CHAPTER

10

EFFECTIVE COMMUNITY PREVENTION PROGRAMS FOR ORAL DISEASES

Myron Allukian, Jr. • Alice M. Horowitz

An ounce of prevention is worth a pound of dental cure.
—Olde Dental Public Health Proverb

Oral diseases have been referred to as "the neglected epidemic" because they affect almost the total population, with many people having new diseases each year.[1] For example, at age 6 years only 5.6% of U.S. schoolchildren have had tooth decay in their permanent teeth. However, by age 17 years, 84% have had the disease with an average of eight affected tooth surfaces (for more information about the epidemiology of dental caries, see Chapters 2 and 8).[2] For vulnerable populations, such as those with low incomes, minorities, the developmentally disabled, and persons with acquired immunodeficiency syndrome (AIDS), the extent of oral disease is even greater. The national goal for oral health as stated in *Healthy People 2010* is to "prevent and control oral and craniofacial diseases, conditions, and injuries and improve access to related services."[3] The oral health objectives shown in Box 10-1 are intended to prevent, decrease, or eliminate oral health disparities in the U.S. population. Yet our country has not made oral health a priority.[4] Further, the United States does not have a national oral disease prevention program, despite an estimated $65 billion annual dental bill.[5] Compounding the problem, a 1996 study of children eligible for Medicaid reported that only one out of five, or 20%, received dental treatment, and a 2000 study showed that most dentists do not participate in Medicaid.[6,7] Despite the progress made in the prevention of oral diseases in the last several decades as a result of community water fluoridation, use of other fluorides, and greater emphasis on prevention in general, much more remains to be done.

PREVENTION

Prevention of premature death, disease, disability, and suffering should be a primary goal of any society that hopes to provide a decent future and a better quality of life for its people. *Primary prevention*, or preventing

From: Allukian, Jr, M. and Horowitz, A.M., Effective Community Prevention Programs for Oral Diseases, Chapter 10 in Jong's Community Dental Health, fifth ed., Gluck, G., And Morganstein, W., ed., Mosby Press, St. Louis, p. 237-276, 2002

BOX 10-1

Healthy People 2010 Oral Health Objectives

21-1 Reduce the proportion of children and adolescents who have dental caries experience in their primary or permanent teeth
21-2 Reduce the proportion of children, adolescents, and adults with untreated dental decay
21-3 Increase the proportion of adults who have never had a permanent tooth extracted because of dental caries or periodontal disease
21-4 Reduce the proportion of older adults who have had all their natural teeth extracted
21-5 Reduce periodontal disease
21-6 Increase the proportion of oral and pharyngeal cancers detected at the earliest stage
21-7 Increase the proportion of adults who, in the past 12 months, report having had an examination to detect oral and pharyngeal cancers
21-8 Increase the proportion of children who have received dental sealants on their molar teeth
21-9 Increase the proportion of the U.S. population served by community water systems with optimally fluoridated water
21-10 Increase the proportion of children and adults who use the oral health care system each year
21-11 Increase the proportion of long-term care residents who use the oral health care system each year
21-12 Increase the proportion of low-income children and adolescents who received any preventive dental service during the past year
21-13 (Developmental) Increase the proportion of school-based health centers with an oral health component
21-14 Increase the proportion of local health departments and community-based health centers, including community, migrant, and homeless health centers, that have an oral health component
21-15 Increase the number of states and District of Columbia that have a system for recording and referring infants and children with cleft lips, cleft palates, and other craniofacial anomalies to craniofacial anomaly rehabilitation teams
21-16 Increase the number of states and District of Columbia that have an oral and craniofacial health surveillance system
21-17 (Developmental) Increase the number of the tribal, state (including the District of Columbia), and local health agencies that serve jurisdictions of 250,000 or more persons that have in place an effective public dental health program directed by a dental professional with public health training
1-8.1 In the health professions, allied and associated health profession fields, and the nursing field, increase the proportion of all degrees awarded to members of underrepresented racial and ethnic groups
3-6 Reduce the oropharyngeal cancer death rate
5-15 Increase the proportion of persons with diabetes who have at least an annual dental examination

Numbering in box indicates the chapter and objective number as listed in *Healthy People 2010*.
From the US Department of Health and Human Services: *Healthy People 2010: with understanding and improving health objectives for improving health*, ed 2, Chapters 1, 3, 5, and 21, Washington, DC, US Government Printing Office.

a disease before it occurs, is the most effective way to improve health and control costs. *Secondary prevention* is treating or controlling the disease after it occurs, such as placing an amalgam restoration. *Tertiary prevention* is limiting a disability from a disease or rehabilitating an individual with a disability, such as providing dentures for those who have lost all their teeth.

Prevention may be accomplished at the

Table 10-1. Three Levels of Caries Prevention by Individual and Community Approaches

	Levels of Prevention				
	Primary		*Secondary*	*Tertiary*	
Preventive Services Provided by the	*Health Promotion*	*Specific Protection*	*Early Diagnosis and Prompt Treatment*	*Disability Limitation*	*Rehabilitation*
Individual Approach					
Individual patient (self-administered)	Diet planning; demand for preventive services; periodic dental visits	Appropriate use of fluoride: • Fluoridated water • Fluoride prescriptions • Fluoride dentrifice • Oral hygiene	Self-examination and referral; use of dental services	Use of dental services	Use of dental services
Dental professional	Patient education; plaque control program; diet counseling; recall reinforcement; dental caries activity tests	Topical fluoride; fluoride supplement/rinse prescription; pit and fissure sealants	Complete examination; prompt treatment of incipient lesions; preventive resin restorations; simple restorative dentistry; pulp capping	Complex restorative dentistry; pulpotomy; root canal therapy; extractions	Removable and fixed prosthodontics; minor tooth movement; implants
Community Approach					
Community	Dental health education programs; promotion of research, policy, and legislation	Community or school water fluoridation; school fluoride mouth rinse or tablet program; school sealant program	Periodic screening and referral; provision of dental services	Provision of dental services	Provision of dental services

Modified from Dunning JM: *Principals of dental public health*, ed 4, Cambridge, MA, 1986, Harvard University Press; Mandel I: What is preventive dentistry? *J Prev Dent* 25, 1974; Leske GS, Ripa LW, Callanen VA: Prevention of dental diseases. In Jong AW, editor: *Community dental health*, St. Louis, 1993, Mosby.

individual or community level. On the individual level a procedure is either provided by a professional on a one-on-one basis, for example, a dental hygienist providing dental sealants for a child patient, or it is self-administered, that is, the patients perform the procedure themselves, such as toothbrushing. An individual procedure also may be a combination of actions of an individual patient and a dental professional, such as the prescription by a dentist of a systemic fluoride that is taken daily by a patient. Table 10-1 shows the three levels of prevention for dental caries at the individual and community level or approach.

This chapter focuses on primary preventive measures that are science based and that have been shown to be effective in preventing oral diseases with a community- or population-based approach. There are many ways to prevent oral diseases with the individual approach. The community approach, however, helps ensure a greater impact at a lower cost for a larger number of individuals, especially vulnerable populations, such as low-income and minority groups. Self-responsibility by individuals for prevention also is important and is discussed as an adjunct to effective community prevention programs.

DEFINITIONS

To put "effective community prevention programs" in perspective with how prevention is often considered, the following definitions are used for this chapter:[8]

Effective—1. having an effect: producing a result; 2. producing a definite or desired result (efficient); 3. in effect: operative, active; 4. actual, not merely potential or theoretical

Community—1. all the people living in a particular district, city, etc.; 2. a group of people living together as a smaller social unit within a larger one, and having interests, work, etc., in common

Prevention—1. the act of preventing . . . prevent; 2. to keep from happening: make impossible by prior action; hinder

Program—1. orig. (a) a proclamation, (b) a prospectus or syllabus. . . . 2. a plan or procedure for dealing with some matter.

In essence, an "effective community prevention program" is a planned procedure that prevents the onset of a disease among a group of individuals. Stated another way, *effective community prevention programs are those that work for groups of individuals.* A group may be as small as a school classroom or as large as a nation. Although many different oral diseases and conditions exist, this chapter focuses on methods of preventing dental caries, gingivitis, unintentional oral-facial injuries, and oral and pharyngeal cancers.

DENTAL CARIES

Dental caries, or tooth decay, is both a universal and a lifelong disease. This disease is universal in the sense that the prevalence or percent of the population affected increases with age, ultimately affecting almost the entire population. All of us are at risk for caries as long as we have our natural teeth. Thus it is lifelong and may occur as early as the first year of life as early childhood caries (ECC) (sometimes referred to as nursing or baby-bottle tooth decay; see Chapter 7), continue throughout childhood and young adulthood, and continue in adults as root surface caries. During adolescence and into adulthood, the incidence of

dental caries continues depending on the level of community, personal, and professional protection; genetic influences; and dietary habits. Approximately 99% of adults have had tooth decay by age 40 to 44 years, with an average of 30 affected tooth surfaces.[9] For adults over age 75, nearly 60% had root surface caries with 3.1 affected tooth surfaces.[10] Recurrent decay can occur at any time throughout the life cycle. Thus it is important to prevent the onset of the disease because once a tooth has been restored the restoration must be replaced over time, and each restoration becomes larger and larger. Ultimately, costly crowns, root canals, or extractions may be needed.

Prevention of Dental Caries

Because dental caries is nearly ubiquitous, treating this disease is costly in terms of health, time, and money. On the basis of what we now know, dental caries can be controlled or nearly eliminated when science-based, preventive measures are applied appropriately. Because caries can continue throughout life, preventive measures must be a part of everyone's lifestyle. Many different approaches to preventing caries exist. The most cost-effective method is use of a community- or population-based approach.

FLUORIDES

The use of fluorides has made a significant impact on preventing dental caries in the United States. Fluoride is a naturally occurring compound of the element fluorine, which is never found in its free state in nature. It is the thirteenth most abundant element in the earth's crust and is found at different concentrations in all water supplies and most foods. Everyone's diet contains some fluoride, but not necessarily enough to prevent dental caries. The caries-preventive benefit of fluoride was first discovered by Dr. Frederick McKay, who was trying to determine the cause of "Colorado brown stain" (fluorosis, sometimes referred to as mottled enamel) in the 1920s. Dr. H. Trendly Dean subsequently demonstrated the relation between dental fluorosis, the concentration of fluoride in the water, and caries prevention with his classic epidemiologic studies in the 1930s. The first controlled study of adjusted fluoride level in a public water supply began on January 25, 1945, in Grand Rapids, Michigan.

Fluoride is now used in many different ways to prevent dental caries. Table 10-2 shows individual and community preventive measures that have been shown to be effective, the primary mode of application, and the target population. Initially it was believed that the primary anticaries benefit from fluoride was systemic, when the fluoride ion was ingested and became part of the developing tooth, before the tooth erupted in the mouth. The exact mechanisms of action of fluorides are not yet known. There are both preeruptive and posteruptive benefits from fluoride. A recent study from Australia reconfirms the preeruptive benefits from community water fluoridation.[11] Major benefits also are a result of posteruptive fluoride levels in plaque, saliva, and gingival exudate that continuously bathe the teeth and increase the remineralization of demineralized enamel caused by acids produced by cariogenic bacteria.

COMMUNITY WATER FLUORIDATION

Community water fluoridation was first implemented in the United States in 1945. Since then, millions of Americans have enjoyed the health and economic benefits of this prevention measure. According to *Healthy People 2010*, community water fluo-

ridation "is an ideal public health method because it is effective, eminently safe, inexpensive, requires no cooperative effort or direct action, and does not depend on access or availability of professional services. It is equitable because the entire population benefits regardless of financial resources."[3]

Further, the Centers for Disease Control and Prevention (CDC) has recognized community water fluoridation as "one of the great public health achievements of the 20th century."[12] Community water fluoridation should be the foundation of oral disease prevention or treatment programs in communities with a central water supply. *Community water fluoridation* is defined as the adjustment of the concentration of fluoride of a community water supply for optimal oral health. Fluoridation is often referred to as nature's way to help prevent tooth decay. The recommended level of fluoride for a community water supply in the United States ranges from 0.7 to 1.2 parts per million (ppm) of fluoride, depending on the mean maximum daily air temperature over a 5-year period.[13] Thus in a warm climate the fluoride level would be lower, and in a cold climate it would be higher. In the United States most communities are fluoridated at approximately 1 ppm, which is equivalent to 1.0 mg of fluoride per liter of water. To put this concentration in perspective, consider that one part per million is equivalent to 1 inch in 16 miles, 1 minute in 2 years, or 1 cent in $10,000. At this level fluoridated water is odorless, colorless, and tasteless.

Natural Fluoridation. All water contains at least trace amounts of fluoride. In the United States in 1992 approximately 10 million people lived in 1924 communities with 3784 water systems that are fluoridated naturally at 0.7 ppm or higher.[14] The eight states with the most people served with natural fluoridation—6.6 million in 662

Table 10-2. Effective Community and Individual Preventive Measures for Dental Caries Prevention

Measure	*Method of Application*	*Target*	*Period of Use*
Community Programs			
Community water fluoridation	Systemic	Entire population	Lifetime
School water fluoridation	Systemic	Schoolchildren	School years
School fluoride tablet program	Systemic	Schoolchildren	Age 5-16 yr
School fluoride rinse program	Topical	Schoolchildren	Age 5-16 yr
School sealant program (professionally applied)	Topical	Schoolchildren	Age 6-8 and 12-14 yr
Individual Approach			
Prescribed fluoride tablets or drops	Systemic	Children	Age 6 mo-6 yr
Professionally applied fluoride treatment	Topical	Individual need	High-risk populations
Over-the-counter treatments	Topical	Individual need	High-risk populations
Fluoride toothpaste	Topical	Entire population	Lifetime
Professionally applied dental sealants	Topical	Children	Age 6-8 and 12-14 yr

communities—are shown in Table 10-3. Texas has the highest, with almost 3 million people in 284 communities.

In Alaska, Rhode Island, Maine, Tennessee, Pennsylvania, Vermont, and the District of Columbia, no one is served with a naturally fluoridated water supply at the recommended level (0.7 to 1.2 ppm). The next three lowest states are Massachusetts, Hawaii, and West Virginia with 659 communities. The five states with the highest proportion of their populations having access to naturally fluoridated water are Idaho (28.5%), Texas (16.7%), Colorado (23.4%), Montana (11.6%), and New Mexico (18.2%). In 2000, an estimated 11 million people lived in communities naturally fluoridated at the recommended level.

