Public Knowledge of Prevention of Dental Disease

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Synopsis

The authors present data describing the level and extent of the general public's knowledge of oral diseases and their prevention. They discuss data from the 1990 National Health Interview Survey's Health Promotion and Disease Prevention Supplement in the context of national oral health objectives. They focus on demographic and socioeconomic differences seen in the public's knowledge of the preventive purposes of fluorides and dental sealants for dental caries and of symptoms of gum disease.

Reported low levels of knowledge regarding oral disease symptoms and their prevention show the continuing trend reported during the past decade. Racial and ethnic minorities and groups with low levels of formal education demonstrate the least knowledge of prevention of oral diseases. For example, 76 percent of those with more than 12 years of schooling know the preventive purpose of water fluoridation, compared with 61 percent of those with 12 years, and 36 percent of those with less than 12 years of school. Efforts to increase levels of knowledge about oral disease prevention are required to achieve national objectives for oral health.

ORAL DISEASES continue to be among the most prevalent problems in our society, despite the importance of oral health to personal overall health and well-being. Oral health is being without oral cancer, dental caries, periodontal diseases, or other forms of oral problems *(1–3)*.

The general level of oral health has improved steadily in recent decades. The prevalence of dental caries (tooth decay) among children has been declining steadily since the 1940s. Half of all school-age children in 1986—87 had no decay of permanent teeth. Yet, 18- and 19-year-olds had an average of 12 tooth surfaces with decay. Unlike previous generations, nearly all employed adults (96 percent) today have at least some natural teeth. Employed persons who were 40–44 years of age in 1985–86 had an average of more than 30 tooth surfaces with decay *(4, 5)*.

Periodontal diseases are a persistent problem. For example, in the mid-80s, 40 to 50 percent of employed adults and 60 percent of 15-year-olds experienced some gingival inflammation. More serious periodontal infections were less prevalent, but 24 percent of employed adults had lost at least 4 millimeters of periodontal attachment on at least one tooth, and one in five adolescents had lost at least 2 millimeters *(4, 5)*.

Dental caries and periodontal diseases are preventable and controllable. Dental caries result from the concurrent risk factors of susceptible tooth surfaces, sufficient cariogenic microorganisms, and caries-conducive diets *(6)*. The most effective approach to preventing dental caries is the application of an appropriate combination of fluorides and dental sealants *(3, 7)*. Fluorides are provided either singly or in combination through community water supplies, by professional prescription or application, or by self-administration. Fluoride appears to have a cumulative effect and provides protection for the young as well as the old *(7)*. Because fluorides provide more protection for smooth surfaces of teeth than rough surfaces, the key method of protecting tooth surfaces with pits and fissures, particularly on chewing surfaces, is dental sealants *(8, 9)*.

Most periodontal diseases are infections of the gums and supporting bone structure of teeth caused by bacteria contained in plaque *(10)*. The most common periodontal disease is gingivitis, which can be prevented or controlled with thorough plaque removal using tooth brushing and flossing or other

interdental cleaning. The most widely accepted methods for preventing periodontal diseases are personal and professional mechanical plaque removal procedures and professional scaling and cleaning of tooth structures *(10–12)*.

For the most part, oral diseases can be prevented and controlled, if health care professionals and the public know and use appropriate procedures. Attempts to improve personal dental care by changing individual attitudes, knowledge, and behaviors have been reported, but the outcomes have not always been successful *(2, 3, 12–15)*. Evidence suggests that improved knowledge alone does not always translate into behavior change. Yet, improved strategies to increase knowledge should assist people in making informed decisions about their oral health, such as requesting dental sealants, or voting for community water fluoridation *(2, 16)*.

The need to improve public knowledge about risk factors for oral diseases and strategies for their prevention was addressed directly in national and community health objectives for 1990, but those objectives were only partially achieved *(17–19)*. Results from surveys conducted during the 1980s indicated that adults reported appropriate knowledge about personal oral hygiene and professional dental care, but that school children and their parents were unable to identify the principal risk factors related to dental caries or the importance of fluoridation and dental sealants *(17, 18)*.

