

The Economics of Pit and Fissure Sealants in Preventive Dentistry: A Review

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Abstract

Oral diseases are progressive, cumulative, and become more intricate to treat with advancement. While dental caries is an infectious transmissible disease with children being at the highest risk, primary prevention can reduce this risk. Primary prevention in dentistry is usually considered to be community fluoridated water supplies, professional fluoride treatments, and pit and fissure sealants. While community fluoridated water supplies have been proven to be cost-effective, the cost-effectiveness of pit and fissure sealants has primarily been studied in school-based programs of children from low socio-economic backgrounds. Dental sealant programs are just one way to help increase primary prevention in the oral health disparities of children. The purpose of this paper is to review the literature regarding the cost-effectiveness of pit and fissure sealants as a preventive strategy in preventive dentistry.

Keywords: Sealants, primary prevention, cost-effectiveness, risk assessment

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Introduction

Oral diseases are progressive, cumulative, and become more intricate to treat with advancement. Untreated oral disease can affect a person's ability to masticate and communicate efficiently. Esthetically, untreated dental disease can impact on one's self-esteem and attribute to poor self image. Primary prevention in medicine involves techniques and agents to prevent the onset of disease, to reverse the progress of disease, or to arrest the disease process. In dentistry the agents or methods of primary prevention of dental caries includes fluorides, pit and fissure sealants, plaque control, and dietary analysis to control the consumption of fermentable carbohydrates.^{1,2}



Risk Assessment

Dental caries is a transmissible and multi-factorial disease in which streptococci mutans bacteria create a primary oral infection.³ Dental caries can occur at any age after teeth erupt into the oral cavity, but the individuals at highest risk are children. According to the National Center for Health Statistics (1997) six out of ten children have one decayed tooth by the age of five, while over 50% of 5 to 9 year olds and more than 78% of 17 year olds have at least one cavity or filling in the occlusal portion of the tooth.⁴

The review of the U.S. Department of Health and Human Services Healthy People 2000 objectives found more than half of all second graders, children aged 6 to 8, still experience cavities. Dental caries remains the single most common childhood disease that is neither self-limiting nor corrective with antibiotics.^{5,6}

Dental care is the most prevalent unmet health need among American children.⁷ Among 5 to 7 year olds dental caries is five times more prevalent than asthma and seven times more

prevalent than hay fever.⁴ Dental-related illness causes more than 51 million school hours to be lost per year^{8,9}, that is approximately 3.1 days per year for children ages 5 to 17.¹⁰ The burden of oral disease can affect not only the quality of life but also the productivity and the psychological well-being of an individual.



5 to 9 year olds



17 year olds

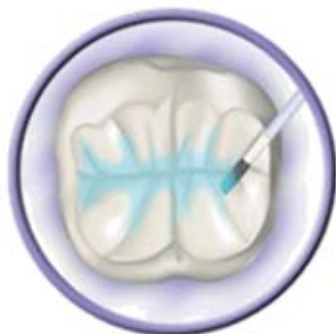
Prevention Strategies

Effective measures for caries prevention did not exist at the beginning of the 20th century and usual treatment was extraction of the affected teeth.¹¹ In the early 1930's and 1940's oral epidemiologists developed the DMFS (decayed, missing, or filled tooth surface) Index to measure caries per tooth surface. This measurement was critical in proving and helping to define preventive measures. The earliest utilization of the DMFS Index was to assess the effectiveness of water fluoridation.¹¹ In 1945 a prospective field study on the fluoridation of community drinking water began in eight cities (one control and one intervention city) in Michigan, Illinois, New York, and Canada to study the effect of fluoride on caries prevention. By 1962 caries incidence had been reduced in a range from 50% to 70%.¹² Presently, fluoridating the community drinking water is still a major factor in reducing dental caries.