Table 10-3. Eight Highest-Ranking States by Number of Persons and Communities Served with Natural Water Fluoridation, 1992

State	*Number of Persons*	*Number of Communities*
Texas	2,955,995	284
Florida	929,105	35
Colorado	811,024	106
Illinois	442,714	127
California	414,798	29
South Carolina	386,940	2
Louisiana	359,906	31
Arizona	345,266	48
TOTAL	6,645,748	662

Adjusted Fluoridation. In 1992, 134.6 million Americans had access to adjusted community water fluoridation in 8572 communities with 10,567 water systems compared with approximately 151 million Americans in 2000.[14,15] Fig. 10-1 shows the national fluoridation rank of states with the percentage of the population served by adjusted and natural community water fluoridation in 2000. Adjusted fluoridation is accomplished "by adding fluoride chemicals to fluoride deficient water: by blending two or more sources of water naturally containing fluoride, or partial de-fluoridating, that is removing naturally occurring excessive fluoride to obtain the recommended level."[14] There is no difference between adjusted or natural fluoridation in safety or preventive benefits. A fluoride ion is a fluoride ion, whether it occurs naturally in the water supply or whether it is placed or added by a water engineer. The three major fluoride compounds used for fluoridation in 1992 with the population served and number of water systems are given in Table 10-4. The type of compound used depends on the size and type of water facility and the preference of the water supply engineer.[16]

Table 10-4. Population and Number of Public Water Supply Systems Served by Major Fluoride Compounds, 1992

	Population	*%*	*Number of Water Systems*
Hydrofluosilic acid (fluosilic acid)	80,019,175	62.2	5876
Sodium silicofluoride (sodium fluorosilicate)	35,084,896	28.2	1635
Sodium fluoride	11,701,979	9.1	2491
TOTAL	127,806,050		

NOTE: Fluoride compound used was not indicated for all systems, so these data do not reflect national total.

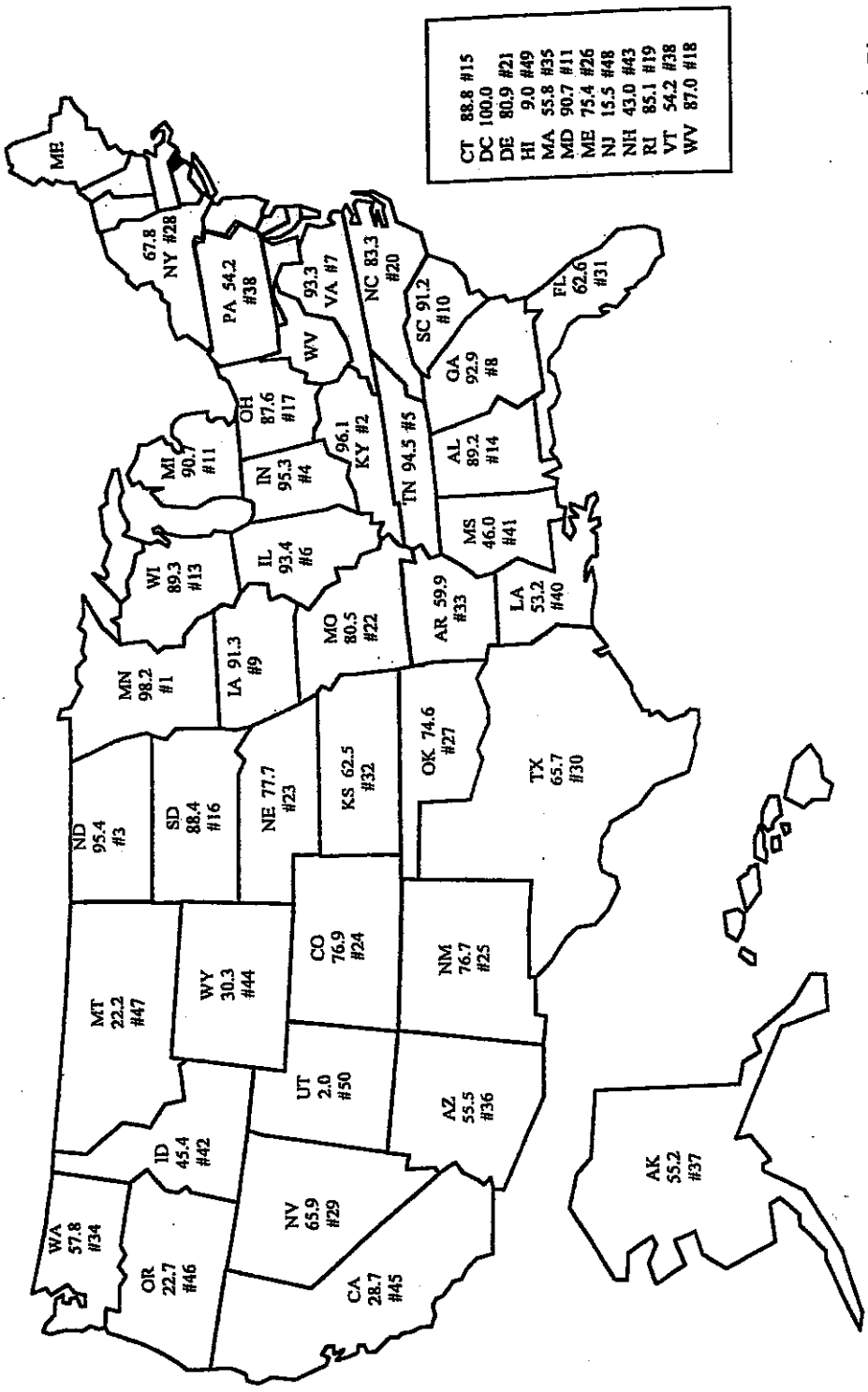

Fig. 10-1. Percentage of state populations on public water systems using fluoridated water and state rank, 2000. (From Centers for Disease Control and Prevention, http://www.cdc.gov/nccdphp/oh)

The United States has more people served by fluoridation than any other country in the world. Consider the following data. In 2000, 162 million Americans, or 65.8% of the 246.1 million on public water supplies, had fluoridation compared with 144.2 million Americans, or 62.1% of the 232 million on public water supplies in 1992.[14,15] This is approximately 57.5% of the total U.S. population. More than 119 million Americans did not have access to fluoridation, of whom approximately 35 million were not served by a public water system. Federal government policy requires fluoridation of water supplies on military installations. In 1992, a total of 133 military installations had adjusted fluoridation, serving 1.36 million residents with another 78,528 served by natural fluoridation.[14]

Of the 50 largest cities in the United States, all but eight have a fluoridated water supply. These eight cities, which have a combined population of approximately 5.4 million people, are San Diego, San Jose, and Fresno, California; Portland, Oregon; San Antonio, Texas; Tucson, Arizona; Honolulu, Hawaii; and Wichita, Kansas. Three of these cities are in California, which passed a statewide fluoridation law in October 1995 requiring fluoridation of all public water systems with at least 10,000 service corrections, depending on available funding. San Diego and San Antonio, respectively, ordered and voted for fluoridation in 2000, but have not yet implemented it. Fresno is partially fluoridated. Tucson, which is partially fluoridated naturally, voted for fluoridation in 1992, but it has yet to be implemented.[17]

Safety. The safety of fluoridation has been well documented by numerous studies over the years.[18-22] Soon after fluoridation became known as a public health measure, beginning in the 1950s, a variety of diseases and conditions, including premature death, have been alleged to be caused by fluoridation. All have been shown to be false. The following is a partial list of some of the more common conditions *falsely* attributed to fluoridation: AIDS, allergies, Alzheimer's disease, bone disease, cancer, chromosomal damage, pregnancy, gastrointestinal damage, heart disease, infertility, kidney disease, Down syndrome, and sterility.

Those opposed to fluoridation for a variety of reasons have had a tendency to use any argument possible to capture the public interest to oppose fluoridation. The arguments range from "being a communist plot" to "causes rusty pipes" in the 1950s and 1960s to cancer, AIDS, and Alzheimer's disease in the 1970s, 1980s, and 1990s, respectively. A misuse of facts and quoting from studies lacking scientific rigor are often used to support these allegations.[23-25] The safety of fluoridation has been time-consuming and costly to document because of the range of allegations made by the opponents, or "antifluoridationists," over the years. As a result, fluoridation is one of the most well researched public health measures. Concomitantly, the safety of this preventive measure has been relatively easy to document because millions of Americans have for generations lived in communities with naturally fluoridated water. In addition, many communities in the United States and other countries have a fluoride level that is naturally much higher than the recommended level, so that it is much easier to do studies to disprove these false allegations. The safety and effectiveness of water fluoridation as a public health measure is well established for the scientific and health communities; thus most national organizations representing these disciplines, such as the American Medical Association, the American Public Health Association, the American

Association of Public Health Dentistry, and the American Dental Association, have endorsed or supported fluoridation (Box 10-2).

Effectiveness. The effectiveness of fluoridation in preventing dental caries has been well documented.[26] Early controlled studies of adjusted fluoridation demonstrated that 50% to 70% of caries in the permanent teeth of children was prevented.[27-30] Since 1980, because of the widespread use of fluorides in the United States, the measurable effectiveness of water fluoridation is now approximately 20% to 40%.[26] This phenomenon is due, in part, to the fact that many other fluoride-containing products are now available, such as dietary fluoride supplements, rinses, toothpaste, professionally applied treatments, and dilution and diffusion effects, which are described here.

A comprehensive review of fluoridation states that fluoridation prevents caries in primary teeth by 30% to 60% for children 3 to 5 years of age, 20% to 40% for children with a mixed dentition (ages 6 to 12 years), and approximately 15% to 35% for adolescents and adults.[18,31] Fluoridation also helps prevent root caries in senior adults by 17% to 35%.[31] In countries or communities where there is no widespread use of fluorides, the effectiveness would be expected to be similar to that in early studies conducted in the United States. A recently reported study documented this phenomenon.[32]

Dilution and Diffusion Effects. Water fluoridation is as effective now as it was in the past. Because of the widespread use of fluorides in the United States in both fluoridated and nonfluoridated communities, however, the measurable benefits of fluoridation are lower in the United States. This phenomenon is called the *dilution* effect. Communities without fluoridation also benefit from foods and drinks processed in communities with fluoridation and sold or used in communities without fluoridation. This factor is called the *diffusion* effect and it also affects the measurable benefits of water fluoridation.[26] A recent study showed that in nonfluoridated communities that had a high diffusion effect from fluoridated communities, there is less dental caries.[33] Diffusion effects also can occur when individuals who live in communities without fluoridation work or go to school in a community that has optimal fluoridation. In contrast, the effects of the increased use of bottled water and filters for tap water are not known.

Cost. Of all the measures used to prevent dental caries in the United States, water fluoridation is the most economical and cost-effective. In 1989 the weighted average cost of fluoridation was estimated to be $0.51 per capita per year for the United States, with a range of $0.12 to $5.41, depending on the size of the community and the complexity of the water system.[34] In 1999 dollars, this would translate to an average per capita cost of $0.72 per year with a range of $0.17 to $7.62.[35] For larger communities the cost of fluoridation is usually less and for smaller communities it is more, as shown here in 1999 dollars:

Annual Cost per Capita	Community Population
$0.84–$7.62	Less than 10,000
$0.25–$1.05	10,000 to 200,000
$0.17–$0.29	Greater than 200,000

Weighted average: $0.72

For approximately 85% of the population in fluoridated communities, the average annual cost per capita was $0.12 to $0.75 in 1989 dollars[36] or $0.17 to $1.05 in 1999 dollars. A recent study showed that Medicaid-eligible children who lived in

BOX 10-2

National and International Organizations That Recognize the Public Health Benefits of Community Water Fluoridation

Academy of Dentistry International
Academy of General Dentistry
Academy of Sports Dentistry
Alzheimer's Association
American Academy of Allergy, Asthma and Immunology
American Academy of Family Physicians
American Academy of Oral and Maxillofacial Pathology
American Academy of Pediatrics
American Academy of Pediatric Dentistry
American Academy of Periodontology
American Association for the Advancement of Science
American Association for Dental Research
American Association of Community Dental Programs
American Association of Dental Schools
American Association of Endodontists
American Association of Oral and Maxillofacial Surgeons
American Association of Orthodontists
American Association of Public Health Dentistry
American Cancer Society
American College of Dentists
American College of Physicians—American Society of Internal Medicine
American College of Prosthodontists
American Council on Science and Health
American Dental Assistants Association
American Dental Association
American Dental Hygienists' Association
American Dietetic Association
American Federation of Labor and Congress of Industrial Organizations
American Hospital Association
American Medical Association
American Nurses' Association
American Osteopathic Association
American Pharmaceutical Association
American Public Health Association
American School Health Association
American Society of Clinical Nutrition
American Society for Dentistry for Children
American Society for Nutritional Sciences
American Student Dental Association
American Veterinary Medical Association
American Water Works Association
Association for Academic Health Centers
Association of Maternal and Child Health Programs
Association of State and Territorial Dental Directors
Association of State and Territorial Health Officials
British Dental Association
British Fluoridation Society
British Medical Association
Canadian Dental Association
Canadian Dental Hygienists Association
Canadian Medical Association
Canadian Nurses' Association
Canadian Paediatric Society
Canadian Public Health Association
Chocolate Manufacturers Association
Consumer Federation of America
Delta Dental Plans Association
Dental Health Foundation (of California)
European Organization for Caries Research
FDI World Dental Federation
Federation of Special Care Organizations in Dentistry
Academy of Dentistry for Persons with Disabilities
American Association of Hospital Dentists
American Association for Geriatric Dentistry
Health Insurance Association of America
Hispanic Dental Association
International Association for Dental Research—International Association for Orthodontics
International College of Dentists
Institute of Medicine
National Academy of Sciences
National Alliance for Oral Health

Continued

BOX 10-2

National and International Organizations That Recognize the Public Health Benefits of Community Water Fluoridation—cont'd

National Association of County and City Health Officials
National Association of Dental Assistants
National Confectioners Association
National Council Against Health Fraud
National Dental Assistants Association
National Dental Association
National Dental Hygienists' Association
National Down Syndrome Congress
National Down Syndrome Society
National Foundation of Dentistry for the Handicapped
National Kidney Foundation
National PTA
National Research Council
Society of American Indian Dentists
U.S. Department of Defense
U.S. Department of Veterans Affairs
U.S. Public Health Service
Centers for Disease Control and Prevention (CDC)
Health Resources and Services Administration (HRSA)
Indian Health Service (IHS)
National Institute of Dental and Craniofacial Research (NIDCR)
World Federation of Orthodontists
World Health Organization (WHO)

fluoridated communities in Louisiana had approximately 50% lower dental bills than Medicaid-eligible children who lived in nonfluoridated communities.[37] For every dollar spent on water fluoridation there is an estimated $25 to $80 savings in treatment costs based on community size, costs, and different study methodologies.[38,39] This is an excellent cost-benefit ratio and is the highest for all the caries preventive measures used in the United States.

