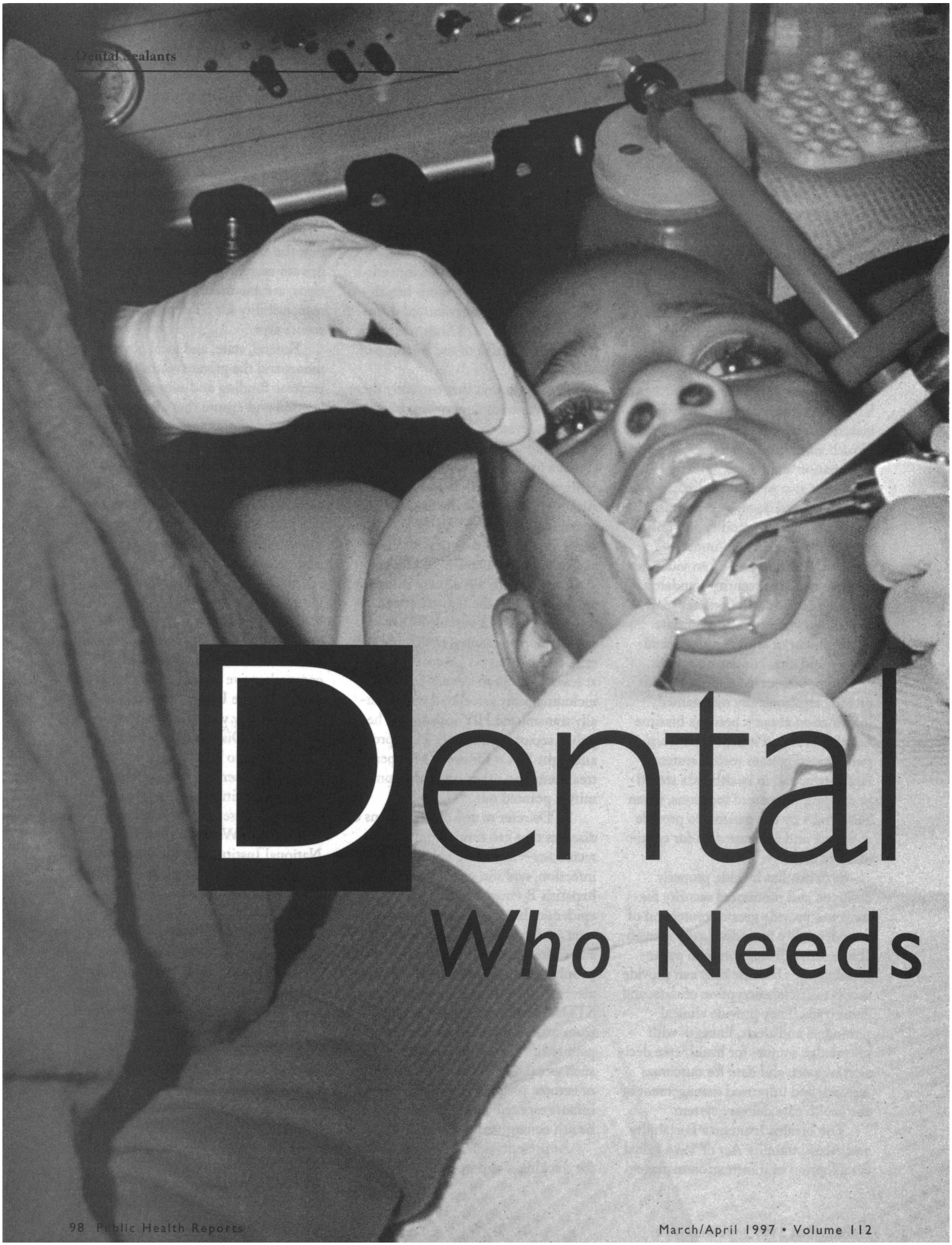
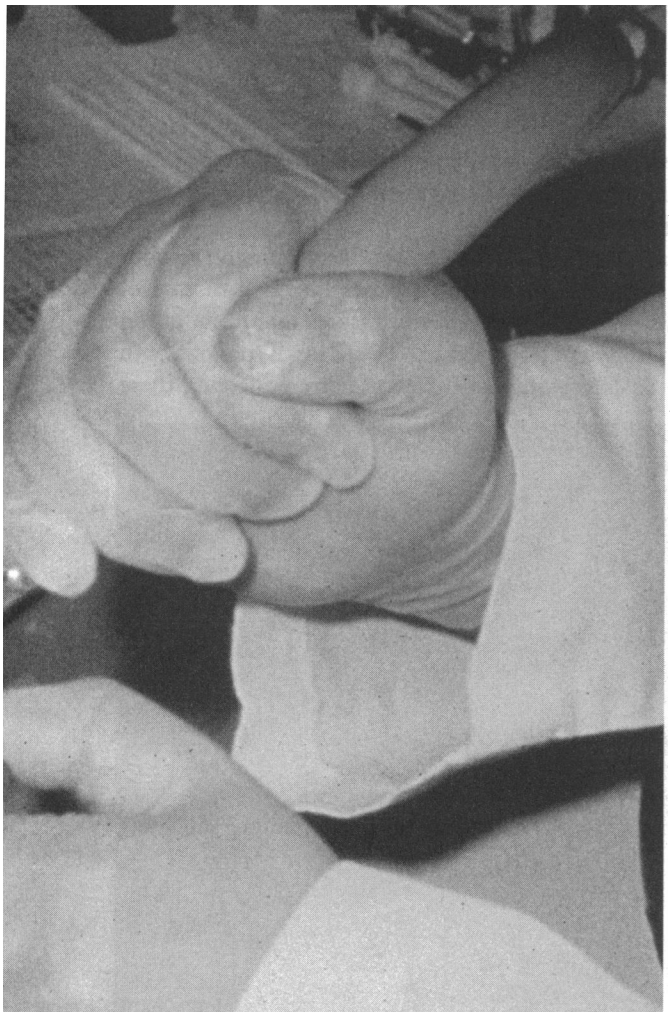