While fluorides are effective in reducing the number of carious lesions on the smooth enamel surfaces of teeth, the anatomy of the occlusal surfaces of teeth have deep pits and fissures that cannot be adequately brushed or protected by fluoride administration.³ According to Harris and Garcia-Godoy, 95% of all carious lesions occur on the occlusal surfaces of teeth. The occlusal surfaces of teeth comprise 12% of the total number of tooth surfaces, which means the pit and fissures of the occlusal surfaces of teeth are eight times more susceptible to decay as the smooth surfaces of the teeth.¹³ The teeth at highest risk for carious lesions are the first and second molars, and 90% of all dental caries in school children occurs in pits and fissures of the occlusal surface of the molars.³

Sealant application is a conservative preventive measure that can be accomplished without anesthesia or drilling of the tooth structure. Sealants can be placed on sound teeth and over incipient decay.¹⁴ When utilized in a preventive dental program in conjunction with water fluoridation, the effectiveness of the water fluoridation increases by 20%.¹ Sealants are plastic resinous materials developed from enamel bonding techniques in dentistry of the mid-1970's.¹⁵ Sealants are usually applied as a liquid that is allowed to flow into the crevices of the occlusal surface of the tooth and then allowed to harden. Once the sealant hardens on the tooth surface, it forms a barrier between the tooth and the oral environment preventing bacteria from embedding in the occlusal surface of the tooth.³ The sealant is virtually 100% effective in protecting the tooth surface from the bacteria in the oral environment if it is fully retained on the tooth.¹³ Retention varies for sealant coverage and averages 96% after one year, 82% after 5 years, 57% after 10 years, and 52% after 15 years.⁴



Economics

In 1998 expenditures for dental services constituted 4.7% of the nation's health expenditures—\$53.8 billion out of \$1.1 trillion.⁹ No figures were found to estimate the portion of the 4.7% that was spent on primary prevention in dentistry.

In cost effectiveness analysis costs are considered relating to a single outcome. While costs can be in monetary terms, outcomes are often stated in terms of treatment needs, such as the number of carious lesions prevented.^{16, 17}

Studies have tried to quantify cost-benefit based on the compared cost of the fissure sealing to the cost of the restorations saved.^{18, 19, 20} According to Mitchell and Murray¹⁸ this method of comparison is deficient because a monetary value cannot be assessed for a healthy restored or unrestored tooth. In preventive dental programs cost-benefit analysis is used to determine the cost to save one decayed, missing, or filled tooth or surface.¹⁸ The cost of preventing a single carious lesion cannot be compared to the cost of a single sealant application because not every tooth is certain to become carious.¹⁸

Leverett et al.²⁰ speculated over a period of 60 months five sealants would need to be placed on healthy teeth to prevent one carious lesion, while Rock and Anderson¹⁶ projected sealants would be effective in preventing carious lesions in only one-third of the teeth. While sealants would be most cost-effective if they could be placed only on those teeth that would eventually become carious, to date dentistry does not have a diagnostic predictor of caries with that precision.³

The focus of the literature on the cost-effectiveness of pit and fissure sealants is primarily linked with school-based sealant programs and children from low socioeconomic backgrounds. The financial impact of oral disease is easiest to quantify in terms of direct costs per capita of oral disease and treatment within publicly supported dental care programs.⁹ Klein et al.²¹ conducted the National Preventive Dentistry Demonstration Program project between 1976 and 1981 to assess the cost and effectiveness of different types of school-based preventive programs in five fluoridated

and five non-fluoridated communities with 20,052 first, second, and fifth graders. The variables considered included dental health education on brushing and flossing, fluoride tablet and mouth-rinse, and sealant applications. Analysis four years later of 9,599 children showed sealant application was the only school-based procedure that was consistently effective in reducing decay. The treatment analysis focused on the number of decayed, missing, and filled permanent tooth surfaces between baseline and the end of the study 48 months later. Treatment costs were based on years two and three to eliminate biases of start-up or close-down costs. The sealant cost was \$23 per child per year, which was more than the cost of treatment to restore the tooth \$19.92 (in 1981 dollars). Fluoridation of community water supplies ranged from \$0.06 to \$0.80 cost per capita per year. This study showed sealants prevented decay by 23% to 65%, which translated to one or two carious lesions in four years.²¹