Practicality. Fluoridation is the most practical preventive measure in dentistry. No individual effort is needed. Everyone who lives in a community with fluoridation and consumes the water or uses it to prepare foods will receive some benefit, irrespective of age, sex, race, lifestyle, or level of education or income. Those individuals who are born in such a community and live there for their entire lives accrue maximum benefits because they receive both systemic and topical benefits for a lifetime.

The concentration of fluoride in a water supply must be monitored on a routine and systematic basis. Thus it is important for water operators to have the appropriate training in fluoridation and to maintain and monitor the concentration of fluoride as recommended.[13,40]

Antifluoridationists. Individuals who are opposed to community water fluoridation are termed *antifluoridationists.* Reasons used for opposing fluoridation include safety, individual rights, government mistrust, home rule, and religious freedom. None of the arguments against fluoridation has any merit based on scientific knowledge and public health experience. Further, none of the arguments has any merit on the basis of state or federal laws. The U.S. Supreme Court has denied a review of fluoridation cases 13 times between 1954 and 1984.[41] The primary reasons antifluoridationists have had some limited success are mainly due to an uninformed public, weak or uninformed decision makers, and a weak or poorly organized program to promote and imple-

ment fluoridation. A number of significant fluoridation battles have occurred over the years; however, with more than 55 years of health and economic benefits for millions of Americans, the arguments against fluoridation become weaker and weaker. This reality does not mean antifluoridationists have given up or ever will.

Antifluoridationists attempt to appeal to the emotions of the public and elected officials and promote fluoridation as a political issue rather than a public health program. Most communities in the United States make their decisions to fluoridate administratively on the basis of public health expertise. From 1989 to 1994, 337 communities in the United States decided to fluoridate the water supply, and 318, or 94%, were decided by administrative decisions from a city council or commission.[42] Of the 32 referenda or public votes that occurred during that time, 19 (61%) supported fluoridation. In fall 2000 there were 23 fluoridation referenda in different communities throughout the United States. Of these, there were 9 (39%) wins for fluoridation and 14 (61%) losses. However, the 9 winning communities had a population of approximately 3.9 million people compared with approximately 366,347 for the losing communities, more than a tenfold difference.[43] When the public is forced to vote on a complex public health program such as fluoridation, the antifluoridationists usually use deceptive, misleading, and incorrect information to confuse the public so that they vote for the status quo, to their own detriment. Compounding this problem is the fact that we have failed to educate the American population about how fluorides work and who benefits from their use. Numerous studies have shown that, in general, the U.S. public is not knowledgeable about fluorides and does not know that the use of fluoride is the best approach to caries prevention.[44,45] Fluoridation battles still occur in some communities; however, if the political and professional will is present and the public and decision makers are well informed, the implementation of fluoridation will be successful.[46-51] For example, in 2000 three major U.S. communities—Clark County (Las Vegas), Nevada; Salt Lake County (Salt Lake City), Utah; and San Antonio, Texas—had public votes in support of fluoridation, after extensive educational efforts in these communities.

Community Support. The key to achieving fluoridation in most communities is through organized community support, which is the essence of dental public health, defined by the American Board of Dental Public Health as "the science and art of preventing and controlling dental diseases and promoting dental health through organized community efforts."[52] Just as community water fluoridation should be the foundation of any caries prevention program, educating the public is the key to achieving and maintaining community water fluoridation or any other public health measure. Box 10-3 includes basic concepts about fluorides that everyone should know and understand.

A planned educational program for community leaders, organizations, agencies, and institutions is important, beginning with health and human services leadership and then including all other community groups. Once there is widespread community support for fluoridation or any other type of population-based program, it is much easier to implement, support, and sustain. As part of such an educational effort, dentists and physicians also should educate their patients, especially those who are community leaders, about the benefits of fluoridation for the community. It is beyond

BOX 10-3

What Everyone Should Know about Preventing Oral Diseases

DENTAL CARIES

FLUORIDE

- What fluoride and fluoridation are
- How fluorides work to protect teeth from decay
- Methods of application
- Safety, effectiveness, and cost of each procedure
- Who needs them
- Recommended frequency of use and duration

PIT AND FISSURE SEALANTS

- What dental sealants are
- How they work to protect teeth from decay
- Who needs them and when
- Monitoring and reapplication

ORAL CANCERS

- Risk factors for oral cancers
- Signs and symptoms of oral cancers
- What comprises a thorough oral cancer examination and recommended frequency
- Need for oral cancer examination
- Protective factors against oral cancers

GINGIVITIS

- What dental plaque is
- Role of dental plaque in oral diseases
- How to remove plaque
- Frequency of plaque removal
- Recommended types of toothbrushes and floss

the scope of this chapter to detail how to organize an educational campaign for fluoridation. Many states and large cities have dental directors who have had experience with implementing and monitoring fluoridation. Further, the dental literature has many articles on fluoridation campaigns that may be helpful.[46-51,53-59]

National Fluoride Plan. In 1996 a national fluoride plan to promote oral health in the United States was developed by the U.S. Public Health Service.[60] The purpose of this plan was to determine what must be done to reach the water fluoridation or fluoride-related objectives of *Healthy People 2000* and to respond to the recommendations of the U.S. Public Health Service report *Review of Fluoride: Benefits and Risks*.[18] The plan was organized into four areas: policy, research, surveillance, and education. A status report for each area was given with recommendations for future strategies of action, which should include the following:

1. Promote and support effective coalition building to ensure the appropriate use of fluorides and the community adoption of water fluoridation
2. Develop "on-site" field expertise and "steering committees" in states with large numbers of nonfluoridated communities
3. Encourage research in areas related to fluorides and water fluoridation
4. Provide a collateral strategy for the surveillance and quality of water fluoridation to ensure that community water systems consistently supply water with fluoride within recommended ranges, as outlined in the CDC Engineering and Administrative Recommendations for Water Fluoridation, 1995
5. Promote the effective, proper, and safe use of fluorides and community water fluoridation through education; training; publications; endorsements; and broadcast, print, electronic, and visual media coverage

The national fluoride plan addressed the need to provide fluoridation and fluoride to

the more than 100 million Americans who do not live in communities with a fluoridated water supply. In addition, the plan encouraged continued studies of fluorides, especially with regard to the increase in fluorosis. An ongoing national fluoridation plan with appropriate resources is key to improving the oral health of all Americans.

Dental Fluorosis. In recent years an increase in dental fluorosis has occurred in the United States in both fluoridated and nonfluoridated communities as a result of inappropriate uses of fluorides.[18,35] Dental fluorosis is the hypomineralization of enamel and the disruption of enamel development from excessive fluoride intake. It occurs in primary and permanent teeth, but in the United States it is less common in primary teeth. The severity of fluorosis depends on the amount of excess fluoride consumed over a period of time while teeth are developing, between ages 6 months and 6 years. One study suggests that the maxillary central incisors are at greatest risk for fluorosis from 15 to 24 months of age for males and from 21 to 30 months for females.[61] Once teeth have erupted, fluorosis cannot develop. Most dental fluorosis in the United States is considered a cosmetic problem, not a health problem. Very mild and mild fluorosis may occur in 10% to 15% of children reared in a community with fluoridated water.[18] In its mild form, usually only dental personnel will notice the bilateral white chalky appearance. In its more severe form, which occurs most often in communities in which the concentration of fluoride is naturally at much greater than the recommended level, there may be pitting and discoloration of teeth. Most of the increase in fluorosis in the United States is of a very mild or mild form.

The increase of fluorosis is caused by inappropriate prescribing and use of dietary fluoride supplements, ingesting fluoride toothpaste, prolonged use of infant formula made from powder and mixed with fluoridated water, and the fluoride concentration of the water supply. Authorities have estimated that only a twofold increased risk of fluorosis exists in an optimally fluoridated community today compared with an eighteenfold increase in the 1930s because of the increased risk in nonfluoridated communities.[62] A recent study showed that in nonfluoridated communities, 65% of the fluorosis was caused by fluoride supplementation under the pre-1994 protocol and 34% was the result of children under age 1 using more than a pea-size amount of fluoride toothpaste.[63] In fluoridated communities, 68% of the fluorosis resulted from more than a pea-size amount of fluoride toothpaste being used by children under age 1, 13% was caused by inappropriate fluoride supplements, and 9% resulted from the use of powdered concentrate infant formula.[63]

Teeth with dental fluorosis are less susceptible to dental caries. In 1994 the American Dental Association's Council on Scientific Affairs recommended a new dosage schedule that reduced the dosage for dietary fluoride supplements[64] (Table 10-5). Physicians and dentists can help prevent fluorosis by prescribing dietary fluoride supplements appropriately (according to the current dosage schedule) and only for children living in communities without fluoridation. Parents should be educated by their health providers on the appropriate use of infant formula and to use only a pea-size amount of fluoride toothpaste for children younger than 6 years old and to monitor their children closely to help prevent the ingestion of toothpaste.[35]

Comparison of Effective Community Prevention Programs. In the United States, five effective community prevention programs for dental caries are used (Table 10-6). Of the five

Table 10-5. Supplemental Fluoride Dosage Schedule, 1994*

Age of Child	Concentration of Fluoride in Drinking Water (ppm)			Preparation
	<0.3	0.3-0.6	>0.6	
6 mo-3 yr	0.25 mg	0	0	Drops
3-6 yr	0.50 mg	0.25 mg	0	Tablets
6-16 yr	1 mg	0.50 mg	0	Tablets

*Recommended by American Dental Association, American Academy of Pediatric Dentistry, and American Academy of Pediatrics.

NOTE: Amounts represent milligrams of fluoride per day.

Table 10-6. Comparison of Five Effective Community Prevention Programs for Dental Caries*

Program	Effectiveness (%)	Adult Benefits	Cost per Year	Practicality
Community fluoridation	20-40	Demonstrated	$0.51 per capita‡ $0.72 per capita†	Excellent; most practical; no individual effort necessary
School fluoridation	20-30§	Expected but not demonstrated	$0.85-$9.88 per child‡ $1.19-$13.83 per child†	Good; if there is no central community water supply, no individual effort necessary
School dietary fluoride	30	Expected but not demonstrated	$0.81-$5.40 per child‡,‖ $1.13-$7.56 per child†	Fair, continued school regimen Daily supplement program required for 8-10 yr
School fluoride mouth rinse program	25-28§	Not expected	$0.52-$1.78 per child‡,‖ $0.73-$2.49 per child†	Fair; continued daily or weekly school regimen required
School sealant program	51-67¶	Expected but not demonstrated	$13.07-$28.37 per child‡ $18.30-$39.72 per child†	Good; primarily done for children ages 6-8 yr and 12-14 yr

Data from Burt B: Proceedings of the workshop. Cost-Effectiveness of Caries Prevention in Dental Public Health, *J Public Health Dent* 1989:49(5, spec iss): Allukian M: Oral diseases: the neglected epidemic. In Scutchfield FD, Keck WC, editors: *Principles and practices of public health.* Albany, NY, 1996, Delmar.

*This table is a simplified comparison of these prevention programs. A thorough analysis of the literature should be done to understand the relative merits of these programs.

†In 1999 dollars.

‡In 1989 dollars.

§This range may now be high; no recent studies.

‖Includes use of volunteer personnel.

¶First molar chewing surfaces only over 5-year period.

programs, community water fluoridation is not only the most cost-effective and practical but also the only community preventive measure that has demonstrated benefits for adults. Although salt fluoridation has been used successfully in other countries, it has not yet been used in the United States; therefore it is not included in the list. Table 10-6 applies to the United States only because the fluoride dilution and diffusion effects decrease the measurable benefits of fluoride. In other countries where there are fewer communities with fluoridation and other fluoride products, the effectiveness would be comparable to the 50% to 70% reduction in caries found in the 1950s to 1970s in the United States. Table 10-6 shows the relative differences among these preventive measures. Studies are needed on effectiveness and cost because of the diffusion and dilution effects of fluoride. A thorough analysis of the literature also would be helpful to appreciate the differences in these prevention regimens.

School-Based Programs. When a community does not have a public or central water supply or does not yet have fluoridation for whatever reason, another approach is to use a caries-preventive regimen in schools. This approach is logical in that most children in the United States attend school regularly. Preventive regimens provided in schools can be one of three types: (1) a community type, such as school water fluoridation; (2) self-applied, which refers to any health activity that is performed by an individual student, such as fluoride mouth rinse conducted in a school setting; or (3) operator applied, which refers to any health activity that is performed by a health care provider for a student, such as the application of pit and fissure sealants in a school setting.

Increasingly, school-based health centers are being viewed as an effective approach to improve access to health, including oral health, and social support services for underserved populations.[65] The number of school-based health centers was estimated to be 1380 in 1999–2000; however, the number with a dental component may be low.[66] Interestingly, in 2001 the Robert Wood Johnson Foundation announced a new program, Caring for Kids: Expanding Dental and Mental Health Services, through expanded services organized by school-based health centers. They will fund up to six oral health projects.[67] (For more information about school-based educational programs, see Chapter 11.)