Dental Who Needs



SYNOPSIS

MOST CHILDHOOD TOOTH decay is preventable with a combination of fluoride—which protects the smooth surfaces of a tooth—and dental sealants—which protect tooth surfaces with irregularities called pits and fissures. Sealants are plastic coatings that protect these vulnerable areas, often narrower than a single toothbrush bristle, from decay-causing bacteria and food in the mouth. Yet, 1988–1991 data from the National Health and Nutrition Examination Survey showed that while many children still had cavities, over 80% of which were related to pits and fissures, relatively few children had sealants applied to permanent teeth.

As caries has gone from a ubiquitous disease to one affecting only half of children in early elementary school and two-thirds of those who are 15 years of age, dentists must consider how to best target sealants to individual children who are at greatest risk for new disease. Most sealants are placed in private dental offices, but children at greatest risk for problems resulting from tooth decay are least likely to get private care. State and local health departments, therefore, have gone after hard-to-reach children and adolescents through school-based and school-linked sealant programs, often using portable dental equipment. This article focuses on public health strategies for community-based prevention.

Sealants

Them?

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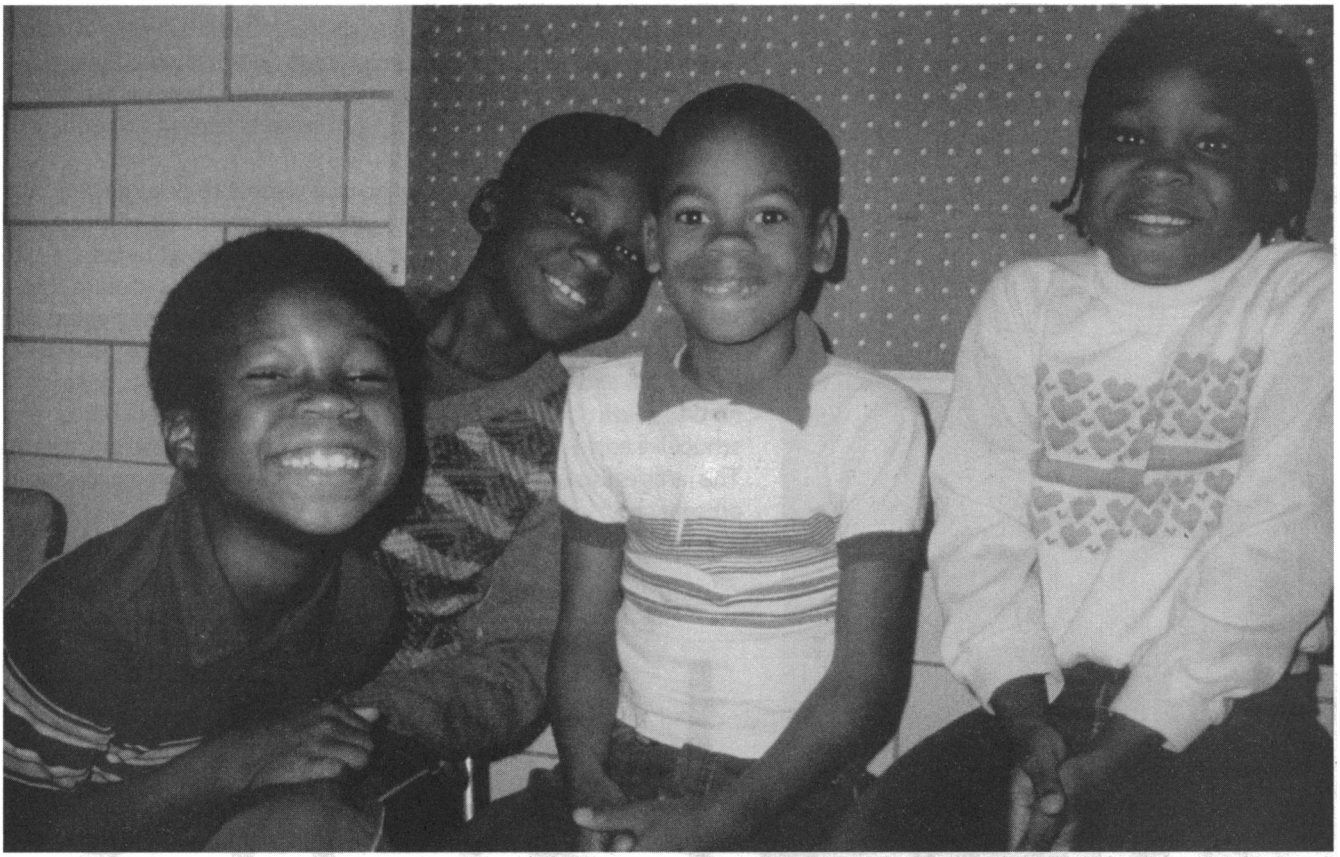
During World War II, almost 9% of U.S. military recruits were rejected because they did not meet the standard of six opposing teeth in each jaw. Tooth decay may no longer affect our national defense, but the U.S. Public Health Service still considers it an important public health problem.[1] Today, dental cavities are unevenly distributed across the population and show a distinct preference for particular teeth. Studies have shown that although most young people have had at least one cavity by the time they graduate from high school, the disease is concentrated in a relatively small group who have multiple cavities. The uneven distribution of caries highlights the need for targeted public health strategies to further reduce, and potentially eradicate, tooth decay in the United States.