Weintraub et al.²² conducted a retrospective analysis to compare the cost-effectiveness of dental treatment with and without the inclusion of sealants among 139 low-income children at Mott Children's Health Center in Flint, MI. They found the optimal time for sealant cost-savings was not until the fourth to sixth year, and the incremental cost-effectiveness ratios became more favorable in the tenth and eleventh year after application. Sealed and non-sealed groups were matched by age. Costs were calculated for restorations and sealants using the 1985 American Dental Association median fee schedule—\$12 per sealant and \$25 per one-surface amalgam restoration. Life-table analysis was used to determine the probability of each first molar surviving without a restoration. Analysis compared the non-sealed group to the sealed group and a subset of children that had all four six year molars sealed. The cumulative differences in cost per tooth were divided by the cumulative differences in expected restoration-free tooth years. The use of sealants would be cost-effective if a total cost reduction was achieved and as many restoration-free years was achieved. If better effects were achieved, even at a higher cost, then sealants are cost-effective in the sense that one pays for what they receive. If, however, sealant costs are higher and achieve

results that are the same or worse, they are a bad investment. Incremental cost-effectiveness (CE) comparisons of sealed and non-sealed children showed the incremental CE ratio for the non-sealed children was \$4.06 for each healthy tooth year after the eleventh year. The incremental CE ratio for the sealed children was \$81.96 for each year of having a restoration-free tooth. These amounts were high, but the use of sealants became cost-effective by the tenth year and improved in the eleventh year. The sealed teeth had a higher survival probability than did the non-sealed teeth. This study emphasized the importance of the dental profession's responsibility in providing primary prevention strategies to high-risk patients.²² Selective sealing of caries-prone teeth increases the cost-effectiveness and cost-savings, while selective sealing of teeth not caries-prone decreases the cost-effectiveness and cost-savings of sealant placement.²³

Mitchell and Murray¹⁸ determined sealants were not likely to be economically feasible if applied to teeth that were not likely to develop caries. They reported not only was tooth selection of major importance but also that maximum benefits were achieved if used in conjunction with other preventive measures. They reported on factors to consider when the cost-effectiveness of sealants is being assessed. The utilization of sealant retention rates was considered to be increased if second or third generation resins were used. The level of professional education of the operator increased the cost of sealant placement. Since the placement of sealants is a relatively simple procedure, auxiliary placement (if state law allows) instead of the dentist placement would reduce the cost of sealants. Durability of the sealant resin and sealant re-application also have to be considered when calculating costs of sealant cost-effectiveness.

Weintraub et al.²³ did a retrospective cohort analysis of 15,438 children enrolled in the North Carolina Medicaid program from 1985 to 1992 to compare Medicaid expenditures for teeth with or without dental sealants. This analysis was based on eight years of administrative data from dental Medicaid claims. Procedure reimbursements were assigned by the 1992 Medicaid fee schedule—\$11.60 per sealant and \$18.57 per

one-surface amalgam restoration. The analysis showed for low-risk children with no prior restoration placement sealants reduced the need for restorations for four years, in middle-risk children for six years, and in high-risk children for seven years. Sealants were effective overall but did not produce sufficient savings to the Medicaid program to warrant placing sealants in the first molars of all Medicaid-eligible children. This study showed the importance of targeting high-risk children for preventive treatments.

Challenges

Health promotion and disease prevention are goals of preventive health programs in the healthcare professions. Evidence shows health promotion, health education, health literacy, and disease prevention need to be combined for a general understanding of the public.⁴



Healthcare providers face challenges to provide safe and effective disease prevention measures that can be integrated into clinical, academic, and public health domains. There are many oral as well as general health disparities within the U.S. population⁴ that have an impact on society. Reducing disparities requires improving access to care for targeted high-risk populations.

The incorporation of risk assessment models of disease prevention into community-based public health programs and into private clinical practice would help target high-risk dental populations for appropriate interventions assessment.⁴

Conclusion

Oral health needs to become an accepted component of overall health. Economics can be a motivating factor in changing the oral health attitudes of patients and professionals. Traditional dental care has involved restorations, extractions, and prosthetics for replacement of missing teeth. With risk assessment and primary preventive measures the number of restorations, extraction, and prosthetics can be reduced. The concept of purchasing good oral health is foreign to many patients and professionals. The dental profession needs to move more toward identifying and preventing dental disease in its reversible state as well as toward its overall impact on general health.³ The inclusion of sealants into primary preventive programs is one way to address cost-effectively this movement toward better oral health.