SCHOOL WATER FLUORIDATION

School water fluoridation was developed and tested in the United States in the 1960s for use in rural schools with an independent water supply, preferably those schools that included grades kindergarten through 12. Fluoridation of water supplies of individual schools is similar to community water fluoridation in that no direct action is required of beneficiaries other than direct consumption of or use of the water in food preparation. The major difference is that the recommended concentration for school water fluoridation is 4.5 times the concentration of fluoride recommended for community water supplies in the respective geographic area. The higher concentrations are recommended to compensate for part-time exposure because children spend only part of their time at school.[68]

Effectiveness. Studies conducted on school fluoridation have shown that a 20% to 30% reduction in caries can be expected when children have consumed school water fluoridation for 12 years.[68,69] Despite the higher fluoride concentration, no dental fluorosis

has been produced. A primary reason for this lack of fluorosis is because of the age of children when they start school, 5 or 6 years, when dental fluorosis is less likely to occur. There are disadvantages to school water fluoridation in that there is both delayed and part-time exposure. Further, it benefits only the children attending school and the adults who work there. Finally, unlike community water fluoridation, we do not know whether there are retained benefits after a child leaves a fluoridated school environment and goes to a community in which the water is not fluoridated. In the 1980s there were approximately 600 schools in the United States whose water was fluoridated. In 1992 there were 332 schools with 117,430 children in 12 states that had access to school water fluoridation.[14] The number has diminished for several reasons. Some rural schools with an independent water supply previously using school water fluoridation have been incorporated into major, central water systems that are now optimally fluoridated, thus eliminating the need for a school water fluoridation system. One state discontinued the school water fluoridation program because state officials determined that children were receiving ample fluoride from other sources.

Cost. In 1989 school water fluoridation was estimated to cost between $0.85 and $9.88 per child per school year.[34] In 1999 dollars, this would be $1.19 to $13.83 per child per school year.

Practicality. The practicality of school water fluoridation is good when a community does not have a central water supply. All the children benefit with no individual effort required on the part of the recipient. Monitoring the concentration of fluoride in the water must be conducted daily. The role and responsibility for monitoring must be worked out between the school and health and water departments. The individual responsible for monitoring the school fluoridation equipment must be well trained.

FLUORIDE TABLETS

Another method for administering systemic fluoride in school settings is the daily use of dietary fluoride supplements in the form of tablets. Table 10-5 shows the currently recommended fluoride dosage schedule, which should be adhered to whether the supplement is used at school or home. This procedure is most often identified as one to use at home when a health care provider prescribes a fluoride supplement with or without vitamins. Because the compliance required for this regimen—daily for 16 years—may be more than most parents can achieve, this procedure often is used in schools. The usual procedure is for an adult to distribute the tablets to each participating student and then under supervision the tablet is chewed for approximately 30 seconds. The resultant solution is then swished between the teeth for another 30 seconds and then swallowed.[69] Thus this procedure provides both systemic and topical benefits. A supervising adult maintains a record of when each child takes a tablet. Supervised, self-administered use of fluoride tablets is a well-established regimen that has been used in the United States and abroad for more than 40 years.

Effectiveness. Although it is not the most popular school-based fluoride regimen used in the United States, this method is well documented with research and has been shown to be effective. Studies conducted in this country have shown that the

daily use of fluoride tablets on school days will provide up to a 30% reduction in new carious lesions.[70]

Cost. The average cost of a school-based fluoride tablet program in 1989 was approximately $2.53 per child per school year with a range of $0.81 to 5.40, depending on whether paid personnel or volunteers are used to supervise the procedure.[34] In 1999 dollars, this would be $3.54 per child with a range of $1.13 to $7.56.

Practicality. The daily consumption of fluoride tablets in school settings is an excellent method to use in areas where the water is fluoride deficient. This procedure can be supervised by a classroom teacher or volunteer with minimal training. It takes only a few minutes of classroom time and it is highly accepted by students, faculty, and parents. A major drawback to this method is that it is a daily procedure. Therefore the practicality is fair. Only children with parental consent may participate. Table 10-7 compares the advantages of using either a school-based fluoride tablet or mouth rinse regimen.

FLUORIDE MOUTH RINSE

Fluoride mouth rinse has been used in schools in the United States for approximately three decades, and it is the most popular school-based fluoride regimen in the United States.[69] Fluoride rinsing is generally supervised in classrooms by teachers or adult volunteers. In some cases health or teacher aides are responsible for this activity. For children in grades 1 and above the procedure consists of distributing a paper napkin and a paper cup with 10 ml of solution to each participating student. In unison, the students empty the contents of the cup into the mouth and rinse the solution vigorously for 60 seconds. The supervising adult times the procedure; at the end of 60 seconds students are requested to empty the contents of the mouth into the cup and to place a tissue into the cup to absorb the liquid. The materials are then collected and disposed of properly.[69] The supervising adult also maintains a record for each child who rinses.

The rinse procedure for children in kindergarten is the same as that for older students except they are advised to use only 5 ml of the solution. The rationale for this

Table 10-7. Comparison of School-Based Fluoride Regimens

Fluoride Mouth Rinse	*Fluoride Tablets*
Safe and effective	Safe and effective
Inexpensive	Inexpensive
Easy to learn and do	Easy to learn and do
Nondental personnel can supervise	Nondental personnel can supervise
Well accepted by participants	Well accepted by participants
Little time required—5 minutes *weekly*	Little time required—3 minutes *daily*
Provides topical benefits	Provides systemic and topical benefits
	No waste materials
	Suitable for preschool children

Modified from Horowitz AM: Community-oriented preventive dentistry programs that work, *Health Values* 8(1):21, 1984.

recommendation is that younger children tend to swallow some of the solution, which may contribute to fluorosis if this practice continues over time among children 6 years old or younger. Practice sessions with plain water are recommended, especially for younger children.

Effectiveness. Numerous studies have demonstrated that dental caries can be reduced by approximately 25% to 28% by rinsing daily or weekly in school with dilute solutions of fluoride.[34] Because rinsing weekly with a 0.2% neutral sodium fluoride (NaF) solution requires fewer supplies and less time than daily rinsing with a 0.05% NaF solution, weekly school-based rinse programs are more common. Further, studies have shown that when used in school, there is little difference in caries protection between daily and weekly use.[71] This procedure is usually not used in schools in communities that have been fluoridated for three or more years. Table 10-8 shows appropriate fluoride programs for use in grades 1 through 12.

Cost. The cost of this procedure in 1989 ranged from $0.52 to $1.78 per child depending on whether paid or volunteer adult supervisors were used.[34] In 1999 dollars, it would cost $0.73 to $2.49.

In addition, the cost varies depending on whether a unit dose (individual, premixed serving) is used or whether packets of NaF are purchased and mixed with water and dispensed into cups. The premixed unit dose is more convenient and requires less time, but the materials cost more.

Practicality. The practicality of this measure is fair because it is performed once a week. It is somewhat more practical in terms of frequency than the use of fluoride tablets, but it is less practical in that the children should not swallow the rinse; thus close monitoring is required and the used products must be collected and disposed of properly.

DENTAL SEALANTS

The appropriate use of fluorides is the best approach to preventing caries. Fluoride, however, is believed to be least effective on the occlusal or chewing tooth surfaces. Most decay among school-age children now occurs on the chewing surfaces. Thus the use of fluorides and pit and fissure sealants is needed to provide nearly total caries prevention.[72] In the United States the

Table 10-8. Appropriate Self-Applied Fluoride Programs for Use in Grades 1 through 12

Fluoride in Water Supply (ppm)	Tablets (Daily)	Mouth Rinse (Weekly)	Grade	Recommended Procedure
<0.3	1 mg fluoride		1-8	Fluoride tablets
	1 mg fluoride	or 0.2% NaF	9-12	Fluoride tablets or fluoride mouth rinse
0.3-0.6	0.5 mg fluoride	or 0.2% NaF	1-8	Fluoride tablets or fluoride mouth rinse
>0.6	Dietary fluoride tablets should *not* be provided	0.2% NaF	1-12*	Fluoride mouth rinse*

*For high-risk children or youths in a fluoridated community.

application of dental sealants must be performed by a dentist, a dental hygienist, or a dental assistant, depending on individual state practice acts. The application procedure is relatively simple; however, it is operator dependent. Because sealant material is extremely susceptible to saliva contamination, the procedure must be done with great care.[72]

Oral health objectives in *Healthy People 2010* specify that 50% of children should have their permanent molars sealed by ages 8 and 14.[3] Unfortunately, the most recent data show that only approximately 23% of 8-year-olds and 15% of 14-year-olds have had this preventive procedure.[73] Unlike other countries, for example, Finland, where 85% of children have pit and fissure sealants on the permanent molars, practitioners in the United States have basically ignored this procedure. Concomitantly, the public (parents) have not been educated about the existence of and need for sealants; thus most do not have enough knowledge about them to request this preventive procedure for their children.[74]

Effectiveness. This procedure was first demonstrated to be effective in studies conducted approximately 30 years ago. Their effectiveness has been reported to be in the range of 51% to 67%.[34]

Cost. The 1989 estimated cost for dental sealants ranged from $13.07 to $28.37, depending on whether a dentist or dental auxiliary placed the sealant, whether they were paid or volunteer, and the type of equipment used.[34] In 1999 dollars, the cost would be from $18.30 to $39.72.

Practicality. Numerous states have school-based sealant programs, which, in itself, speaks for their practicality. Sealant programs focus on children 6 to 8 years old and 12 to 14 years old because the first and second permanent molars usually erupt during these years. These two molars are the teeth most often sealed in school-based programs. Some programs use mobile dental vans that are sent to schools, and children receive sealant application in the van. Other programs use portable equipment that is transported from school to school where it is set up in whatever space is available and students are brought to the designated room for the procedure. A few schools have dental clinics where they provide this service as well. The process is well accepted by students, parents, faculty, and staff and has been shown to reduce racial and economic disparities in sealant prevalence among school children.[75] As with all school-based caries-preventive measures, parental consent is required. Box 10-3 includes concepts about dental sealants, about which parents and children should be educated.

Community-Based Programs Used in Other Countries

For a variety of reasons, several different approaches to preventing dental caries are available and have supporting research but are used rarely or not at all in the United States. A few of these preventive approaches are salt fluoridation, fluoride varnishes, and atraumatic restorative treatment.

SALT FLUORIDATION

Salt fluoridation is the controlled addition of fluoride during the manufacturing of salt for use by humans. Sodium or potassium fluoride is usually used. Salt fluoridation is generally not recommended in countries that are using community water fluoridation. Adding fluoride to salt was first sug-

gested by Wespi, who recognized the value of adding iodine to salt to prevent goiter. Recognized as an expert on iodized salt, he urged health authorities in Switzerland to add fluoride to iodized salt. Zurich was the first canton to authorize the sale of fluoridated domestic salt in 1955. By 1966 fluoridated salt accounted for 65% of the domestic salt market in Switzerland. The generally recommended concentration is roughly the equivalent of 1 ppm; however, each country must determine its needs on the basis of the consumption of salt and the concentration of fluoride in the local water supply.[76] Many other countries also have adopted Switzerland's innovative approach; these countries include France, Germany, Costa Rica, Jamaica, and Uruguay. The Pan American Health Organization (PAHO) has a major initiative to promote salt fluoridation in eight countries in the Region of the Americas, Belize, Bolivia, Dominican Republic, Honduras, Nicaragua, Panama, Paraguay, and Venezuela.[77]

Effectiveness. Fluoridated salt has been demonstrated to be as effective as community water fluoridation, when all domestic salt is fluoridated.[78] Domestic salt refers to that salt sold in markets and salt sold in bulk to restaurants, bakeries, hospitals, schools, and other institutions and companies that process foods. In Jamaica a caries reduction study among 1120 children showed a 69% decrease in caries experience for 15-year-olds and an 87% decrease for 6-year-olds after 8 years of salt fluoridation. Fluorosis was negligible.[79]

Cost. Generally, salt fluoridation is as effective as community water fluoridation but costs less. Authorities estimate that in some Latin American countries the potential saving may be as high as $391 for dental expenditures, with an average of $172, for each dollar invested in the regimen. The cost-benefit ratio range for seven countries in the Americas was 1:18 to 1:391.[77] On average the cost is approximately $0.08 to $0.12 per kilogram of salt.[77]

Practicality. Salt fluoridation provides a choice to consumers that community water fluoridation does not, sometimes a major issue in initiating this procedure. There has been some opposition to salt fluoridation by individuals who are concerned about the need to reduce salt consumption; however, this concern is not justified for several reasons. Although excess salt consumption over a lifetime is linked to higher blood pressure, the use of salt does not increase when fluoride is added. Further, the amount of fluoride added to salt can be adjusted. Another concern that is often cited is the question about distribution of salt in a country, state, or canton where some water has natural concentrations of fluoride that range from 0.6 to 1.2 ppm and higher. This situation, of course, is true for most countries and can be accommodated by educating the salt manufacturers and the food distributors and the public at large. In countries where fluoridated salt is sold, containers are not only labeled but are also usually color coded, a procedure also used to distinguish iodized salt from plain salt. Further, salt manufacturers ship fluoridated salt only to communities with specified lower concentrations of fluoride in the water supply. This effort does not preclude the fact that an uninformed consumer could go to a market in another community and inadvertently purchase fluoridated salt. Overall, this approach to offering a preventive regimen has been given little notice in North America, where community water fluoridation is well established.

However, many rural locations, for example, Native American reservations in Canada and the United States and states such as Alaska, might benefit dramatically from the use of this preventive procedure.

FLUORIDE VARNISHES

Fluoride varnishes were developed in Europe more than 35 years ago and remain in wide use there. They are operator applied, and biannual application is the usual recommendation. In Finland varnishes are used in 92% of the community preventive programs for children.[80] Most of the clinical studies, with the exception of one Canadian trial, were conducted in Europe.[81] The original purpose for their development was to increase the uptake of fluoride by enamel, when it was thought that this factor would lead to greater caries protection. Fluoride varnishes do increase the fluoride concentration in saliva for a longer period of time than do other professionally applied fluoride products.[82] The U.S. Food and Drug Administration recently approved the marketing of DuraFlor (formerly Duraphat), which has been hailed by some as a giant step forward.[83]

Effectiveness. Numerous studies have shown that there is a wide range of efficacy, between 7% and 75%. Fluoride varnishes are as efficacious as other caries-preventive agents.[84] Studies have been conducted mostly on children, but there is no reason the product could not be studied and used on adults. This kind of fluoride may be especially useful to prevent root surface caries among the growing number of older adults who have gingival recession. In addition, fluoride varnishes may be especially attractive for use with disabled children and bed-bound patients who still have their own teeth. More recently, fluoride varnishes have been used in demonstration programs to help prevent infant or early childhood caries among children in some Women, Infants, and Children (WIC) and Head Start programs. North Carolina and Washington State allow physicians to apply fluoride varnishes to the teeth of young children to prevent early childhood caries. In 2001 the Nevada Medicaid program began reimbursing physicians, physician assistants, and nurse practitioners for applying fluoride varnish.