Although not addressed directly in the objectives of "Healthy People 2000" *(20)*, education strategies for achieving oral health goals on a personal, community, and national level were integrated into the background and justifications for its health objectives. The chapters that address education-based and community-based programs in "Healthy People 2000" and "Healthy Communities 2000: Model Standards" *(21)* include objectives that reinforce the need to provide accurate oral health information to the public and to professional workers.

The description of current public knowledge about dental caries prevention and the symptoms of gum disease is based on data from the 1990 National Health Interview Survey (NHIS), in the context of observed trends as well as the 1990 and Year 2000 oral health Objectives for the Nation.

Methods

The analyses are based on the Health Promotion and Disease Prevention Supplement of the 1990 NHIS *(22)*. The supplement was administered to a sample of adults within the NHIS household sample; the topics covered are similar to those in the 1985 NHIS supplement *(23)*. The response rate for the 1990 NHIS was 83.4 percent (95.5 percent household response rate multiplied by the 87.3 percent sample person response rate) *(22)*. There were 41,104 respondents 18 years and older.

Selected questions and response categories from the dental component of the 1990 NHIS used in these analyses are shown in the accompanying box. The analyses are shown in the table; standard definitions of demographic and socioeconomic variables were used *(22)*.

The category of "Percent who know the preventive purpose of water fluoridation" was defined as those subjects who answered question 1 with response A (prevent tooth decay, protect teeth, or related response).

The category of "Percent who know the preventive purpose of sealants" was defined as those who answered question 3 with response B (prevent tooth decay).

The category of "Percent who know at least one sign of gum disease" was defined as those who answered question 4 with response A, B, C, or D (one correct symptom).

The category of "Percent who believe fluoride is the best way to prevent tooth decay" was defined as those who answered question 5 with response B (fluoride).

Estimates for the table and test statistics were calculated using SUDAAN statistical software, to account for clustering introduced by the complex sample design *(24)*. Log linear chi-square was used to test the independence between the row and column variables for each analysis. *P*-values were based on the F-statistic, using the Wald chi-square, with denominator degrees of freedom equal to the number of primary sampling units minus the number of strata, in this case 198 minus 73 *(24)*. The findings were weighted to provide more accurate estimates of adult population parameters.

Results

Purpose of water fluoridation. In response to question 1, most adults (62 percent) correctly identified prevention of dental caries as the primary purpose of water fluoridation. About two-thirds of persons 25–64 years of age knew that water fluoridation helps prevents caries, compared with 51 percent of those 65 years and older. Only 49 percent of young adults (18–24 years) knew the purpose of water fluoridation. Whites (65 percent) were far more likely to know that water fluoridation helps prevent

dental caries than were blacks (38 percent) (figure 1). Hispanics (41 percent) were less likely than non-Hispanics (68 percent) to know that water fluoridation helps prevent dental caries.

Higher levels of education were associated with the knowledge that water fluoridation helps prevent tooth decay (figure 2). Adults with more than a high school level education were more than twice as likely to know the purpose of water fluoridation (76 percent) as those with less than 12 years of education (36 percent).

Persons with a dental visit in the previous 12 months were more likely to know the purpose of water fluoridation (68 percent) than those without a visit (51 percent). Persons with teeth (dentate) were more likely to know the purpose of water fluoridation (64 percent) than those who were edentulous (46 percent).

One best way to prevent tooth decay. In question 5, adults were asked to indicate the one best way to prevent tooth decay from five alternatives (limiting sugary snacks, using fluorides, chewing sugarless gum, brushing and flossing the teeth, and visiting the dentist every 6 months). Only 7 percent of adults considered fluoride to be the most effective method of caries prevention; more than two-thirds (70 percent) indicated tooth brushing and flossing to be most effective. Far behind brushing and flossing were visiting a dentist every 6 months (11 percent), limiting sugary snacks (8 percent), chewing sugarless gum (1 percent), and did not know (3 percent).

The table summarizes only the results for fluoride, because using fluorides is scientifically accepted as the most effective way of preventing tooth decay. Demographic and socioeconomic variables were not statistically associated with knowledge of the relative effectiveness of fluoride for preventing dental caries.

Preventive purpose of dental sealants. In response to question 2, about one-third of adults (32 percent) had heard of dental sealants. Adults ages 35–44 were the most likely age category to have heard of dental sealants (45 percent). Less than one-fourth (23 percent) of those ages 18–24 had heard of sealants. Whites were more likely than blacks to have heard of sealants (34 percent and 22 percent respectively).