References

1. Cons NC, Pollard ST, Leske GS. Adhesive sealant clinical trial: results of a three-year study in a fluoridated area. *J Prev Dent.* 1976 May-Jun;3(3 Pt 2):14-9.
2. Holloway PJ, Clarkson JE. Cost: benefit of prevention in practice. *Int Dent J.* 1994 Aug;44(4):317-22.
3. Harris N, Godoy-Garcia F. *Primary Preventive Dentistry*, 5th ed. Stanford, Connecticut: Appleton and Lange, 1999.
4. U.S. Department of Health and Human Services (USDHHS). *Oral Health in America: A Report of the Surgeon General.* Rockville, MD: U.S. Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institutes of Health, 2000.
5. Newacheck P, Hughes D, Hung Y, et al. The unmet health needs of America's children. *Pediatrics.* 2000 Apr;105(4 Pt 2):989-97.
6. Edelstein BL, Douglass CW. Dispelling the myth that 50 percent of U.S. schoolchildren have never had a cavity. *Public Health Rep.* 1995 Sep-Oct;110(5):522-30; discussion 521, 531-3. Review.

7. Newacheck P, Hughes D, Hung Y, et al. The unmet health needs of America's children. *Pediatrics*. 2000 Apr;105(4 Pt 2):989-97.
8. National Center for Health Statistics (NCHS). Current estimates from the National Health Interview Survey 1996. Series 10, No. 200. Hyattsville (MD): Public Health Service; 1996.
9. Health Care Financing Administration (HCFA). National health expenditures, 1998. Washington: Health Care Financing Administration. Available from: <http://www.hcfa.gov/stats.NHE-Proj> (2000b Apr 25).
10. National Center for Health Statistics (NCHS). Current estimates from the National Health Interview Survey 1996. Series 10, No. 200. Hyattsville (MD): Public Health Service; 1996.
11. *JAMA*, 283 (10), March 8 2000, 1283-6, Achievements in Public Health, 1990-1999: Fluoridation of Drinking Water to Prevent Dental Caries, The Centers for Disease Control and Prevention: Morbidity and Mortality Weekly.
12. Burt BA, Eklund SA. *Dentistry, dental practice, and the community*. 5th ed. Philadelphia, PA: WB Saunders, 1999.
13. Bohannon H, Caries Distribution and the case for sealants. *J Public Health Dentistry*. 1983;33:200-204.
14. Rethman J. Trends in preventive care: caries risk assessment and indications for sealants. *J Am Dent Assoc*. 2000 Jun;131 Suppl:8S-12S. Review.
15. Buonocore M. Caries prevention in pits and fissures sealed with an adhesive resin polymerized by ultraviolet light: a two-year study of a single adhesive application. *J Am Dent Assoc*. 1971 May;82(5):1090-3.
16. Rock WP, Anderson RJ. A review of published fissure sealant trials using multiple regression analysis. *J Dent*. 1982 Mar;10(1):39-43. Review.
17. Deery C, Fyffe H, Nuttal N, et al. The dental caries status of Scottish adolescents reported to the regular attendees. Initial results from a primary dental care based network. *Br Dent J*, July 1999; 24(2) 95-100.
18. Mitchell L, Murray J. Fissure sealants: a critique of their cost-effectiveness. *Community Dent Oral Epidemiol*. 1989 Feb;17(1):19-23. Review.
19. Niessen L, Douglass C. Theoretical considerations in applying benefit-cost and cost-effectiveness analyses to preventive dental programs. *J Public Health Dent*. 1984 Fall;44(4):156-68.
20. Leverett DH, Handelman SL, Brenner CM, et al. Use of sealants in the prevention and early treatment of carious lesions: cost analysis. *J Am Dent Assoc*. 1983 Jan;106(1):39-42.
21. Klein S, Bohannon H, Bell R, et al. The cost and effectiveness of school-based preventive dental care. *Am J Public Health*. 1985 Apr;75(4):382-91.
22. Weintraub J, Stearns S, Burt B, et al. A retrospective analysis of the cost-effectiveness of dental sealants in a children's health center. *Soc Sci Med*. 1993 Jun;36(11):1483-93.
23. Weintraub J, Stearns S, Rozier G, et al. Treatment outcomes and costs of dental sealants among children enrolled in Medicaid. *Am J Public Health*. 2001 Nov;91(11):1877-81.

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Dr. Kitchens was a dental hygienist for 18 years before returning to professional school to become a dentist. After dental school she completed a residency in Advanced Education in General Dentistry at the University of Louisville, then an MSPH in clinical investigation. She is currently a faculty member at the School of Dentistry at the University of Louisville where she teaches preventive dentistry and provides general dental services at an intermediate care facility for the mentally and developmentally disabled.

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