Prevention-Centered Caries Management Strategies During Critical Periods in Early Childhood

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ABSTRACT

The current caries management model in the United States is based on restoring teeth rather than preventing disease. Scarce resources make this approach unsustainable, especially in clinical settings that serve vulnerable child populations. This paper presents specific prevention-centered caries management strategies that should form the basis of clinical interventions targeted at children during four critical periods in childhood: pre-age 1, ages 1–3, ages 4–5, and ages 6–7.

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Efforts to prevent and manage childhood tooth decay in vulnerable populations are hindered by scarce resources. In the current dental care delivery system, restorative procedures are delivered by highly trained dental professionals and require greater amounts of chairtime than preventive procedures, which are rate-determining factors in the number of patients a dental practice can serve. Furthermore, there is high demand for dentists in community health centers but dentists are in short supply. Without structural changes to the financing and dental care delivery system, the maldistribution of dentists is unlikely to change.

Furthermore, a recent study found that significantly larger proportions of children in states with higher Medicaid dental reimbursement rates see a dentist than children in states with lower reimbursement rates. While workforce distribution and reimbursement rates are only part of the strategy to manage and prevent childhood tooth decay, federal and state budget crises make it unlikely that new financial resources will become available to implement these and other strategies. Scarce resources make it essential that we optimize existing resources and change our thinking about caries management. Ultimately, this change in thinking needs to translate to changes in how tooth decay is approached and managed chairside. In this paper, the authors specify four critical periods in childhood and corresponding evidence-based patient care strategies:
Pre-Age 1: Prevent mutans streptococci infections in the infant;
Ages 1 to 3: Primary prevention of tooth decay in the deciduous teeth;
Ages 4 to 5: Arrest tooth decay in the deciduous teeth; and
Ages 6 to 7: Primary prevention of tooth decay in first permanent molars.

Readers may recognize that some of these strategies are being implemented. However, change is needed to align current practices with these caries prevention and management goals. Materials for dental practices that provide information on the strategies outlined in this paper are available at no cost from the Northwest Center to Reduce Oral Health Disparities website http://depts.washington.edu/nacrohd/. Practitioners and public health workers may have difficulty implementing all of these recommendations but this paper provides the basis for making reasoned decisions about what to do with limited funding and personnel.

Pre-Age 1: Prevent Mutans Streptococci Infections in the Infant

Children at high risk for tooth decay become infected with cariogenic bacteria at a young age.4,5 The mother or primary caregiver with high levels of mutans streptococci is generally the source of infection. Early mutans infections are consistently predictive of tooth decay in the deciduous teeth.6 The proportions of children colonized with cariogenic bacteria increase with age. Available evidence suggests colonization rates can be lowered or postponed to an age at which the infections are less damaging to the deciduous dentition.7 There is an appropriate analogy in medicine. As HIV/AIDS infection rates in pregnant women rose in previous decades, so did the number of infants born with maternally transmitted infection. Testing and treatment of maternal HIV/AIDS reduced the number of infected infants dramatically. There are two approaches that prevent the transmission of caries-causing bacteria from mother to infant that are supported by scientific evidence. The first is providing high quality basic dental care including repair of caries-damaged teeth, extraction of teeth with large lesions and poor prognosis, and intensive use of chlorhexidine.9 In a randomized controlled trial of this approach, new mothers with high initial levels of salivary mutans streptococci were randomized to either a treatment condition or control group. The treatment condition included...
dietary counseling, professional tooth cleaning and oral hygiene instructions, fluoride and chlorhexidine treatment, and treatment of large carious lesions. Mothers in the control group received no preventive treatment. At age 23 months, 11 percent of treatment infants were infected with mutans compared to 45 percent of infants in the control group. The preventive program was stopped when the children reached age 3. At age 7, children in the treatment group continued to have much lower levels of salivary mutans than children in the control group.19

The second approach is the use of xylitol. Three of four clinical trials in which pregnant women and new mothers chewed xylitol gum habitually led to a greater proportion of infants being free of infection as their teeth erupted.14,15,16 The time of initiation, dose, and frequency of gum chewing varied. However, the best results were seen when gum chewing began during the first year of the child’s life and continued until all the deciduous teeth were erupted. Two of these studies suggest that prevention of early infection results in lower overall tooth decay prevalence in the deciduous teeth.20 A frequency of chewing two to three times per day for five minutes and a total daily dose of five to six grams appears to be effective, although lower doses and frequencies may also be helpful. Figure 1 provides a comparison of the outcomes of these studies.