Dentistry has two magic bullets for preventing tooth decay: fluo-

ride and dental sealants. Sealants—thin plastic coatings applied to the tops of back teeth—prevent the most common type of cavities seen today. Although dentists have been slow to adopt sealants during the 30 years since their introduction, notable increases in sealant prevalence suggest that the trend is changing.[2,3] Whereas dentists once questioned the value of sealants by asking, "Who needs *sealants?*" today's question should be about how best to target sealants to people who will benefit most: "*Who* needs sealants?" Public health agencies must continue to take a lead role in answering this question and in implementing strategies to efficiently prevent the initiation and progression of tooth decay.



A One-Two Combination

The increased availability of fluoride, primarily through drinking water and toothpaste, is widely accepted as the primary reason for the decline in caries documented over the last 20 years. Even residents of communities without an optimal fluoride level have benefited from water fluoridation through a diffusion effect created by the widespread consumption of processed beverages and foods prepared with fluoridated water.[4] About half of the U.S. population is served by fluoridated water, and over 95% of toothpaste sold in the United States contains fluoride. When necessary, these highly cost-effective population-based approaches to fluoride delivery can be supplemented by more costly individualized prescriptions for home use or by in-office professional fluoride applications for those children receiving regular dental care.

Fluoride's great success in preventing cavities on smooth tooth surfaces has made dental caries largely a disease of rough irregularities called pits and fissures that form during tooth development (see sidebar: "Two Basic Types of Tooth Decay"). Sealants complement fluoride by protecting these highly susceptible areas; once sealants have been bonded to the enamel adjacent to pits and fissures, these areas are sealed off from decay-causing bacteria in the mouth. In addition, sealing a tooth kills most of the bacteria colonizing the pit or fissure, and essentially all remaining microorganisms soon become nonviable from lack of food and air. The one-two combination of fluoride and sealants can prevent almost all tooth decay and plays a role similar to that of vaccinations. Yet many children still have tooth decay.

Where Are the Cavities?

The most recent national data on the prevalence of caries comes from the 1988–1991 phase of the National Health and Nutrition Examination Survey (NHANES III-Phase I).[2] Researchers found not only that tooth decay was unevenly distributed across the population but that it demonstrated a predilection for particular teeth, permanent molars with their extensive pits and fissures. While tooth surfaces with pits and fissures accounted for about 15% of

all surfaces, they were the sites of at least 83% of the tooth decay in children.[2]

When the NHANES III-Phase I data were analyzed to assess progress toward accomplishing the *Healthy People 2000* oral health objectives, the data revealed that over half of 6- to 8-year-old children and two-thirds of 15-year-olds showed evidence of tooth decay (cavities or fillings) in either their permanent or primary teeth.[5] (These were the age groups used in *Healthy People 2000* as sentinel indicators for childhood caries.) In general, children of different ethnicities had similar numbers of cavities and fillings. However, among children with at least one cavity or filling, those from minority groups were more likely than white children to have untreated cavities and less likely than white children to have fillings. For example, while 84% of non-Hispanic white children's cavities had been filled, only 57% of the cavities of non-Hispanic black children and 61% of those of Mexican American children had been filled.[2] These findings support the observation that poor children and others who do not receive regular dental services do not tend to have more cavities but are more likely to suffer consequences in terms of having more untreated cavities.

The one-two combination of fluoride and sealants can prevent almost all tooth decay and plays a role similar to that of vaccinations.