Non-Hispanics (35 percent) were more likely than Hispanics (19 percent) to have heard of dental sealants. Education was related to having heard of dental sealants. Forty-four percent of those with more than 12 years of education had heard of dental sealants compared with 13 percent of those with less than 12 years. Persons with a dental visit in the previous 12 months were more likely to have heard of dental sealants (38 percent) than those without a visit (21 percent). Dentate persons (34 percent) were more likely than those who were edentulous (17 percent) to have heard of dental sealants.

The indication of having heard of dental sealants is not a reflection of knowledge, however. Persons who responded that they had heard of dental sealants were asked their purpose in question 3. Among adults who had heard of dental sealants, almost three quarters (73 percent) correctly stated that dental sealants prevent tooth decay. Less than 10 percent gave any other specific purpose, for example, 7 percent fillings, 9 percent to improve appearance, 5 percent to hold

1990 National Health Interview Survey Health Promotion and Disease Prevention Supplement Dental Questions and Response Categories

1. As you understand it, what is the purpose of adding fluoride to the public drinking water? [no prompts, one response coded]
   - A. To prevent tooth decay, protect teeth, or related response
   - B. To purify the water or related response
   - C. Other
   - D. Do not know
2. Have you ever heard of dental sealants?
   - A. Yes
   - B. No [skip]
3. Which of the following best describes the purpose of dental sealants? [read response categories]
   - A. Fill cavities
   - B. Prevent tooth decay
   - C. Improve appearance of teeth
   - D. Hold dentures in place
   - E. Do not know
4. What is ONE common sign of gum disease? [no prompts, one response coded]
   - A. Swollen, red, inflamed, sore, or bleeding gums
   - B. Chronic bad breath
   - C. Loose teeth
   - D. Receding gums
   - E. Other
   - F. Don't know
5. In your opinion, which ONE of these is the BEST method for preventing tooth decay? [read response categories]
   - A. Limiting sugary snacks
   - B. Using fluoridated water and dental products with fluoride
   - C. Chewing sugarless gum
   - D. Brushing and flossing the teeth
   - E. Visiting the dentist every 6 months
   - F. Don't know

Percent of adults 18 years and older with knowledge of oral diseases and preventive measures

Characteristic	Know preventive purpose of water fluoridation (N = 40,613)	Believe fluoride is the best way to prevent tooth decay (N = 40,571)	Know the preventive purpose of sealants (N = 40,358)	Know at least 1 common sign of gum disease (N = 40,596)
Total	62	7	23	79
Age (in years):				
18–24	49	7	15	76
25–34	65	7	25	82
35–44	70	7	36	85
45–54	68	8	27	82
55–64	64	9	18	78
65 and older	51	8	11	68
Race:				
White	65	7	25	80
Black	38	8	12	72
Ethnicity:				
Hispanic	41	8	12	66
Non-Hispanic	68	7	26	82
Education (in years):				
Less than 12	36	7	7	60
12	61	8	21	79
More than 12	76	7	34	89
Dental visit in past 12 months:				
Yes	68	7	29	84
No	51	8	13	70
Dentate:				
Yes	64	7	25	81
No	46	9	9	64

NOTE: Comparisons are significant ($P \leq 0.05$) using chi square, except those in column 2.

SOURCE: 1990 National Health Interview Survey's Health Promotion and Disease Prevention Supplement.

dentures, and 6 percent did not know. Among adults who had heard of dental sealants, knowing the preventive purpose was associated with age, race, ethnicity, education, and recent dental visit.

The results in the third column of the table demonstrate knowledge of the preventive purpose of dental sealants in the whole adult population (the denominator is not restricted to the base in the screening question). Adults 25–54 years of age were most likely to know that sealants are preventive procedures. White adults (25 percent) were more likely than black adults (12 percent) to know their purpose (figure 1). Hispanics (12 percent) were less likely than non-Hispanics (26 percent) to know the purpose of sealants.

Education was directly associated with knowing that dental sealants have a preventive purpose (see figure 2). Persons with less than 12 years of schooling (7 percent) were less likely than those with more (34 percent) to believe that dental sealants have a preventive purpose.

