early 1980s, Dr. Rosalie Warpeha, a dentist with the Jamaican Ministry of Health, surveyed Jamaican children's teeth and found that severe caries was widespread. By age 12, fewer than 3 in every 100 children were free of caries, and on average children had 6.7 decayed, missing, or filled teeth (Warpeha 1985). Dr. Warpeha sought ways to introduce fluoridation to reduce the prevalence of this problem, and identified salt, rather than water, as the vehicle. Regulated water distribution systems are largely unavailable outside the capital, Kingston, and many people use rainwater (Estupiñan-Day 2004).

Jamaica's circumstances were highly favorable for introducing fluoridated salt, says Dr. Saskia Estupiñan-Day, regional adviser on oral health for the Pan American Health Organization (PAHO). The island's water supply naturally contains very low levels of fluoride islandwide, meaning that fluoridated salt could be used everywhere rather than in patches across the island. Equally important, the island has only one salt producer, Alkali Limited, so the intervention could be achieved fairly simply.

In 1984, Dr. Warpeha visited Alkali Limited. Trevor Milner, a chemical engineer there, was interested in what she had to say. "She sold us the idea of salt fluoridation," he says. Dr. Warpeha also told Milner and his colleagues the results of Colombian community trials (see box 16.1). She knew that Alkali Limited already iodized its salt. "Why not add fluoride too?" she asked. "We said, yes, this looks like something we could do," says Milner.

There were questions to answer first, however, says Milner. Which fluoride chemical should be used? At what levels? Would the fluoride interact with other compounds in the salt? For answers, Milner and other chemical engineers from salt manufacturers in Latin America and the Caribbean travelled to Switzerland, with support from PAHO, to learn about salt fluoridation. After this visit, Alkali Limited installed the necessary equipment at a cost of about $3,000, which the company recovered with a slight increase in the price of salt. In 1985 and 1986 the Ministry of Health and the Jamaican Parliament completed the necessary legal and regulatory framework for salt fluoridation. A major advertising campaign informed Jamaicans of the fluoridation program, and in 1987, fluoridated salt went on sale. The salt contained 250 mg per kilogram of potassium fluoride, a concentration used for domestic salt in Switzerland and France.

The Ministry of Health provided biological and chemical monitoring of the salt, while the company

Box 16.1 Water or salt?

Water fluoridation is effective only if the water supply system is regulated and the majority of inhabitants have access to the piped water system. In the 1960s and early 1970s, a community trial of salt fluoridation was conducted in Colombia, supported by the Pan American Health Organization and the US National Institutes of Health. Two communities receiving fluoridated salt—fluoridated at the rate of 200 mg of fluoride per kilogram—experienced reductions of nearly 50 percent in dental caries, compared with no reduction in a third community that served as a control and with a 60 percent reduction in a fourth community that received fluoridated water (Mejía 1986). Thus, while slightly less efficient than water fluoridation, salt fluoridation was shown to be highly beneficial.

performed its own quality control tests daily. The Jamaican Bureau of Standards monitored the fluoride concentration of the salt.

Major Improvements in Oral Health

In 1995, Drs. Warpeha and Estupiñan-Day and their colleagues again surveyed children's teeth. A dramatic improvement was evident. The index of the severity of caries had fallen by more than 80 percent in both 6-year-olds and 12-year-olds. (Estupiñan-Day et al. 2001). The risks appeared to be minimal: less than 1 percent of children examined showed any evidence of excess exposure to fluoride, and even in these cases the problem was mild.

These striking results delighted the researchers. "We were surprised and very happy," says Dr. Estupiñan-Day. "It was almost too good to be true." Independent scientists confirmed the findings and, in a separate line of evidence, the island's dentists reported that dental caries was rapidly diminishing.

Are There Other Explanations?

Because the introduction of fluoridated salt in Jamaica was a national-level community intervention, it is impossible to be certain that the fluoridated salt alone achieved the reduction in dental caries. Communities elsewhere in the world without access to fluoridated water or salt have also seen some modest reduction in dental caries in recent decades, usually attributed to the introduction of fluoride-containing toothpastes (US Department of Health and Human Services 2000). In Jamaica, fluoridated toothpaste had been available for 12 years before the 1984 survey and may have already reduced caries levels somewhat by that date. However, in the absence of data on the proportion of children using fluoride toothpastes in 1984 or 1995, it is impossible to judge what part these toothpastes may have played in improving children's teeth during the decade. During the 1980s and early 1990s children in Jamaica rarely had access to dental health education in school, and school dental services are very limited. Dr. Estupiñan-Day and her colleagues concluded that although a combination of factors may have been responsible for the improvement in children's teeth, salt fluoridation is "the likeliest factor." Since 1995, the program has continued and success has been maintained, in part through the passage of legislation to protect the fluoridation program; fluoridated salt is also being exported to neighboring countries now.

Cost-Effectiveness of Salt Fluoridation

The cost of the chemicals is low, at about 1 cent per person per year; taking account of the entire cost of the fluoridation program, including equipment, running costs, and monitoring, salt fluoridation in Jamaica costs around 6 cents per person annually. This is an even lower cost than water fluoridation, which may cost up to 90 cents per person per year depending on the size of the community (US Department of Health and Human Services 2000).

In treatment costs alone, the return on investment in salt fluoridation is substantial, leaving aside any less easily measured benefits such as reduced absence from school. It is estimated that for each

$1 spent on salt fluoridation in Latin America and the Caribbean, about $250 will be saved in reducing the need for future dental treatment (Estupiñan-Day et al. 2001). "This makes fluoridation of salt one of the most cost-effective interventions known to modern public health," says Dr. Estupiñan-Day.

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