Why the Foot Dragging?

Sealants are not new, yet their adoption by the dental community has been slow. Enamel bonding, the technology that lead to sealants, was first reported in the mid-1950s. Dental sealants were introduced 12 years later, in 1967, and their effectiveness was recognized by the American Dental Association in 1971. Although dentists have embraced the use of bonding in many areas of restorative dentistry during the last 20 to 25 years, they have largely left sealants behind. Over the years, dentists have cited a variety of reasons for not using sealants, including concern about inadvertently sealing in a small, undetected cavity, the belief that sealants were not effective, and the perception that insurance programs did not include sealants among their covered services. The clinical excuses, however, have not stood up to scientific scrutiny. Sealing small cavities, in fact, is a recommended conservative treatment that arrests decay and can prevent the need for fillings, a more expensive and invasive dental procedure.

Resistance to sealants can be explained in part by their being introduced before the technology was sufficiently developed. Dentists did not appreciate the need to use meticulous technique when placing the sealant—specifically, keeping the tooth perfectly dry. This, coupled with the inferiority of the early sealant materials compared to subsequent formulations, meant that in the early years many sealants failed to bond to the enamel and fell off the teeth. With improvements in technique and materials, the effectiveness of sealants at preventing decay is well documented.

The Surgeon General issued a Policy Statement on Sealants in 1993, which reiterated the Public Health Service's strong support for sealants, as had been stressed 10 years earlier at the National Institutes of Health's consensus development conference.[6]

Back when only a few dentists were using sealants, most seemed to believe that parents wouldn't pay out of pocket for this service. Dentists who believed in the benefits of sealants, however, reported little trouble in convincing parents of the value of sealants for their children. In 1995, the average fee for placing a sealant ($24.42) was 45% of the average cost of a one-surface filling ($53.60).[7]

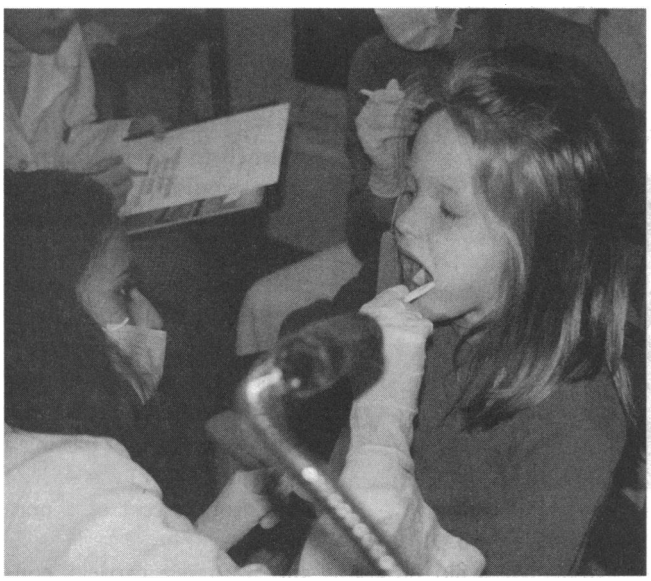
State Medicaid programs and insurance carriers, concerned about the potential for increased claims, were slow to cover sealants. The number of private carriers offering coverage for sealants increased dramatically following the 1983 Consensus Development Conference.[8,9] However, it was not until late 1994 that all 50 state Medicaid programs provided coverage for sealants.[10]

That First Filling: A Small Down Payment on a More Expensive Tooth?

In the past, a dentist might have told a patient he or she had a small cavity that wasn't big enough to fill and would need to be "watched." This meant that the dentist would watch it grow into a bigger cavity then remove the decayed portion along with a healthy portion of the tooth. Sealants are a perfect alternative to watching pits and fissures decay. If a sealant is placed over the beginnings of a cavity, essentially no enamel is removed and it won't grow into full-fledged tooth decay.

Unlike diamonds, fillings are not forever. The average filling is replaced in 10 to 12 years, although many last considerably longer. Usually when a traditional filling is replaced, additional tooth structure has to be removed. Sometimes the decay progresses to the nerve and a root canal is needed, followed by extensive and relatively expensive dental procedures necessary to restore and strengthen the tooth. If the tooth is beyond repair, it has to be removed, generally requiring replacement with a bridge, implant, or

partial denture—none of which is inexpensive. If this natural history of untreated tooth decay plays itself out, some people might view the first invasive procedure, silver amalgam filling, as a down payment on a very expensive tooth. Because sealants are not invasive, no additional tooth structure is removed to replace a sealant that is lost. Thus, sealants are not likely to be the first step in a progression of more expensive treatments to the same tooth over the years in the way that fillings are. Because dentists don't make a hole to place a sealant, there is no hole to grow bigger and bigger. When a patient chooses a $50 amalgam over a $24 sealant, it may not seem like a large difference in cost until one factors in the potential down-the-line cost of repeated refillings and enlargements.