Practicality. The use of fluoride varnishes is as practical as any operator-applied fluoride treatments.

ATRAUMATIC RESTORATIVE TREATMENT

In recent years research has provided an increased understanding of the process of dental caries, how to prevent it, and better approaches to treating the disease. Keeping a tooth healthy and intact through appropriate use of fluorides and pit and fissure sealants helps to prevent costly repairs.[85] In many developing countries, and for some populations within highly industrialized countries, dental caries is a widespread problem and treatment often is available only for the affluent. When the caries process is left untreated, the only choice of treatment often is extraction of the tooth. A new method for treating caries is atraumatic restorative treatment (ART).[86,87] ART is a secondary preventive measure. This procedure offers treatment to disadvantaged populations and consists of caries removal with use of hand instruments only and then the application of adhesive restorative material. No electricity, water, drill, or expensive dental equipment is necessary. This procedure is used in at least 25 countries, including Zimbabwe, China, Thailand, and Cambodia. Further, the World Health Orga-

nization endorses its use. A growing body of research supports the use of this procedure, and additional studies are underway.[86,87]

Practicality. ART is extremely practical in that only hand instruments are used along with an adhesive dental material. Thus the equipment and materials are easy to pack, carry, or mail. This procedure may have applicability for bed-bound patients and others who are physically challenged. Although ART has yet to be used in the United States, the procedure could be beneficial for the disadvantaged, especially children, who have no way to finance dental treatment. ART is closely related to the application of pit and fissure sealant material in that similar dental material is used and both are minimal intervention methods. The major difference, of course, is that sealants are used to prevent caries, whereas ART is used to treat the disease.

Periodontal Disease Prevention

Periodontal diseases consist of a variety of inflammatory and degenerative conditions of the supporting structures of the teeth. The two most common types are gingivitis and periodontitis. There is ample evidence to demonstrate the relationship between the presence of bacterial plaque and gingivitis. These diseases are insidious and can affect children and adults, although more severe types are more likely to be found among adults. Gingivitis—inflammation of the soft tissue surrounding teeth—can be prevented or controlled by thoroughly removing dental plaque periodically.[88]

Although no studies clearly define the necessary frequency of thorough plaque removal to prevent gingivitis, it is generally recommended that plaque should be removed at least daily. Generally, thorough plaque removal is accomplished mechanically with a toothbrush and dental floss or tape.[88] Dental plaque also can be controlled with the use of antimicrobial products such as chlorhexidine.[89] In community-based programs, however, only mechanical plaque removal has been used. At one time, school-based plaque removal regimens were popular. These toothbrushing drills often did not include the use of a fluoride dentifrice, thus severely limiting their value. Today, toothbrushing in classrooms is not used as much as it was two decades ago. Instead, children often are shown in school how to remove plaque with a toothbrush and sometimes dental floss or tape. These procedures may or may not include actual use of the implements. In either case, a toothbrush and floss are sometimes sent home with instructions to use them on a routine basis. If toothbrushing is to take place in a school environment, a fluoride dentifrice should be used so that both dental caries and gingivitis prevention are addressed. Dental floss or tape should be used only after proper instructions, so that the gingival tissues are not injured. All students should be taught the concepts listed in Box 10-3 regarding the prevention of gingivitis.

EFFECTIVENESS

Studies conducted in the 1970s and early 1980s showed that regular, thorough plaque removal under supervision could reduce gingivitis among schoolchildren.[90] In one study, however, in which examinations were conducted at the beginning and at the end of each school year, it was observed that much of the gain achieved in reducing gingivitis over the school year disappeared or at least was reduced over the summer when plaque removal was not supervised.[90]

COST

An estimated cost for this procedure for use in schools is not known, but it is relatively expensive because of the expense of toothbrushes, dentifrice, floss (if used), and various paper products if a sink is not used. In addition, teachers' time must be taken into consideration.

PRACTICALITY

Although toothbrushing in classrooms is possible, most public school teachers are less than enthusiastic about its practice. Much of this reluctance is understandable in that the procedure is invariably messy when dealing with younger children. Further, not all classrooms have sinks, thus making it necessary to use multiple types of paper products including paper cups, towels, or napkins. Moreover, the toothbrushes must be stored in a place where they can be kept clean and the waste products must be properly disposed of.

Brushing in school-based programs is found more frequently in Head Start classes where teachers appear to be more accepting of spills and the need to clean up than in public schools. The purpose is to teach the children how to brush, to help instill the need for routine toothbrushing and the feel of a "clean, fresh mouth," and, in some cases, to provide the only toothbrush the child has owned.

High-Risk or Vulnerable Populations

Some groups of individuals are more vulnerable, more susceptible, or at higher risk for oral diseases and conditions than others because of their knowledge, attitudes, behavior, education, income, occupation, sex, age, health status, residency location, race, ethnicity, culture, or minority status.[3,4,52,91-94] These individuals have been called high-risk, vulnerable, underserved, special needs, or disadvantaged populations. Effective community prevention programs for dental caries are either for the whole community, such as fluoridation, or a specific age group, such as school prevention programs. However, a school prevention program such as dental sealants may be targeted to higher-risk children, maximizing access to limited services.[75,95] Also a school dental program may be targeted for those schools where there are children either at higher risk for disease or at higher risk for being unable to obtain treatment. Effective community prevention programs for dental caries can also be supplemented with an individual approach for children who are at high risk, such as use of home fluoride gels or rinses for individuals undergoing orthodontic treatment or taking medications that decrease salivary flow.[64] Populations also may be at "high risk" because of beliefs, behavior, or cultural patterns. Early childhood caries may be high in groups of children whose mothers or other caregivers put sugar or juices in their baby bottles, and oral cancer is high among persons who smoke and drink alcohol excessively.

When a community prevention program is being planned, the needs of high-risk populations must be considered. A high-risk group in one culture, neighborhood, or community may not be at high risk in another. For example, low-income children in the United States usually are at high risk for dental caries. However, low-income children in a developing country, especially in rural areas, usually are at low risk for dental caries because they do not have access to candies and other sweets.[91] Examples of some high-risk or vulnerable populations are as follows: bed bound, chemically dependent, cultural minorities,

dentally indigent, developmentally disabled, elderly, ethnic minorities, children in Head Start programs, homebound, homeless, institutionalized, linguistic minorities, medically compromised, migrants, Native Americans, persons with human immunodeficiency virus or AIDS, rural populations, and teenagers.

The diversity of high-risk populations requires an understanding and appreciation of their needs, attitudes, knowledge, and behavior to develop an effective prevention program. These high-risk populations often have the greatest dental needs, the least resources and access to care, the least knowledge about preventing diseases, and few or no fact-finding skills, making primary prevention of disease even more important.

UNINTENTIONAL ORAL-FACIAL INJURIES

Oral-facial injuries may be intentional or unintentional. Intentional oral injuries may occur from abuse, domestic violence, self-mutilation, or violence in general. Dental personnel have a role in and responsibility for early detection, treatment, and referral for these patients. This section discusses the prevention of unintentional injuries that usually occur from contact sports, recreational activities, motor vehicles, and daily living.

Unintentional injuries result in more than 92,000 deaths per year, with motor vehicle crashes accounting for approximately half of these deaths, followed by other unintentional injuries, falls, poisonings, suffocation, and drownings.[3] For persons age 1 to 34 years, unintentional injuries are the major cause of death. Injury costs are estimated to be more than $441 billion a year, and approximately 29 million people per year go to emergency wards as a result of unintentional injuries.[3] Unintentional oral-facial injuries may result in broken and avulsed teeth, facial bone fractures, concussion, permanent brain injury, temporomandibular joint dysfunction, blinding eye injuries, and even death.[96] Although no national data exist on the extent of oral-facial injuries, the following is known:

- Approximately 25% of the U.S. population ages 6 to 50 years has had incisal tooth trauma.[97]
- Almost half of abused children have oral-facial trauma.[98]
- Approximately 25 million children in the United States participate in competitive school sports and approximately 20 million play in organized sports outside of school.[99]

PREVENTION OF UNINTENTIONAL ORAL-FACIAL INJURIES

No single mechanism or program can prevent all the different types of unintentional injuries. An organized community effort is needed that includes many different disciplines, such as health, education, transportation, law, engineering, architecture, and safety services.[3] Although not directly related to dentistry, support by the dental profession of the following injury prevention programs on community and individual levels may result in fewer oral-facial injuries:

- Increased use of mass transit
- Drunk driving prevention programs
- Seat belt and child safety seat laws and programs
- Improved pedestrian safety
- Motorcycle and bicycle helmet laws and programs
- Safe playground equipment

- Protective bars on upper-story windows
- Home fire safety measures
- Protective mouthguards and headgear for sports
- Home environment modifications
- Timely emergency medical services

Although no national data for the various causes of oral-facial injuries exist, sports appear to account for a significant proportion, with some estimates as high as 33%.[100,101] More than 14 million of the 20 million school-age children in the United States who participate in sports do so in at least one sport listed in Table 10-9, which does not include basketball. More than 25% of these children participate in two sports.[96] Baseball and softball are the most popular sports, played by 24% of school-age children, followed by 12.8% of children for soccer and 10% for football.[96] The highest number of unintentional injuries from product-associated sports treated in emergency departments in 1995 were from basketball, followed by bicycling, football, baseball, soccer, and softball (Table 10-10).[102] In a recent nationwide study of parents whose 5- to 14-year-old children play at least one of six organized team sports (soccer, football, basketball, baseball, softball, or T-ball), 53% of the parents stated that they do not worry much about injuries. In contrast, 30% of these children were injured at least once, with football (28%) and soccer (22%) having the most injuries, followed by the batting sports (18%) and basketball (15%).[103]

Protective headgear and mouthguards have been demonstrated to prevent unintentional injuries in sports. Approximately 50% of all high school football injuries were to the face and mouth before 1962, when protective oral-facial devices became required by the National Alliance Football Rules Committee.[104] One in 10 players had a chance of receiving such an injury during the playing season.[104] With the use of face guards and mouth protectors, there has been a dramatic reduction in oral-facial injuries in football since 1962.[104] Currently, only five amateur sports require mouth-

Table 10-9. Estimated Number and Percentage of Children Who Played Organized Sports in the United States, 1991

Sport	*Number of Children*	*%*
Baseball/softball	9,338,980	24.4
Soccer	4,906,134	12.8
Football	3,824,708	10.0
Karate/judo	977,180	2.6
Wrestling	960,763	2.5
Field/ice hockey	603,008	1.6
Lacrosse	141,480	0.4
Boxing	144,380	0.4
Rugby	52,686	0.1

Data from Nowjack-Raymer RE, Gift HC: Use of mouthguards and headgear in organized sports by school-aged children, *Public Health Rep* 111:82, 1996.

Table 10-10. Estimated Number of Sports Injuries Treated in U.S. Hospital Emergency Departments by Age, 1995

	Number of	*Percentage by Age*		
Sport	*Cases*	*0-4 yr*	*5-14 yr*	*15-24 yr*
Basketball	692,386	0.3	30.5	48.0
Bicycling	549,988	7.4	56.3	15.1
Football	389,463	0.3	45.9	43.5
Baseball	210,395	4.0	50.3	23.2
Soccer	156,960	0.3	44.9	38.6
Softball	155,669	0.9	23.0	27.5

Data from National Safe Kids Campaign: *Sports injury fact sheet*, Washington, DC, 1996.

guards during games and practice: boxing, football, ice hockey, lacrosse, and women's field hockey.[105]

Mouth protection is needed in other sports. One statewide study showed that nearly 31% of high school basketball players sustained an oral-facial injury during the varsity basketball season, and 22% of these injuries required professional attention.[106] Only 4% of these players wore mouth protectors, and the injury rate for those without mouth protection was nearly seven times greater. In a study in another state of high school athletes, 9% of all players had some form of injury and 3% reported loss of consciousness.[107] Approximately 40% of the injuries were in baseball and basketball, with 75% occurring in players not wearing mouth protection. There also were fewer concussions in those athletes wearing

Table 10-11. Percentages of Children Who Wear Headgear and Mouthguard while Playing Baseball or Football by Selected Variables

	Baseball		*Football*	
	Headgear	*Mouthguard*	*Headgear*	*Mouthguard*
Total	35%	7%	72%	72%
Gender				
Male	40	8	77	77
Female	25	5	15	15
Grade level				
Elementary school	35	6	52	52
Middle school	36	9	80	79
High school	35	12	88	88
Race				
Black	33	17	74	71
White	35	6	72	72
Ethnicity				
Hispanic	33	11	46	52
Non-Hispanic	36	7	77	75
Poverty level				
Below	24	11	54	54
At/above	36	6	77	75
Parent's education				
<HS/HS	34	8	68	69
>HS	36	6	78	75

From Nowjack-Raymer RE, Gift HC: Use of mouthguards and headgear in organized sports by school-aged children, *Public Health Rep* 111:82, 1996.

HS, high school.

mouth protection. In a recent state survey of five sports (boys and girls soccer, boys and girls basketball, and wrestling) at seven high schools, only 6% of the athletes reported mouthguard use. The seasonal incident rate for at least one oral-facial injury per athlete was 28% in soccer, 72% in wrestling, and 55% in basketball, with 10% of athletes sustaining dental injuries.[108] In a national study of high school students who played baseball or softball, only 35% wore headgear and 7% mouthguards all or most of the time.[96] Approximately 40% of the males wore headgear compared with 25% of the females. Approximately 12% of these ballplayers wore mouthguards compared with 7% of soccer players and 72% of football players.[96] Table 10-11 shows the comparison of headgear and mouthguard use for baseball and football by gender, grade level, race, ethnicity, and socioeconomic level.