About a fourth (29 percent) of adults with a dental visit in the preceding 12 months knew that sealants had a preventive purpose, compared with 13 percent of those without a visit. Dentate persons (25 percent) were more aware of the preventive purpose of sealants than were edentulous adults (9 percent) who had heard of them.

Signs of gum disease. Based on respondents' own descriptions, inflamed gums (described as red, swollen, sore, or bleeding) was the symptom identified most often as a common sign of gum disease (63 percent) in response to question 4. About 9 percent indicated that the presence of receding gums was a symptom of gum disease; 7 percent identified other symptoms. Sixteen percent could not name a common symptom; 5 percent provided an incorrect response.

Most adults (79 percent) named at least one common sign of gum disease (see table). As shown in figure 1, whites (80 percent) were more likely to know at least one symptom of gum disease than blacks (72 percent). Non-Hispanics (82 percent) were more likely than Hispanics (66 percent) to indicate a common sign of gum disease.

Level of education was directly related to knowledge of gum disease (figure 2). Eighty-nine percent of those with more than high school level of education were able to name a common sign of gum disease, compared with 79 percent of those with a high school education and 60 percent of those with less.

Persons with a dental visit in the previous 12 months were more likely to correctly identify a sign of gum disease (84 percent) than those without a visit (70 percent). Those with a dental visit were more

likely to indicate that bleeding gums were a symptom of gum disease (68 percent) than those without a dental visit (55 percent) (not shown).

Summary and Discussion

The findings indicate that adults have a wide range of levels of knowledge regarding the prevention of dental caries and the symptoms of gum disease. The range is from a low of 7 percent who identified fluoride as the primary method for prevention of dental caries to 62 percent who identified the preventive purpose of community water fluoridation. These results are particularly disappointing because preventive strategies for dental caries and gingivitis were foci of the 1990 health objectives *(17, 18)* and continue to be central concepts in "Healthy People 2000" *(20)*.

The importance of knowledge about health and preventive strategies has been interpreted within health education and health promotion theories and models, including those of Becker *(25)*, Greene *(26)*, and Janz *(27)*. A person's adoption of a preventive behavior is based on beliefs of susceptibility to a disease, perceptions of severity and impact on lifestyle, and beliefs that personal action will make a difference and outweigh the personal costs *(25, 27, 28)*.

Those beliefs and perceptions are affected by knowledge that is facilitated or restricted by a person's social environment. Providing information alone is not sufficient to improve health. However, lacking knowledge of disease etiology and preventive strategies, a person will find it difficult to make informed decisions about appropriate health behaviors. Such decisions may be on the personal or the community level, such as whether to request dental sealants or how to vote on community water fluoridation.

Fluoridation of public drinking water in the United States began in some cities more than 4 decades ago. Fluoridation and the use of fluoride dentifrices are credited with significant reductions in childhood dental decay during several decades *(19, 29)*. However, many persons remain unaware of the relative importance of community water fluoridation (38 percent) or other fluorides (93 percent) in caries prevention. The public health community advocates a combination of approaches (specifically fluorides and dental sealants) to enhance caries prevention, yet many adults (68 percent) have not heard of dental sealants.

The findings demonstrate large differences between the general public's perceptions of how to prevent dental caries and current scientific knowledge of