The retention and effectiveness of sealants can be increased by replacing or adding to a sealant or a portion of one that is found missing on a check-up. Studies have shown that after one year 92% to 96% of sealants are completely retained.[11] A review of several long-term studies of sealant retention revealed that 41% to 57% of sealants were completely retained 10 years after a single application.[11]

Reflecting the recognition that healthy natural tooth structure is preferable to even the best large restoration, many dentists have adopted conservative approaches to treating small cavities. One such technique is a cross between a traditional filling and a sealant. If the cavity has passed through the enamel to the inner layer of tooth (dentin) but is still relatively small, dentists can use a conservative filling called a preventive resin restoration. Rather than removing the decay and a considerable amount of healthy tooth structure around it, dentists can remove just the decayed portion and fill the small hole with a plastic material that they cover with sealant. Preventive resin restorations offer the potential to avoid the progression of ever larger fillings.

Surveys have shown an increase in self-reported sealant use by dentists, from 38% in 1974[12] to 90%–95% in more recent studies.[13–16] In the past, discrepancies between the proportion of dentists reporting sealant use and the percent of children with sealed teeth had been noted.[13] That gap, however, appears to be closing, as state and national surveys have shown dramatic increases in sealant use. In fact, NHANES III data for 1988–1991 show that sealant prevalence in young people from upper socioeconomic families (head of household having 13 or more years of formal education, family income of $30,000 or more, or family had dental insurance) approached the year 2000 target of 50%. However, as shown in the table, children from several minority subpopulations had significantly lower rates of sealant placement than white children.

Questions about the safety of dental sealants have been raised by a recent *in vitro* study which suggested that a component of sealants may cause pathology in estrogen-sensitive tissues. The study's finding that a potentially estrogenic substance was present in the mouths of subjects one hour after sealant placement and that the substance caused tumor cells to proliferate in the laboratory has not been replicated, and some scientists are questioning the relationship of these *in vitro* findings to conditions present in the oral environment. Furthermore, there is no evidence that the presence of the substance under these circumstances would have an effect on human health. The American Dental Association (ADA) has taken the position that the issue merits further investigation and has suggested areas for further research. The ADA has also stated that the single study does not warrant any modifications to the recommended use of sealants at this time.

The cost-effectiveness of sealants and other caries prevention strategies depends on targeting them to populations, individuals, and teeth at risk for the disease.

Who Should Get Sealants?

As caries levels decrease and tooth decay becomes more concentrated among specific groups, the cost-effectiveness of both sealants and other caries prevention strategies depends on targeting them to populations, individuals, and

teeth at risk for the disease. Recognizing this situation, recent ADA recommendations have encouraged dentists to target sealants and other caries prevention strategies based on patient risk.[4] Predicting an individual's future risk for tooth decay, however, is not a highly refined science.

A key factor in risk assessment is the level of recent caries incidence. For example, someone who has had multiple new cavities in the past year may be considered at high risk for more cavities. This person should benefit the most from an intensive program of caries prevention, including sealants. On the other hand, an individual with just one recent cavity may be at moderate risk for more caries, requiring some preventive services utilizing fluoride and sealants, while someone with no cavities in the past year would be at relatively low risk for tooth decay and would need only to continue using fluoride toothpaste and maintain good oral hygiene. Other risk factors may enter into the decision as well. Using recent guidelines, dentists can improve the cost-effectiveness of caries prevention by prescribing services in accordance with individual patient risk level.[4,17]

Healthy People 2000 Objective 13.8: increase to at least 50% the proportion of children who have received protective sealants on the occlusal (chewing) surfaces of permanent molar teeth.

A number of articles on risk-based approaches to caries prevention have been published in recent years, but little is known about the extent to which dentists have incorporated this strategy into their practices. One recent example demonstrated the gap between expert recommendations and practice. In 1995, upon recommendation of a task force of educators, researchers, clinicians, and public health specialists, the state of Washington's Medicaid program eliminated dental cleanings as a covered service for children under age 8, judging the cost to significantly outweigh the benefit. Dentists protested so much that the procedure was restored within months. Studies of community programs have found that selective sealant application based on individual caries risk—as indicated by past tooth decay—can significantly increase the cost-effectiveness of using sealants to prevent caries.[18–20]

The decreasing caries rate and increasing sealant prevalence raises the question of whether the *Healthy People 2000* sealant objective is too broad to be meaningful. The objective for the year 2000 is that 50% of 8-year-olds and 14-year-olds will have at least one sealed permanent molar. For this objective to be meaningful, the children at high risk for caries will have to be included in that 50%. If we were to accomplish the objective by placing sealants on the 50% of 8-year-olds and 14-year-olds who are unlikely to have cavities anyway, our victory would be hollow.

Prevalence of dental sealants in 8-year-old and 14-year-old U.S. children, NHANES III data, 1988–1991

Group	Percent of children with sealant applied to at least one permanent molar	
	Age 8	Age 14
U.S. children	21	27
Non-Hispanic Black	9	5
Hispanic	10	11
White	27	36

NOTE: Percentages were rounded in the table from which most of these data were drawn.