Studies also show that more children are injured in sports outside of school (60%) than when in school, and more injuries occur during practice (60%) than during games.[99,109] Protective sportswear usually is used much less often in sports outside of school and in practice. In *Healthy People 2010* one of the national prevention objectives is to "increase the proportion of public and private schools that require use of appropriate head, face, eye, and mouth protection for students participating in school-sponsored physical activities."[3]

Promotion of regulations, requirements, and guidelines for the use of effective protection in sports should include the mouth. Custom-fitted mouthguards allow for easier breathing and better speech; therefore compliance is much better than with stock mouthguards. Referees, coaches, parents, school officials, the dental profession, athletic organizations, and local and state health departments should all play a role in protecting the health and safety of children and athletes.[110-112]

PREVENTION AND EARLY DETECTION OF ORAL AND PHARYNGEAL CANCERS

Annually, nearly 30,000 Americans are diagnosed with oral and pharyngeal cancers, which translates into the fact that about one person dies each hour, nearly 8000 annually, as a result of these cancers. More Americans die from oral cancers than from cervical cancer.[113] Oral cancers can occur in all sites of the oral cavity, including the tongue, floor of the mouth, soft palate, tonsils, salivary glands, back of the throat, and lips. Of these, the floor of the mouth and the tongue are the primary sites. Nearly 90% of all oral cancers are squamous cell carcinoma.[114] In the United States, oral cancer is more prevalent among males than females and is most often diagnosed among persons age 45 years and older.

Oral cancers in advanced stages cause pain, loss of function, and frequently disfiguring impairment that can cause social isolation. The 5-year relative survival rate for oral cancers is 58% for whites and 34% for blacks. Oral cancers have one of the lower 5-year survival rates of the major cancer sites.[115] When oral cancers are detected early, prognosis for survival is much better than for most other cancers. Dentists, physicians, nurse practitioners, and other primary care providers can play a significant role in oral cancer prevention and early detection.[116]

Primary risk factors for oral cancers in the United States are use of tobacco and alcohol products and, for lip cancers, unprotected exposure to the sun. Tobacco and alcohol

use account for 75% of all oral and pharyngeal cancers.[114-116] Dietary factors also may play a role. Similar to other cancers, such as colorectal cancer, eating fruits and vegetables that contain essential vitamins (A, C, and E) and other nutrients may provide protection against the development of oral cancers.[117] Variations of use of betel nut combined with tobacco, which is used in many other countries and now is found in the United States, also is a risk factor for oral cancers. In addition, certain viruses and marijuana have been identified as risk factors for these cancers.[118,119]

Despite available knowledge about risk factors for and signs and symptoms of oral cancers, the American public is ill informed about these matters.[120-122] Further, recent data show that only 13% of U.S. adults 40 years of age and older have had an oral cancer examination in the past 12 months, the periodicity recommended by the American Cancer Society.[3] Additionally, data suggest that dentists, dental hygienists, physicians, and nurse practitioners are not as knowledgeable about oral cancer prevention and early detection as they might be.[123-127] Complicating the problem is the fact that approximately 25% of U.S. dental schools use health history forms that are deficient in determining a patient's high-risk behaviors related to oral cancers—use of tobacco and alcohol products.[128] During the 1996 National Strategic Planning Conference for the Prevention and Control of Oral and Pharyngeal Cancer, it became apparent that comprehensive educational interventions directed at all health care providers and the public at large should be implemented.[129-130] Recently, several states have begun these kinds of activities.[131] Box 10-3 contains basic information that everyone should know and understand for the prevention and early detection of oral cancers.

In addition to well-planned educational interventions, community-based supports such as policy, legislation, and ordinances are critically needed for prevention and early detection of oral cancers.[129,131] In the United States there is a trend to use public policy to help decrease or prevent behaviors that contribute to diseases. For example, "no smoking" policies in schools, hospitals, worksites, and restaurants help curtail smoking and make it socially unacceptable. These policies may be especially influential among youth, who are the ones most likely to become addicted to tobacco products. Further, enforcing ordinances and laws make it more difficult for underaged youth to purchase tobacco or alcohol products, thus providing strong support for decreasing the initiation of their use. Concomitantly, enforcing fines and other disciplinary actions against individuals who sell or give these products to youths are equally necessary. A recent report by the Surgeon General evaluates the scientific evidence of educational, clinical, regulatory, economic, and comprehensive approaches to reduce tobacco use.[132] The bottom line is that there is more than enough information to act now and that comprehensive programs (i.e., programs that include all approaches) provide the best results.

Other policies might be directed at health care providers. For example, dental and dental hygiene schools could require students to have exit competence in oral cancer examinations.[129] No state or regional dental board currently requires applicants to demonstrate competence in providing an oral cancer examination. Thus dental examining boards could require that applicants perform an oral cancer examination for licensure. Further, relicensure could require that applicants take a refresher course in oral cancer prevention and early detection—a strategy used in other content areas.[129]

School-based drug interventions frequently begin in primary grades and often focus on developing self-esteem, building skills to resist peer pressure, and urging children to remain free of tobacco, alcohol, and other drugs. These school-based efforts often are implemented in conjunction with other community-based activities aimed at preventing children and youths from starting the habit and urging users to stop. Unfortunately, these kinds of educational interventions often do not identify tobacco products as risk factors for oral cancers. Similarly, efforts focusing on alcohol use as a risk factor for fetal alcohol syndrome, cirrhosis of the liver, and liver cancer usually do not identify alcohol as a risk factor for oral cancers.[120]

NEED FOR HEALTH PROMOTION IN ORAL DISEASE PREVENTION

Today, we know how to prevent or control most oral diseases. With the appropriate use of fluorides and pit and fissure sealants, dental caries can be nearly eliminated among children. Also, with thorough and frequent plaque removal by an individual and periodic appointments with a dental care provider, most periodontal diseases can be prevented. Further, and most important, risk factors for and signs and symptoms of oral cancers have been established and there is an oral cancer screening examination for early detection. The knowledge resulting from scientific studies, however, is superfluous if it is not applied by appropriate lay and professional users. No matter how effective a preventive measure may be, the public cannot benefit if the procedure is unknown and not used appropriately. There are enormous gaps between what we know about preventing oral diseases and what we do.[133] It is now accepted that health promotion influences knowledge and behaviors at all levels of social organization. Health promotion helps bridge the gap between the knowledge generated by scientific studies and its appropriate application.[134]

Over the past 30 years interest in health promotion and disease prevention has increased significantly. At least three factors are responsible for this trend. First, ever-increasing expenditures for health care, most of which pay for the treatment of diseases or conditions, have taken an ever larger proportion of the U.S. gross national product. Second, a growing body of data has confirmed that many chronic diseases result from lifestyles that, theoretically, could be changed, resulting in better health. Third, and very important, a body of scientific literature in health education and promotion has accumulated. Today, health promotion is recognized as a viable approach to preventing diseases and disorders and promoting health. To better understand health promotion, health education must be addressed.

HEALTH EDUCATION

Health education is "any combination of learning experiences designed to facilitate voluntary actions conducive to health."[135] These actions or behaviors may be on the part of individuals, families, institutions, or communities. Thus the scope of health education may include educational interventions for children, parents, policy makers, or health care providers. Education is necessary at all stages of designing, implementing, evaluating, and continuing appropriate oral health programs. Education of all relevant groups is a critical factor in the process to gain acceptance and use of preventive measures, although education alone cannot function as a method to prevent disease. Knowledge is an important aspect of

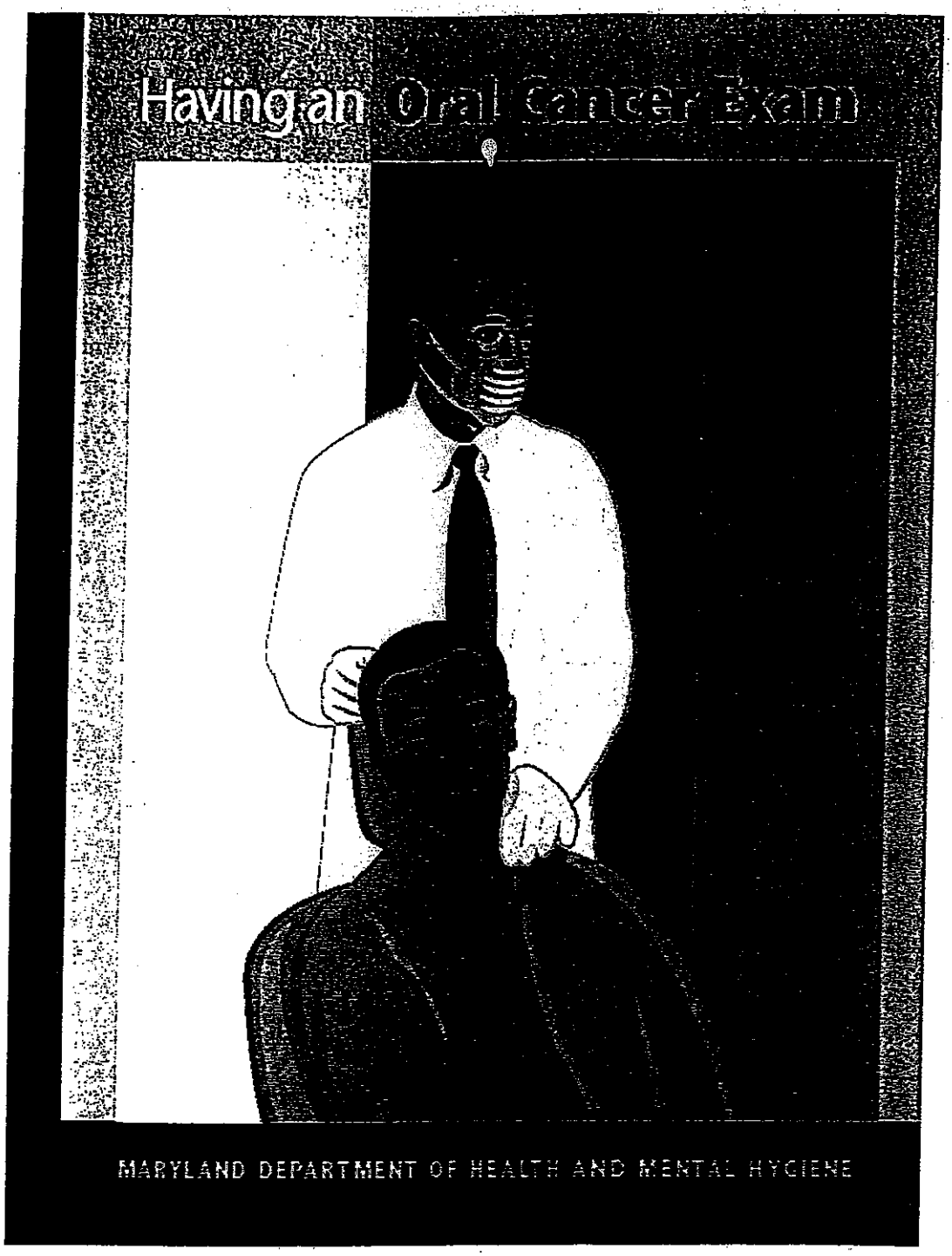

Fig. 10-2. Having an oral cancer exam. (Available from Maryland Department of Health and Mental Hygiene, Office of Oral Health, 201 West Preston St., Baltimore MD 21201.)

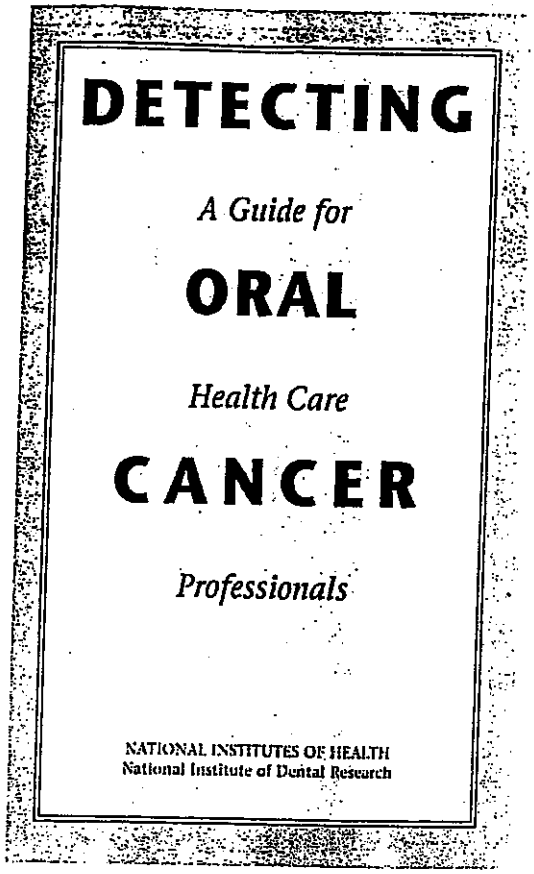

Fig. 10-3. Detecting oral cancer. (Available from the National Oral Health Information Clearinghouse, 1 NOHIC Way, Bethesda, MD 20892-3500.)

empowerment.[134-137] Without appropriate knowledge, individuals can neither make nor be expected to make intelligent decisions about their oral health or, in the case of decision makers, for the oral health of their constituents. Box 10-3 lists content areas that all relevant publics need to know to attain and maintain optimal oral health. Figures 10-2, 10-3, and 10-4 are examples of printed materials that might be used. It must be understood, however, that simply handing out a brochure on water fluoridation or a poster about the evils of tobacco use does not constitute a comprehensive educa-

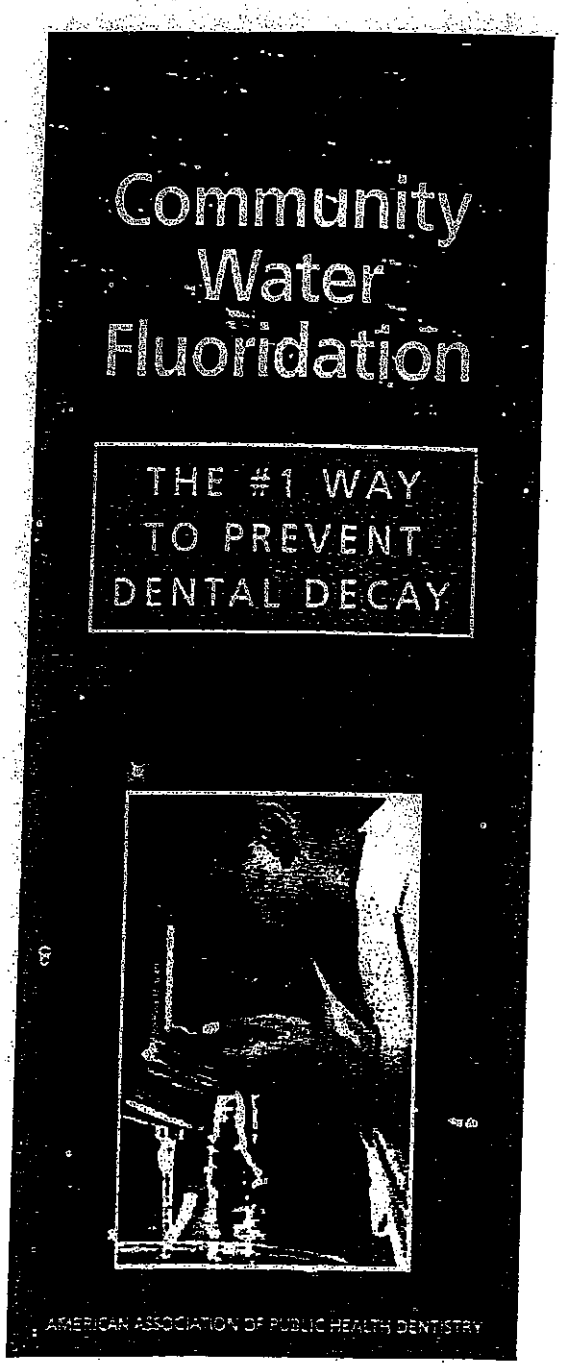

Fig. 10-4. Fluoridation leaflet. (Available from the American Association of Public Health Dentistry, 1224 Center West, Suite 200B, PO Box 7389, Springfield, IL 62791-7389.)

tional program. It is clear that simply having information or knowledge does not automatically mean that appropriate actions or behaviors will follow. Thus education is necessary, but not sufficient, to prevent oral diseases and conditions. However, without such information, the likelihood of taking appropriate actions is severely diminished.