Figure 1. Knowledge of oral disease and preventive measures, by race

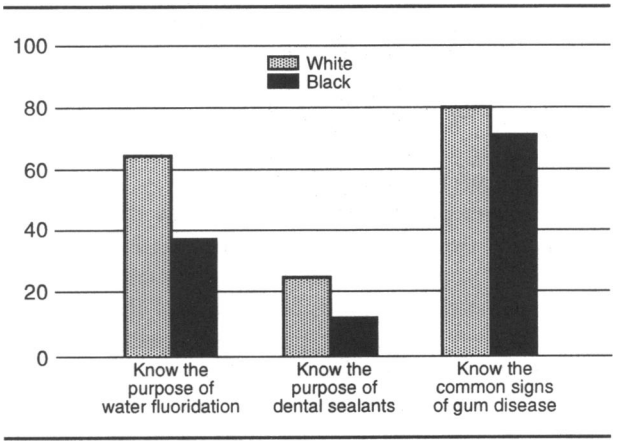
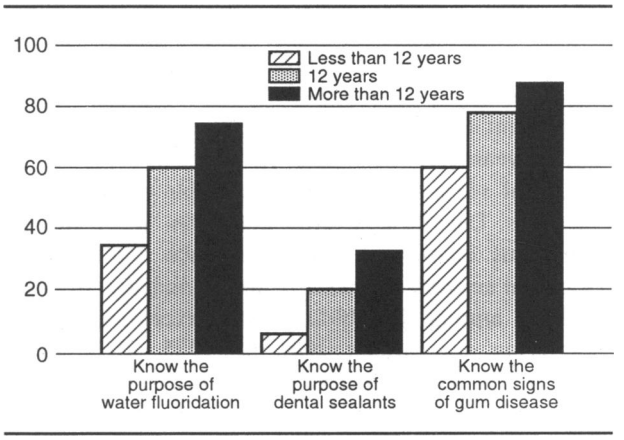


Figure 2. Knowledge of oral disease and preventive measures, by years of education



caries prevention *(6–9)*. The public apparently is confused about the causes and prevention of different oral diseases. During the past 30 years, in public communications and dental care education programs, oral health care professionals in the private and public sectors, in school health programs, and in the commercial sector have advised tooth brushing with a fluoride dentifrice. Those efforts may have instilled strong public beliefs in the value of tooth brushing, and secondarily in visits to a dentist, rather than in the value of the use of fluoride, which is the active ingredient for caries prevention.

The findings of the 1990 NHIS show a continuation of the trend of the past 2 decades toward knowledge gaps and confusion among both the public and health care professions *(2, 11, 30–40)*. For example, in an early 1980s study by Opinion Research Corporation, fluoride as a key factor in controlling dental caries was ranked by the public behind oral hygiene and professional care, but on a level of importance with diet *(32)*. Dentists' beliefs

closely paralleled those of the public. Oral health researchers appropriately ranked fluoride as the most important factor in controlling caries. When the public identified specific factors causing decay, "not brushing teeth" and "eating sweets and candy" were mentioned by nearly two-thirds. Only 6 percent cited "not using fluoride toothpaste." None indicated "absence of fluoridated water" *(32)*.

The lower perceived value of the use of fluoride in preventing dental caries was seen again in 1985 *(30)*. The 1985 supplement to NHIS reported that more adults believed that tooth brushing and flossing teeth were the best method for preventing tooth decay than those who cited the use of fluorides as the best method. Avoiding between-meal snacks and seeing a dentist regularly were believed to be more important than the use of fluorides. In 1985, fewer than one-fourth of adults had heard of dental sealants, and there was a lower level of knowledge of dental sealants among young adults and those with less education. In the 1986 NHIS, nearly two-thirds of adults believed the purpose of water fluoridation was to prevent tooth decay, but 26 percent of those ages 18–24 years did not know its purpose *(31)*.

Dental sealants have been available for more than 20 years. Despite education initiatives and a national consensus conference *(9)*, acceptance and provision of dental sealants by dentists and knowledge of dental sealants among the public remain exceptionally low. Based on comparison with the 1985 NHIS Health Promotion and Disease Prevention Supplement, awareness of dental sealants apparently has increased, from 23 percent to 31 percent *(30)*, yet knowledge of the correct purpose of dental sealants among those who have heard of them appears to have decreased (80 percent in 1985 and 73 percent in 1990).

Age, racial, and education differences persist in the period 1985–90 in the level of knowledge of the preventive purpose of sealants *(30)*. Young adults appear not to have been exposed to dental sealants during their early oral health care and have gained little knowledge of them as adults. This finding is disconcerting because those young adults grew up during a period when they or their siblings could have received sealants.

Adults 35–44 years of age are more likely to have heard of dental sealants, and they have the highest level of recognition of their preventive purpose. It is important for young adults to appreciate the benefits of dental sealants because many of them have children who are dependent on them for receiving dental health services. In the case of fluorides, a person with a low level of knowledge about them might still be a fluoride dentifrice user or exposed to water fluoridation. In contrast, a low level of knowledge regarding dental sealants appears to parallel very low use (15 percent of children ages 6–17 years in 1989) *(33, 41–43)*. While dental sealants require professional application, a public informed of their benefits is more likely to seek delivery of that preventive care or service.