SOURCE: Reference 24.

Sealants Aren't Just for Kids

Although children and adolescents are the most likely candidates for sealants, and insurance plans that cover sealants generally limit the benefit to children and adolescents, sealants can be used for adults, too. The recent national *Workshop on Guidelines for Sealant Use*[17] recommended that sealants be used for people and teeth that are at risk for pit-and-fissure tooth decay, regardless of age. The workshop suggested abandoning the traditional rule of thumb that if a cavity did not form within two to four years after a tooth erupted into the mouth, the tooth was unlikely to ever decay and there was no need to seal it. Caries risk for an individual may change over time. Dentists should monitor their patients and—as much as possible—identify cavities early enough to treat them as conservatively as possible, often with sealants. Therefore, the adult who presents with a beginning cavity in a pit or fissure should be considered for sealants. At the same time, a child with no previous decay and at low risk would not need sealants.

The Role of State and Local Health Departments

The public health approach to using sealants in caries prevention involves a range of activities including: organizing conferences and symposia; promoting the value of sealants to dentists, consumers, community leaders, and third party payers; advocating for policy changes (for example,

Two Basic Types of Tooth Decay

Tooth decay is the result of bacterial infection. Bacteria that are normally found in the mouth colonize tooth surfaces to form plaque. Plaque converts fermentable carbohydrates into acid that dissolves tooth enamel through a process called demineralization. Demineralization engages in a tug-of-war with a remineralization process that is enhanced by the presence of low levels of fluoride. If demineralization overcomes remineralization, a cavity results. For as long as remineralization prevails, the cavity has been prevented.

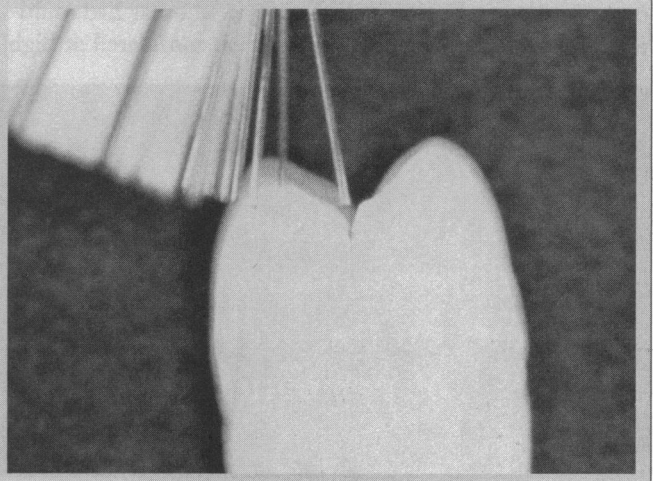
The environments of the different parts of the tooth influence how readily plaque can form, maintain itself, and demineralize enamel. From the standpoint of vulnerability to tooth decay, a key environmental factor is how protected the plaque can be in an area on the tooth. The more protected an area is, the more vulnerable it is.

Plaque has a strategic advantage when it collects in deep crevices, called pits and fissures, of the back teeth (particularly the molars). A pit can be visualized as a dimple, and a fissure as a crease in the enamel. These areas are often narrower than a single toothbrush bristle. Pits and fissures are found on the chewing surfaces of the six- and twelve-year molars and the premolar teeth, which are adjacent to the molars. In addition, many front surfaces of lower molars have a single pit, and the back surfaces of the upper molars often have a pit and sometimes a fissure. Even the back surfaces of upper front teeth may have pits.

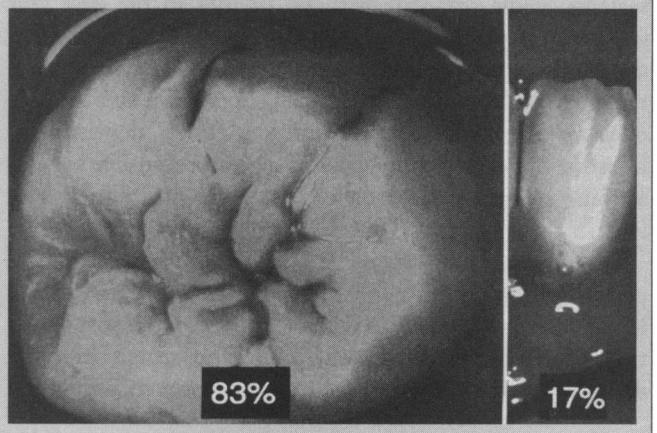
Fluoride provides its greatest benefit to *smooth* tooth surfaces (no pits or fissures). At least 83% of childhood caries occur on tooth surfaces with pits and fissures, particularly permanent molars.

Sealants are used on the pits and fissures in accordance with how likely each tooth is to decay. Therefore, the lion's share of sealants should be on permanent molars, and far fewer on the other tooth surfaces with pits and fissures. Sealants are not used on the smooth sides where teeth touch each other.