Health Literacy

Health literacy is the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions. Increasing health literacy also is one of the *Healthy People 2010* objectives.[3] Frequently people with the greatest health burdens have the least access to information about their condition, appropriate care, and supporting social services. Increasing health literacy may help decrease health disparities by enabling individuals to know more about their condition and how to navigate the health care system.[138]

Health Promotion

Health promotion is "any planned combination of educational, political, regulatory, and organizational supports for actions and conditions of living conducive to the health of individuals, groups or communities."[135] Supports alter a person's environment in a way that will improve health in the absence of individual actions (water fluoridation) or enable the individual to take advantage of preventive procedures by removing barriers to their use. An example is making dental sealants available to children, especially those in low-income groups or in school settings. Health promotion is the process used to transfer research results to appropriate users to improve health.[137]

SUMMARY

Oral diseases are a "neglected epidemic" because they affect almost the total population, with millions of people having new disease each year. By age 17 years 84% of youths have had tooth decay, with an average of eight affected tooth surfaces, and, by age 40 to 44 years, 99% of adults have had tooth decay with an average of 30 affected tooth surfaces. For vulnerable populations, including low-income persons, minorities, the developmentally disabled, the homebound, and those with AIDS, the extent of the problem is even greater. Although approximately $65 billion is spent annually in the United States for dental care, only one of five children receiving Medicaid, or 20%, receive dental care. Unfortunately, oral health is not a priority in this country, and we do not have a national oral disease prevention program.

Prevention of disease, disability, and suffering should be a primary goal of any society that hopes to provide a decent quality of life for its people. Primary prevention is the most effective way to keep people healthy and to control costs because the disease is prevented before it occurs. Secondary prevention treats the disease after it occurs, and tertiary prevention limits or rehabilitates a disability from disease. Prevention on the community or population-based level is the most cost-effective approach and has the greatest impact on a community, whether it is a school, neighborhood, or nation. Community prevention programs should be used only when they have been shown to be effective by well-designed clinical studies. The use of fluorides, the thirteenth most abundant element in the earth's crust, has made a significant impact on preventing caries in the United States.

Community water fluoridation should be the foundation of oral disease prevention and treatment programs. Fluoridation is the most cost-effective prevention measure in dentistry. Water fluoridation at 1 ppm prevented tooth decay by 50% to 70% in the early controlled studies, and now, as a result of the widespread use of fluoridation and other fluoride products in the United States, it prevents caries in primary teeth by 30% to 60% and in mixed dentition by 20% to 40% and 15% to 35% for adolescents and adults, respectively. It also prevents root caries in older adults by up to 35%.

In 2000 more than 162 million Americans, or 65.8% of the 246 million people on public water supplies, had fluoridation, nearly 57.5% of the total population. Approximately 11 million Americans live in communities that are naturally fluoridated at the recommended level. The safety and legality of fluoridation has been well documented since the first controlled studies in 1945. A well-planned educational program for community leaders and decision makers is important to help them understand all the benefits of this public health measure. This education must continue over time. A well-educated community is the best strategy against antifluoridation activities.

School-based fluoride programs are an alternative when community water fluoridation is not available. These programs may include school water fluoridation, dietary fluoride supplements, or fluoride rinses. School dental sealant programs are effective on the occlusal (biting) surfaces of the teeth of children ages 6 to 8 and 12 to 14 years when the first and second molars erupt.

Periodontal disease (gingivitis) prevention programs on a community level have been shown to be effective when supervised, but they are not very practical. Everyone, however, needs to practice proper oral hygiene and have a prophylaxis or mechanical plaque removal periodically.

Unintentional oral-facial injuries may result in broken teeth, facial fractures, concussions, and temporomandibular dysfunction. More than 25 million U.S. children participate in competitive school sports and 20 million in organized sports outside school. Protective headgear and mouthguards have reduced dramatically the number of oral-facial injuries in football. Other sports such as basketball, baseball, wrestling, and soccer should have regulations and promotion for effective head, face, eye, and mouth protection.

Approximately 30,000 Americans are diagnosed with oral cancer each year. More Americans die from oral cancers than from cervical cancer, approximately 8000 persons yearly. Oral cancer has one of the lower 5-year survival rates of the major cancer sites because of late detection. Tobacco and alcohol account for 75% of all oral and pharyngeal cancers. Community-based incentives for policy, legislation, and ordinances to prevent and control tobacco use are important. Dentists, physicians, and other primary care providers can play a significant role in oral cancer prevention and early detection.

Health promotion, which includes health education and health literacy, is pivotal to implementing primary effective community prevention programs. Effective community prevention programs for oral diseases must be the foundation for responding to this neglected epidemic if we are to have a healthy society.

REVIEW QUESTIONS

1. Define an effective community oral prevention program and give three examples.

2. Cite three advantages of an effective community prevention program and describe the major differences between a prevention program on the community versus individual level.
3. How would you define community water fluoridation? Provide three reasons why it is the most cost-effective preventive measure in dentistry.
4. Describe three different school-based prevention programs and give the major advantages and disadvantages of each.
5. Give three examples of how the dental profession may help prevent oral-facial injuries for the public at large.
6. Differentiate health education from health promotion and health literacy and give one example of each.
7. Describe the differences between primary, secondary, and tertiary prevention and give one example of each.

REFERENCES

1. Allukian M: The neglected epidemic and the Surgeon General's Report: a call to action for better oral health, *Am J Public Health* 90:843, 2000 (editorial).
2. National Institute of Dental Research: *Oral health of United States children: the National Survey of Dental Caries in U.S. School Children: 1986-1987*, DHHS pub, NIH 89-2247, Bethesda, MD, 1989, US Department of Health and Human Services.
3. US Department of Health and Human Services: *Healthy People 2010: with understanding and improving health objectives for improving health*, ed 2, 2 vols, Washington, DC, 2000, US Government Printing Office.
4. US Department of Health and Human Services: *Oral health in America: a report of the Surgeon General*, Rockville, MD, 2000, US Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institutes of Health.
5. Health Care Financing Administration, Office of Actuary: National health expenditure amounts and average change by type of expenditure: selected calendar years 1980-2010, June 14, 2001. Available at www.hcfa.gov/stats/NHE-Proj/Proj/2000/tables/t2.htm.
6. Office of Inspector General, Children's Dental Services Under Medicaid: *Access and utilization*, OBI-09-93-00240, Washington, DC, 1996, US Department of Health and Human Services.
7. US General Accounting Office: *Oral health factors contributing to low use of dental services by low-income populations*, GAO/HEHS-00-149, 2000, US General Accounting Office.
8. *Webster's new world dictionary of American English*, ed 3, New York, 1993, Prentice Hall/MacMillan.
9. National Institute of Dental Research: *Oral health of United States adults: the National Survey of Oral Health in US Employed Adults and Seniors: 1985-1986*, DHHS pub, NIH 87-2868, Bethesda, MD, 1987, US Department of Health and Human Services.
10. Winn DM et al: Coronal and root caries in the dentition of adults in the United States, 1988-1991, *J Dent Res* 75(spec iss): 642, 1996.
11. Sing KA, Spencer JA, Allister JH: Pre- and posteruption exposure to fluoridated water and caries prevention of permanent teeth in Australian children, *J Public Health Dent* 60:100, 2000 (abstract).
12. Centers for Disease Control and Prevention: Fluoridation of drinking water to prevent dental caries, *MMWR Morb Mortal Wkly Rep* 48:933, 1999.
13. Centers for Disease Control and Prevention: Engineering and administrative recommendations for water fluoridation, *MMWR Morb Mortal Wkly Rep* 44(RR-13):1, 1995.
14. Centers for Disease Control and Prevention: *Fluoridation census: 1992*, Atlanta, 1993, US Public Health Service, US Department of Health and Human Services.
15. Centers for Disease Control and Prevention: Populations receiving optimally fluoridated drinking water—United States, 2000, *MMWR Morb Mortal Wkly Rep* 51(07):144-147, 2002.
16. Reeves TG: Technical aspects of water fluoridation in the United States and an overview of fluoridation engineering worldwide, *Community Dent Health* 13(suppl 2):21, 1996.
17. Easley M: *National Center for Fluoridation Policy and Research, Buffalo, NY*, personal communication, April 4, 2001.
18. *Review of fluoride: benefits and risks*, Washington, DC, 1991, US Public Health Service.
19. Kaminsky LS et al: Fluoride: benefits and risk of exposure, *Crit Rev Oral Biol Med* 1(4):261, 1990.
20. National Research Council: *Health effects of ingested fluoride*, Washington, DC, 1993, National Academy Press.
21. American Dental Association: *Fluoridation facts*. Chicago, 1999, American Dental Association.

22. Institute of Medicine, Food and Nutrition Board: *Dietary reference intakes: calcium, phosphorus, magnesium, vitamin D and fluoride*, 1997, Washington National Academy Press.
23. Wolf CA et al: *Abuse of the scientific literature in an antifluoridation pamphlet*, Baltimore, 1985, American Oral Health Institute.
24. Hunt J et al: Putting Yiamouyannis into perspective, *Br Dent J* 179:121, 1995.
25. Horowitz HS: Why I continue to support community water fluoridation, *J Public Health Dent* 60:67, 2000.
26. Ripa LW: A half-century of community water fluoridation in the United States: review and commentary, *J Public Health Dent* 53:17, 1993.
27. Arnold FA Jr et al: Fifteenth year of Grand Rapids fluoridation study, *J Am Dent Assoc* 65:780, 1962.
28. Hillboe HE et al: Newburg-Kingston caries-fluorine study: final report, *J Am Dent Assoc* 52:290, 1956.
29. Blayney JR, Hill IN: Fluorine and dental caries, *J Am Dent Assoc* 74(spec iss):233, 1967.
30. Brown HK, Poplove M: The Brantford-Sarnia-Stratford fluoridation caries study: final survey, 1963, *Can J Public Health* 56(80):319, 1965.
31. Newbrun E: Effectiveness of water fluoridation, *J Public Health Dent* 49(spec iss):279, 1989.
32. Tsutsui A, Yagi M, Horowitz AM: The prevalence of dental caries and fluorosis in Japanese communities with up to 1.4 ppm of naturally occurring fluoride, *J Public Health Dent* 60:147, 2000.
33. Griffin SO et al: Quantifying the diffused benefit from water fluoridation in the United States, *Community Dent Oral Epidemiol* 29:120, 2001.
34. Burt B: Proceedings of the workshop: Cost-Effectiveness of Caries Prevention in Dental Public Health, *J Public Health Dent* 49(spec iss):250, 1989.
35. Centers for Disease Control and Prevention: Recommendations for using fluoride to prevent and control dental caries in the United States, *MMWR Morb Mortal Wkly Rep* 50(RR-14):1-42, 2001.
36. Centers for Disease Control and Prevention: *Fluoridation census 1989: summary*, Atlanta, 1991, US Public Health Service, US Department of Health and Human Services.
37. Centers for Disease Control and Prevention: Water fluoridation and costs of Medicaid treatment for dental decay: Louisiana, 1995-1996, *MMWR Morb Mortal Wkly Rep* 48:753, 1999.
38. Griffin S, Jones K, Tomar S: An economic evaluation of community water fluoridation, *J Public Health Dent* 61:78, 2001.
39. Centers for Disease Control and Prevention: Public health focus: fluoridation of community water systems, *MMWR Morb Mortal Wkly Rep* 41(2):372, 1992.
40. Lalumandier JA et al: US drinking water: fluoridation knowledge level of water plant operators, *J Public Health Dent* 61:92, 2001.
41. Block LE: Antifluoridationists persist: the constitutional basis for fluoridation, *J Public Health Dent* 46:188, 1986.
42. Neenan ME: Obstacles to extending fluoridation in the United States, *Community Dent Health* 13(suppl 2):10, 1996.
43. American Dental Association, Council on Access, Prevention and Interprofessional Relations: Unpublished data, November 7, 2000, American Dental Association.
44. Gift HC, Corbin SB, Nowjack-Raymer RE: Public knowledge about prevention of dental caries and symptoms of gum disease—1990 NHIS, *Public Health Rep* 109:397, 1990.
45. O'Neill HW: Opinion study comparing attitudes about dental health, *J Am Dent Assoc* 109:910, 1984.
46. Allukian M, Steinhurst J, Dunning JM: Community organization and a regional approach to fluoridation of the greater Boston area, *J Am Dent Assoc* 104:491, 1981.
47. Allukian M, Ackerman J, Steinhurst J: Factors that influence the attitudes of first-term Massachusetts legislators toward fluoridation, *J Am Dent Assoc* 104:494, 1981.
48. Boriskin JM, Fine JI: Fluoridation election victory: a case study for dentistry in effective political action, *J Am Dent Assoc* 102:486, 1981.
49. Easley MW: The new antifluoridationists: who are they and how do they operate? *J Public Health Dent* 45:133, 1985.
50. Smith KG, Christen KA: A fluoridation campaign: the Phoenix experience, *J Public Health Dent* 50:319, 1990.
51. Frazier PJ: Priorities to preserve fluoride uses: rationales and strategies, *J Public Health Dent* 45:149, 1985.
52. Executive summary: application for continued recognition of dental public health as a dental specialty, *J Public Health Dent* 46:35, 1986.
53. Allukian M: Fluoridation—a continual struggle in Massachusetts, *Harvard Dent Alum Bull* 28:77, 1968.
54. Collier DR: The statewide fluoridation program of Tennessee through the voluntary process, *J Am Dent Assoc* 93:837, 1976.
55. Clark DC, Hann HJ: A win for fluoridation in Squamish, British Columbia, *J Public Health Dent* 49:170, 1989.
56. Faine RC et al: The 1980 fluoridation campaigns: a discussion of results, *J Public Health Dent* 41:138, 1981.
57. Jones RB, Mormann DN, Durtsche TB: Fluoridation referendum in La Crosse, Wisconsin: contributing factors to success, *Am J Public Health* 79:1405, 1989.
58. Horowitz AM, Frazier PJ: Promoting the use of fluorides in a community. In Newbrun E, editor: *Fluorides and dental caries*, ed 3, Springfield, IL, 1986, Charles C Thomas.