Racial or ethnic minorities and groups with the lowest level of formal education have the least knowledge of prevention of dental caries and symptoms of gingivitis. Analyses beyond those presented in the table are being prepared for publication. Those findings illustrate interactions among race and ethnicity and education. Across all variables, lower levels of preventive knowledge were associated with low levels of education, regardless of race. Racial and ethnic differences in levels of knowledge were evident in middle and upper education groups.

Racial, ethnic, and education differences were particularly evident in individual definitions of the purposes of procedures or in describing symptoms. For example, blacks were far more likely to believe that the purpose of sealants was to fill teeth or to hold dentures in place than were whites. Hispanics (14 percent) were more likely than non-Hispanics (5 percent) to believe that sealants were used to fill teeth. About 46 percent of those with fewer than 12 years of education indicated that inflamed gums were a sign of gingivitis, compared with 71 percent of those with more than 12 years of school.

Recommendations

In the analysis and interpretation of survey results, it is appropriate to challenge the methods used in data collection, the sampling strategy, and the wording of questions. Despite years of concerted efforts in refining approaches, even self-reports on ethnicity and obvious behaviors often are inaccurate and may be unreliable. Self reports of more abstract opinions or knowledge are even less reliable. However, taking the likelihood of problems with survey subjects understanding questions and placing them in an appropriate context, the results presented here are substantial enough to require consideration.

The differential in the level of knowledge about preventive strategies and symptoms of dental caries and gum disease among those with greater or lesser access to information (based on education, minority status, and dental visits during the previous year), suggests the need for health promotion programs directed to those who do not have ready access to oral health information.

Evaluation of oral health education in dental offices, schools, and other types of programs suggests that *(a)* low priority is placed by the public on knowledge, opinions, and practices presented in those programs; *(b)* that the content and comprehensiveness of oral health education in established programs are inadequate; and *(c)* that there is a relatively low correlation between what is reported by schools or other public programs, or dental practices, and the instruction that is provided in oral health education *(14, 15, 35–37, 44)*.

The challenge remains for health care professionals in the private and public sectors, for school programs, and for the news media to develop and implement a variety of relevant, culturally sensitive, and effective approaches to enhance public knowledge of the appropriate use of fluorides and dental sealants, control of gingival conditions, and the value of community water fluoridation, specifically for adults in their roles as eligible voters or parents.

Inappropriate knowledge about the causes and prevention of oral diseases appears to represent public beliefs set in outdated or confusing information that may jeopardize the acceptance of newer and more appropriate preventive agents. While improved knowledge by itself does not guarantee that people will pursue healthful behaviors, or change habits that place their health in jeopardy, or ultimately prevent disease from occurring, improved understanding can provide them with the resources to act on their own if they choose to do so.

Action needs to be taken to address the lack of knowledge exhibited by the public and the health professions, particularly in cases in which it parallels inappropriate behaviors, so that gaps do not persist for another decade. Reducing oral diseases and increasing the availability and adoption of appropriate preventive procedures as described in "Healthy People 2000" will not occur without attention to the education of the public and health care providers.

These findings call for actions on many fronts, such as research, transferring and applying scientific information, educating the public and health care professionals, as well as policy and environmental changes. Examples include

- conducting qualitative research among the public and health care professionals to improve understanding of gaps in knowledge and barriers to appropriate practices,
- conducting additional analyses of the 1990 NHIS to identify the specific characteristics of risk groups and to identify cross-cutting issues associated with their knowledge limitations,
- developing and testing health promotion strategies designed to *(a)* improve knowledge and practices regarding oral diseases and their prevention among those most at risk, as well as among legislators, health care financing agencies, and practitioners; and *(b)* improve ultimate oral health outcomes, particularly for groups at high risk,
- developing and testing the outcomes of curriculums and continuing education courses designed to increase understanding of the importance of signs and symptoms of oral diseases and their prevention. Such efforts should be developed for a range of groups to include preschool staff members, elementary and school faculty, health educators, public health officials, nurses and physician assistants, family practitioners, pediatricians, gerontologists, dentists, and dental hygienists.