Deep crevices called pits and fissures can be narrower than a single toothbrush bristle.



At least 83% of childhood caries occur on tooth surfaces with pits and fissures, while only 17% occur on smooth surfaces.



expansion of Medicaid coverage); and operating direct service sealant application programs. Most sealants are placed in private dental offices, but children at greatest risk for problems resulting from tooth decay are least likely to get private care. State and local agency direct service programs, therefore, have gone after hard-to-reach children and adolescents through school-based and school-linked programs.

A major nationwide demonstration project, funded by the Robert Wood Johnson Foundation, found sealants to be the most effective of all school-based caries prevention procedures studied.[21] A recent national survey found 144 sealant programs across 26 states and the Territory of Guam.[22] Sealant programs varied from the small local agencies that served 100 to 200 children to the single statewide program that served over 15,000 annually. Five states accounted for 69% of programs: Illinois (with 47 programs), Ohio (17), New York (13), Virginia (12), and Washington (11). About half of programs were fully school-based, one-third were a combination of school-based and school-linked, and the remainder were school-linked. In school-based programs, children are seen and sealants are placed in school. School-linked programs make contact with children and may even screen them at school, but sealant placement is done offsite, often at a local clinic.

The overwhelming majority of such community-based programs targeted sealants. In doing so, they could have

used population factors (such as income, age/grade, geography), individual factors (for instance, the number of cavities or fillings), or both as criteria for selecting students to participate in the program. Almost all programs relied exclusively on *population* factors:[23] sealants were offered to schools with high percentages of children from low-income families, in grades in which the most caries-susceptible teeth are found (most often second and sixth), and sometimes according to eligibility for free or reduced-cost lunch programs.

One state's public health approach to sealants. Work being done in Ohio is in the forefront of state efforts to reduce tooth decay using dental sealants. The Ohio Department of Health has sponsored a national conference and a national workshop, has published in professional journals, has developed manuals and videos used around the nation and internationally, has promoted sealant use in private practice, and has funded local school-based programs to reach low-income children and adolescents. These efforts are a good example of state-local cooperation toward meeting a *Healthy People 2000* objective.

Most sealants are placed in private dental offices, but children at greatest risk for problems resulting from tooth decay are least likely to get private care.

The state health agency has played an active role in making sealants more accessible through the Medicaid program. Through participation in various advisory committees of the state dental association and the state Medicaid agency, health department officials influenced a widening of the age criteria for sealant eligibility and two significant increases in the fee for sealant placement. The Ohio Department of Health played an important role in organizing and co-sponsoring a national expert workshop to update recommendations for sealant use in both private offices and community programs. The workshop was hosted by the New York State Health Department and co-sponsored by the Association of State and Territorial Dental Directors and the American Association of Community Dental Programs.

Each year the Ohio Department of Health sponsors a one-day workshop for the state's sealant programs, which gives program staff the opportunity to learn from acknowledged experts and from the real experts, each other. In 1994, the Department organized and co-sponsored a national conference with the same goals.

Ohio has also taken the lead in developing creative media approaches to promoting sealants. In 1987, the Columbus Health Department created an award-winning animated short video about sealants and school-based programs, called *Seal in a Smile.* In 1990, the Ohio Department of Health launched a statewide program to promote sealant use among dentists in private practice. The program incorporated an array of public service announcements, news releases, billboards, newspaper and magazine articles, and radio talk shows. During the time that the program, Sealing the Future, was in place, there was a 15% increase in Ohio dentists reporting sealant use.[13]

School-based sealant programs in Ohio. Using Title V Maternal and Child Health Block Grant funding, the state health agency annually awards competitive grants to 15 local agencies, ranging from health departments to universities and school districts. The state's two largest sealant programs, in Columbus and Cincinnati, are completely locally funded, complementing those that receive state support. All programs target children by grade (usually second and sixth) in schools in which a certain proportion (45% in rural areas, 50% in urban areas, not restricted in dentally underserved areas) of children are eligible for the free/reduced cost lunch program. On average, 60% of children return parental consent forms.

Individual arrangements are made with each school for one or more dental teams to set up a portable dental office in the building. Equipment and supplies are delivered in a van and take about 45 minutes to set up. Depending on the enrollment and participation, a sealant program's stay ranges from a day to over a week. After a dentist has evaluated each child's need for sealants and determined which teeth are to be sealed, the sealants are placed by a dental hygienist-dental assistant team. On a typical school day, in programs surveyed nationally, approximately 11 to 12 children received services at a cost of $36/child.[23] The Cincinnati program, Ohio's most experienced, reports serving 15 to 18 children per day. The charges for comparable services in an average private practice would be about $100 per child.