59. American Dental Association: *Community organization for water fluoridation*, Chicago, 1997, American Dental Association.
60. Oral Health Coordinating Committee: *National fluoride plan to promote oral health*, Washington, DC, 1996, US Department of Health and Human Services, US Public Health Service.
61. Evans AW, Darvell BW: Refining the estimate of the critical period for susceptibility to enamel fluorosis in human maxillary central incisors, *J Public Health Dent* 55:238, 1995.
62. Pendrys DG, Stamm JW: Relationships of total fluoride intake to beneficial effects and enamel fluorosis, *J Dent Res* 69(spec iss):529,1990.
63. Pendrys DG: Risk of enamel fluorosis in nonfluoridated and optimally fluoridated populations: considerations for the dental professional, *J Am Dent Assoc* 131:746, 2000.
64. American Dental Association, Council on Access, Prevention and Interprofessional Relations: Caries diagnosis and risk assessment: a review of preventive strategies and management, *J Am Dent Assoc Spec Suppl* 126:1, 1995.
65. Morone J, Kilbreth E, Langwell K: Health affairs: back to school: a health care strategy for youth, *Project Hope*, 20:122, Jan/Feb 2001.
66. The Center for Health and Health Care in Schools: *1999-2000 survey of school-based health initiatives: number of centers and state-financing*. Washington, DC, July 6, 2000, University. Available at www.healthinschools.org/sbhcs/sbhcs_table.htm.
67. The Robert Wood Johnson Foundation: Caring for kids: expanding dental and mental health services through school-based health centers, July 6, 2001. Available at www.rwjf.org/app/rw_applying_for_a_grant/rw_app_opencfp.jsp.
68. Heifetz SB, Horowitz HS, Brunelle JA: Effect of school water fluoridation on dental caries: results in Seagrove, NC, after 12 years, *J Am Dent Assoc* 106:334, 1983.
69. Horowitz AM, Horowitz HS: School-based fluoride programs: a critique, *J Prev Dent* 6:89, 1980.
70. Stephen KW: Systemic fluorides: drops and tablets, *Caries Res* 27(suppl 1):9, 1993.
71. Driscoll WS et al: Caries-preventive effects of daily and weekly fluoride mouthrinsing in a fluoridated community: final results after 30 months, *J Am Dent Assoc* 105:1010, 1982.
72. Ripa LW: Sealants revisited: an update of the effectiveness of pit-and-fissure sealants, *Caries Res* 27(suppl 1):367, 1993.
73. Selwitz RH et al: The prevalence of dental sealants in the US population: findings from NHANES III, 1988-91, *J Dent Res* 75(spec iss):652, 1996.
74. Mertz-Fairhurst EJ: Pit-and-fissure sealants: a global lack of science transfer, *J Dent Res* 71:1543, 1992 (guest editorial).
75. Centers for Disease Control and Prevention: Impact of targeted, school-based dental sealant programs in reducing racial and economic disparities in sealant prevalence among schoolchildren—Ohio, 1998-1999, *MMWR Morb Mortal Wkly Rep* 50:736, 2001.
76. Kunzel W: Systemic use of fluoride and other methods: salt, sugar, milk, etc., *Caries Res* 27(suppl 1):16, 1993.
77. Pan American Health Organization: *Final Report to the W. K. Kellogg Foundation, project #13225. Multi-year plan for salt fluoridation programs in the region of the Americas*, Washington, DC, 2000, Pan American Health Organization, World Health Organization.
78. Marthaler TM et al: DMF teeth in school children after 18 years of collective salt fluoridation, *Caries Res* 23:428, 1989.
79. Estupinan-Day SR et al: Salt fluoridation and dental caries in Jamaica, *Community Dent Oral Epidemiol* 29:247, 2001.
80. Seppa L: Studies of fluoride varnishes in Finland, *Proc Finn Dent Soc* 87:541, 1991.
81. Clark DC et al: Results of a 32-month fluoride varnish study in Sherbrooke and La-Megantic, Canada, *J Am Dent Assoc* 111:949, 1985.
82. Horowitz HS, Ismail AI: Topical fluorides in caries prevention. In Fejereskov O, Ekstrand J, Burt BA, editors: *Fluoride in dentistry*, ed 2, Copenhagen, 1996, Munksgaard.
83. Mandel ID: Fluoride varnishes—a welcome addition, *J Public Health Dent* 54:67, 1994.
84. Beltran-Aguilar ED, Goldstein JW, Lockwood SA: Fluoride varnishes: a review of their clinical use, cariostatic mechanism, efficacy and safety, *J Am Dent Assoc* 131:589, 2000.
85. Anusavice KJ: Treatment regimens in preventive and restorative dentistry, *J Am Dent Assoc* 126:727, 1995.
86. Proceedings of the IADR symposium minimal intervention technique for dental caries, *J Public Health Dent* 56:129, 1996.
87. Frencken JE, Holmgren J: *Atraumatic restorative treatment (ART) for dental caries*, Nijmegen, 1999, Benda Drukkers.
88. Frandsen A: Mechanical oral hygiene practices. In Loe H, Kleinman DV, editors: *Dental plaque control measures and oral hygiene practices*, Washington, DC, 1986, IRL Press.
89. Mandel ID: Antimicrobial mouthrinses: overview and update, *J Am Dent Assoc* 125:2-S, 1994.
90. Horowitz AM et al: Effects of supervised daily dental plaque removal by children after 3 years, *Oral Epidemiol Commun Dent* 8:171, 1980.

91. Chen MS: Oral health of disadvantaged populations. In Cohen LK, Gift HC, editors: *Disease prevention and oral health promotion*, Copenhagen, 1995, Munksgaard.
92. Bolden AJ, Henry JL, Allukian M: Implications of access, utilization and need for oral health care by low income groups and minorities on the dental delivery system, *J Dent Educ* 57: 888, 1993.
93. Allukian M: Oral health—an essential service for the homeless, *J Public Health Dent* 55:8, 1995 (editorial).
94. Mouradian WE, Wehr E, Crall JJ: Disparities in children's oral health and access to dental care, *JAMA* 284:2625, 2000.
95. Heller KH et al: Longitudinal evaluation of sealing molars with and without incipient dental caries in a public health program, *J Public Health Dent* 55:148, 1995.
96. Nowjack-Raynor RE, Gift HC: Use of mouthguards and headgear in organized sports by school-aged children, *Public Health Rep* 111:82, 1996.
97. Kaste LM et al: Prevalence of incisor trauma in persons 6 to 50 years of age: United States, 1966-1991, *J Dent Res* 75(spec iss):696, 1996.
98. Becker DB, Needleman HL, Kotelchuck M: Child abuse and dentistry: oral facial trauma and its recognition by dentists, *J Am Dent Assoc* 97:24, 1978.
99. National Safe Kids Campaign: *Sports injury fact sheet*, Washington, DC, 1996.
100. Lephart SM, Fu FH: Emergency treatment of athletic injuries, *Dent Clin North Am* 35:707, 1991.
101. Meadow D, Lidner G, Needleman H: Oral trauma in children, *Pediatr Dent* 6:248, 1984.
102. National Injury Information Clearinghouse: *Estimates for sports injuries*, Washington, DC, 1995, US Consumer Project Safety Commission.
103. Hart PD, Research Associates: *Get into the game: a national survey of parents' knowledge, attitudes and self-reported behaviors concerning sports safety*, executive summary, conducted for the National Safe Kids Campaign and the National Athletes Trainers' Association Research and Education Foundation, March 2000.
104. Heintz WD: Mouth protection: a progress report, report of councils and bureaus, *J Am Dent Assoc* 77:632, 1968.
105. Ranalli DN, Lancaster DM: Attitudes of college football officials regarding NCAA mouthguard regulations and player compliance, *J Public Health Dent* 53:96, 1993.
106. Maestrello-deMoya MG, Primosch RE: Orofacial trauma mouth protector wear among high school varsity basketball players, *J Dent Child* 56(1):33, 1989.
107. McNutt T et al: Oral trauma in adolescent athletes: a study of mouth protectors, *Pediatr Dent* 11:209, 1989.
108. Kvittem B et al: Incidence of orofacial injuries in high school sports, *J Public Health Dent* 58:288, 1998.
109. Soporowski NJ, Tesini DA, Weiss AI: Survey of oralfacial sports-related injuries, *J Mass Dent Soc* 43:16, 1994.
110. Elliott MA: Professional responsibility in sports dentistry, *Dent Clin North Am* 35(4):831, 1991.
111. Ranalli DR, Lancaster DM: Attitudes of college football coaches regarding NCAA mouthguard regulation and player compliance, *J Public Health Dent* 55:139, 1995.
112. Winters JE: Sports dentistry: the profession's role in athletics, *J Am Dent Assoc* 127:810, 1996.
113. Jemal A et al: Cancer statistics, 2002, *CA Cancer J Clin* 52:23-47, 2002.
114. Silverman S Jr, Shillitoe EJ: Etiology and predisposing factors. In Silverman S Jr, editor: *Oral cancer*, ed 4, Atlanta, 1998, American Cancer Society.
115. Murphy GP, Lawrence W Jr, Lenhard RE Jr, editors: *Textbook of clinical oncology*, ed 2, Atlanta, 1995, American Cancer Society.
116. Mecklenburg RE et al: *Tobacco effects in the mouth: a National Cancer Institute and National Institute of Dental Research guide for health professionals*, NIH pub no 92-3330, Bethesda, MD, 1992, National Cancer Institute, US Department of Health and Human Services, US Public Health Service.
117. Potter JD et al: *Food, nutrition and the prevention of cancer: a global perspective*, Washington, DC, 1997, World Cancer Research Fund; American Institute of Cancer Research.
118. Fouret P et al: Human papillomavirus in head and neck squamous cell carcinomas in nonsmokers, *Arch Otolaryngol Head Neck Surg* 123:513, 1997.
119. Zhang Z et al: Marijuana use and increased risk of squamous cell carcinoma of the head and neck, *Cancer Epidemiol Biomarkers Prev* 8:1071, 1999.
120. Horowitz AM, Nourjah P, Gift HG: US adult knowledge of risk factors for and signs of oral cancers: 1990, *J Am Dent Assoc* 126:39, 1995.
121. Horowitz AM, Nourjah PA: Factors associated with having oral cancer examinations among US adults 40 years of age or older, *J Public Health Dent* 56:333, 1996.
122. Horowitz AM et al: Maryland adults' knowledge of oral cancer and having oral cancer examinations, *J Public Health Dent* 58:281, 1998.
123. Horowitz AM et al: Oral pharyngeal cancer prevention and early detection: dentists' opinions and practices, *J Am Dent Assoc* 131:453, 2000.
124. Yellowitz JA et al: Survey of U.S. dentists' knowledge and opinions about oral pharyngeal cancer, *Am J Dent Assoc* 131:653, 2000.
125. Syme SE, Drury TF, Horowitz AM: Maryland dental hygienists' assessment of patients' risk behaviors for oral cancer, *J Dent Hygiene* 75:25, 2001.

126. Siriphant P et al: Oral cancer knowledge and opinions among Maryland nurse practitioners, *J Public Health Dent* 61:138, 2001.
127. Canto MT et al: Maryland physicians' knowledge, opinions and practices about oral cancer, *Oral Oncology* (in press).
128. Yellowitz JA et al: Assessment of alcohol and tobacco use in dental schools health history forms, *J Dent Educ* 59:1091, 1995.
129. Horowitz AM et al: The need for health promotion in oral cancer prevention and early detection, *J Public Health Dent* 56:319, 1996.
130. Centers for Disease Control and Prevention: *Proceedings: National Strategic Planning Conference for the Prevention and Control of Oral and Pharyngeal Cancer, August 7-9, 1996, Atlanta,* Bethesda, MD, 1997, Centers for Disease Control and Prevention.
131. Alfano MC, Horowitz AM: Professional and community efforts to prevent morbidity and mortality from oral cancer, *J Am Dent Assoc* 132:24S, 2001.
132. US Department of Health and Human Services: *Reducing tobacco use: a report of the Surgeon General,* Atlanta, 2000, US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health.
133. Horowitz AM: The public's oral health: the gaps between what we know and what we do, *Adv Dent Science* 9:91, 1995.
134. Frazier PJ, Horowitz AM: Prevention: a public health perspective. In Cohen LK, Gift HC, editors: *Disease prevention and oral health promotion,* Copenhagen, 1995, Munksgaard.
135. Green LW, Kreuter MW: *Health promotion planning: an educational and environmental approach,* ed 3, Mountain View, CA, 1999, Mayfield.
136. Glanz K, Lewis FM, Rimer BK, editors: *Health behavior and health education theory research and practice,* San Francisco, 1990, Jossey-Bass.
137. Frazier PJ, Horowitz AM: Oral health education and promotion in maternal and child health: a position paper, *J Public Health Dent* 50:390, 1990.
138. Seiden CR et al, editors: *Health literacy, January 1990 through 1999,* NLM pub no CBM 2000-1, Bethesda, MD, 2000, National Library of Medicine.