Increased knowledge and better understanding alone are not sufficient to improve oral health status to the extent possible. Strategies for expanding activities to further the public's oral health include *(a)* changing guidelines for regulations and legislation to provide an oral disease prevention program in each State public health department and federally sponsored health center; *(b)* permitting efficient and cost-effective delivery of services by oral health personnel; and *(c)* making policy, regulatory, or institutional changes to assure adequate reimbursement in the public and private sectors for age-appropriate oral disease prevention strategies.

References

1. Barker, B. D., and Gift, H. C.: Oral health problems in the 'second fifty.' *In* The second fifty years: promoting health and preventing disability, edited by R.L. Berg and J.S. Cassells. National Academy Press, Washington, DC, 1990, pp. 119–135.
2. Frazier, P. J., and Horowitz, A. M.: Oral health education and promotion in maternal and child health: a position paper. J Public Health Dent 50: 390–395 (1990).
3. Nowjack-Raymer, R. E., and Gift, H. C.: Contributing factors to maternal and child oral health. J Public Health Dent 50: 370–378 (1990).
4. 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 Publication No. (NIH) 89-2247. Bethesda, MD, 1989.
5. National Institute of Dental Research: The oral health of United States adults. The National Survey of Oral Health in U.S. employed adults and seniors: 1985–1986. DHHS Publication No. (NIH) 87-2868. Bethesda, MD, 1987.
6. Newbrun, E.: Cariology. Quintessence Publishing Co., Chicago, IL, 1989.
7. Newbrun, E.: Fluorides and dental caries: contemporary concepts for practitioners and students. Charles C Thomas Publications, Springfield, IL, 1986.