Summary

Tooth decay continues to be a public health concern affecting a large proportion of the population. Because sealants protect the tooth surfaces that are most vulnerable and that account for over 80% of cavities, they represent an important prevention strategy. Together, fluoride and dental sealants have the potential to prevent most childhood tooth decay. With an approach that targets sealants to people determined to be at higher risk for caries, the cost-effectiveness of sealant use can be maximized.[4,17] State and local health departments have an important role to play in assuring that sealants are used widely and appropriately targeted

to those at risk and that a system of care delivery reaches everyone in need.

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For More Information

The National Maternal and Child Oral Health Resource Center offers several resources for a state or local health agency or other organization interested in developing community-based sealant programs. The resource center has a comprehensive school-based sealant program manual, videotapes, and reprints of pertinent articles and recommendations.

Address correspondence to the National Maternal and Child Oral Health Resource Center, 2000 15th St. North, Suite 701, Arlington VA 22201-2617; tel. 703-524-7802; fax 703-524-9335; e-mail <sspisak@ncemch.georgetown.edu>; on the web at ***www.ncemch.org****.*

References

1. Lee PR, Collins RJ. Tooth decay: is it still a public health problem? Public Health Rep 1995;110:521.
2. Brown LJ, Kaste LM, Selwitz RH, Furman LJ. Dental caries and sealant usage in U.S. children, 1988–91. J Am Dent Assoc 1996;127:335–343.
3. Waggoner WF, Siegal MD. Pit and fissure sealant application: updating the technique. J Am Dent Assoc 1996;127:351–361.
4. Council on Access, Prevention, and Interprofessional Relations, American Dental Association. Caries diagnosis and risk assessment: a review of preventive strategies and management. J Am Dent Assoc 1995;126 Suppl.
5. Gift HC, Drury TF, Nowjack-Raymer RE, Selwitz RH. The state of the nation's oral health: mid-decade assessment of Healthy People 2000. J Public Health Dent 1996;56:84–91.
6. National Institute of Dental Research. Dental sealants in the prevention of tooth decay. Proceedings of the National Institutes of Health Consensus Development Conference; 1983 Dec 5–7. J Dent Educ 1984;43 Suppl.
7. American Dental Association. 1995 survey of dental fees. Chicago: ADA; 1996 Jul.
8. Glasrud PH. Insuring preventive dental care: are sealants covered? Am J Public Health 1985;75:285–286.
9. Glasrud PH, Frazier PJ, Horowitz AM. Insurance reimbursement for sealants in 1986: report of a survey. ASDC J Dent Child 1987;54:81–88.
10. Siegal MD. Promotion and use of pit and fissure sealants: an introduction to the special issue. J Public Health Dent 1995; 55(5):259–260.
11. Ripa LW. Sealants revisited: an update on the effectiveness of pit-and-fissure sealants. Caries Res 1993:27 Suppl 1:77–82.
12. Gift H, Frew R, Heffernen J. Attitudes toward and use of pit and fissure sealants. ASDC J Dent Child 1975;42:460–466.
13. Siegal MD, Garcia AI, Kandray DP, Giljahn LK. The use of dental sealants by Ohio dentists. J Pub Health Dent 1996;56:12–21.
14. Romberg E, Cohen LA, LaBelle AD. Importance of variables associated with practitioners' estimates of pit and fissure sealant use. J Pub Health Dent 1988;48: 138–146.
15. Gonzalez CD, Frazier PJ, Messer LB. Sealant use by general practitioners: a Minnesota survey. ASDC J Dent Child 1991;58:38–45.
16. Bowman PA, Fitzgerald CM. Utah dentists sealant usage survey. ASDC J Dent Child 1990;57:134–138.
17. Proceedings of the Workshop on Guidelines for Sealant Use. J Public Health Dent 1995; 55(5).
18. Weintraub JA, Stearn SC, Burt BA, Eklund SA. A retrospective analysis of cost-effectiveness of dental sealants in a children's health center. Soc Sci Med 1993;36:1483–1493.
19. Heller K, Reed SG, Bruner FW, Eklund SA, Burt BA. Longitudinal evaluation of sealing molars with and without incipient caries in a public health program. J Public Health Dent 1995;55:148–53.
20. Leverett DH, Handelman SL, Brenner CM, Iker HP. Use of sealants in the prevention and early treatment of carious lesions: cost analysis. J Am Dent Assoc 1983;106:39–42.
21. Klein SP, Bohannon HM, Bell RM, Disney JA, Foch CB, Graves RC. The cost and effectiveness of school-based preventive dental care. Am J Pub Health 1985;75:382–391.
22. Association of State and Territorial Health Officials. School-based dental sealant programs expanding: Ohio among the leaders. ASTHO School Health Report 1995;2(4):1–2.
23. Siegal MD, Lalumandier J, Farquhar CL, Bouchard JM. School-based and school-linked public health dental sealant programs In the United States, 1992–93. Columbus (OH): Association of State and Territorial Dental Directors; 1997.
24. Selwitz RH, Winn DM, Kingman A, Zion GR. The prevalence of dental sealants in the U.S. population: findings from NHANES III, 1988–91. J Dent Res 1996;75:652–660.