8. Ripa, L. W.: The current status of pit and fissure sealants, a review. J Can Dent Assoc 51: 367–380 (1985).
9. National Institute of Dental Research: Proceedings of National Institutes of Health Consensus Development Conference on Dental Sealants in the Prevention of Tooth Decay. J Dent Educ 48 [suppl]: 1984.
10. Dental plaque control measures and oral hygiene practices, edited by H. Löe and D.V. Kleinman. IRL Press Ltd., Oxford, England, 1986.
11. Gift, H. C.: Awareness and assessment of periodontal problems among dentists and the public. Int Dent J 38: 147–153 (1988).
12. Gift, H. C.: Current utilization patterns of oral hygiene practices. *In* Dental plaque control measures and oral hygiene practices, edited by H. Löe and D.V. Kleinman. IRL Press Ltd., Oxford, England, 1986, pp. 39–71.
13. Höllund, U.: Effect of a nutrition education program, "learning by teaching," on adolescents' knowledge and beliefs. Commun Dent Oral Epidemiol 18: 61–65 (1990).
14. Horowitz, A. M.: Effective oral health education and promotion programs to prevent dental caries. Int Dent J 33: 171–181 (1982).
15. Horowitz, A. M., and Frazier, P. J.: Effective public education for achieving oral health. Fam Comm Health 3: 91–101 (1980).
16. Harris, N. O., and Christen, A. G.: Primary preventive dentistry. Appleton and Lange Publishers, New York, NY, 1987, pp. 409–427.
17. Progress toward achieving the national 1990 objectives for fluoridation and dental health. MMWR Morb Mort Wkly Rep 37: 578–583, Sept. 23, 1988.
18. Centers for Disease Control: Progress toward improved oral health: review of objectives. Center for Prevention Services, Dental Disease Activity, Atlanta, GA, September 1990.
19. Public Health Service implementation plans for attaining the objectives for the nation. Fluoridation and dental health. Public Health Rep 98 [Suppl. to September-October issue]: 94–97 (1983).
20. Public Health Service: Healthy people 2000: national health promotion and disease prevention objectives. DHHS Publication No. (PHS) 91-50212. Office of the Assistant Secretary for Health, Office of Disease Prevention and Health Promotion. U.S. Government Printing Office, Washington, DC, 1990.
21. American Public Health Association, Association of State and Territorial Health Officials, National Association of County Health Officials, U.S. Conference of Local Health Officers, and Centers for Disease Control: Healthy communities 2000: model standards, guidelines for community attainment of year 2000 national health objectives. Ed. 3. American Public Health Association, Washington, DC, 1991.
22. Adams, P. F., and Benson, V.: Current estimates from the National Health Interview Survey. Vital Health Stat [10] 181: 131–142 (1991).
23. Schoenborn, C. A.: Health promotion and disease prevention: United States, 1985. Vital Health Stat [10] 163: 1–12 (1988).
24. Shah, B. V., Barnwell, B. G., Hunt, P. N., and LaVange, L. M.: SUDAAN user's manual, version 5.30. Research Triangle Institute, Research Triangle Park, NC, 1991, pp. 6–18.
25. Becker, M. H.: The health belief model and personal health behavior. Health Educ Monogr 2: 324–508 (1974).
26. Greene, L. G., and Kreuter, M. W.: Health promotion planning: an education and environmental approach. Mayfield Publishing Co., Mountain View, CA, 1991.
27. Janz, N. K., and Becker, M. H.: The health belief model: a decade later. Health Educ Q 11: 1–47 (1984).
28. Silversin, J. B., and Kornacki, M. J.: Controlling dental disease through prevention: individual, institutional and community dimensions. *In* Social sciences and dentistry, II, edited by L.K. Cohen and P.S. Bryant. Quintessence Publishing Co., Ltd., London, England, 1984, pp. 145–201.
29. Knowledge of the purpose of community water fluoridation—United States, 1990. MMWR Morb Mort Wkly Rep 41: 919, 925–927, Dec. 11, 1992.
30. Corbin, S. B., Maas, W. R., Kleinman, D. V., and Backinger C. L.: 1985 NHIS findings on public knowledge and attitudes about oral diseases and preventive measures. Public Health Rep 102: 53–60, January-February 1987.
31. Gift, H. C., Larach, D., and Brunelle, J. A.: Public knowledge of fluoride status and purpose. J Dent Res 70 (special issue): 489 (1991).
32. O'Neill, H. W.: Opinion study comparing attitudes about dental health. J Am Dent Assoc 109: 910–915 (1984).
33. Cohen, L., LaBelle, A., and Romberg, E.: The use of pit and fissure sealants in private practice: a national survey. J Public Health Dent 48: 26–35 (1988).
34. Cohen, R. Y., Sattler, J., Felix, M. R. J., and Brownell, K. D.: Experimentation with smokeless tobacco and cigarettes by children and adolescents; relationship to beliefs, peer use, and parental use. Am J Public Health 77: 1454–1456 (1987).
35. Gift, H. C., and Hoerman, K. C.: Attitudes of dentists and physicians toward and use of dietary fluoride supplements. J Dent Child 52: 265–268 (1985).
36. Gift, H. C., Milton, B., and Walsh, V.: Physicians and caries prevention. Results of a physicians' survey on preventive dental services. JAMA 252: 1447–1448, Sept. 26, 1984.
37. Health you have to be taught: an evaluation of comprehensive health education in American public schools. Metropolitan Life Foundation, New York, NY, 1988.
38. Russell, B. A., Horowitz, A. M., and Frazier, P. J.: School-based preventive regimens and oral health knowledge and practices of sixth graders. J Public Health Dent 49: 192–200 (1989).
39. Bausell, R. B.: Health seeking behaviors: public versus public health perspectives. Psychol Rep 58: 187–190 (1986).
40. Frazier, P. J.: Response to "Current utilization patterns of oral hygiene practices." *In* Dental plaque control measures and oral hygiene practices, edited by H. Löe and D.V. Kleinman. IRL Press, Ltd., Oxford, England, 1986, pp. 72–92.
41. Bloom, B., Gift, H. C., and Jack, S. S.: Dental services and oral health: United States, 1989. Vital Health Stat [10] 183 (1992).
42. Gift, H. C., and Newman, J. F.: Oral health activities of U.S. children. J Am Dent Assoc 123: 96–106 (1992).
43. Jack, S. S., and Bloom, B.: Use of dental services and dental health: United States, 1986. Vital Health Stat [10] 165 (1988).
44. Gold, R. S., and Horowitz, A. M.: Evaluation of oral health in school health education programs. Presented at the annual meeting of the American Association of Public Health Dentistry, Orlando, FL, November 1992.