In an application of these concepts, researchers at the Northwest Center to Reduce Oral Health Disparities helped develop and evaluate an intervention program aimed at improving dental care utilization for pregnant women.21 The program, in Klamath County, Oregon, was a partnership of the local health department, managed dental and medical care organizations, and care providers. A community health partnership of stakeholders helped guide it. In the program, a dental hygienist worked at the Women, Infants, and Children (WIC) program of the health department to counsel and case manage dental care for the pregnant clients. Practices received training to overcome a reluctance to treat pregnant women. Dental utilization for the pregnant women rose from a baseline of 8.8 percent to more than 55 percent overall in the subsequent two years. Among women who were actively counseled, utilization reached almost 70 percent. Caries rates were lower in their offspring and a formal multicounty randomized trial is now being conducted.24

Ages 1 to 3: Primary Prevention of Tooth Decay in Deciduous Teeth

It is well-understood today that infants whose teeth are heavily colonized by mutans streptococci will likely develop tooth decay.22 An initial caries risk assessment should therefore be completed by age 2, when the full primary dentition has erupted. Caries risk assessment checklists that include these other risks are available and should help to make sure that resources are not wasted on unnecessary bacterial testing when tooth decay is already present. Assessing mutans levels in infants who have other risk factors before decay can develop is appropriate. The latter practice is uncommon in the United States but may be cost effective if it leads to the implementation of strategies that prevent tooth decay. An example of an inexpensive testing system is shown in Figure 2. Once the infection is identified, steps should be taken to reduce bacterial levels and protect the teeth. These steps might include daily xylitol syrup placed topically on the teeth, introduction of fluoridated toothpaste and free home distribution of toothpaste, and topical application of PVP-iodine and sodium fluoride varnish.

Xylitol mouthrinses and syrups are available in the United States, and parents or compounding pharmacies can also make their own syrup from readily available recipes. In a University of Washington study, mothers applied a viscous, flavored syrup on the child’s teeth either two or three times per day for a total of about 8 grams of xylitol per day.25 Tooth decay was reduced 50 to 70 percent over an ineffective sham treatment. The mothers began treatment when the child was about 15 months of age. Xylitol is safe and causes few side effects. Introducing the syrup slowly over a week’s time can prevent osmotic diarrhea associated with xylitol.

The introduction of toothpaste coincident with eruption of the primary dentition provides a second home strategy. Fluorides and xylitol are compatible and the actions may even be synergistic.27 There is a great deal of confusion among parents and dentists about the introduction of toothpaste caused by poor toothpaste labeling and contradictory advice by professionals. Worries about fluorosis have created uncertainty. There is a great deal of data to show that early introduction of fluoridated toothpaste is effective in preventing tooth decay and that fluorosis is mainly a risk when children are allowed to eat or lick toothpaste.28 Twice per day brushing with fluoridated toothpaste is likely more effective than brushing once per day, and free home distribution is likely to increase the effectiveness of this intervention among families with children at high risk.29

FIGURE 2. Results of plaque Streptococcus mutans testing in a 2-year old using the Dentocult SM system (Orion Diagnostics, Finland). All scores indicate the child is carrying the cariogenic organism with higher scores indicating greater risk for tooth decay (Photograph courtesy of Dr. Eva Söderling, University of Turku).
Two to four sodium fluoride varnish applications per year have become the standard of care since University of Washington researchers helped develop and evaluate the Access to Baby and Child Dentistry (ABCD) program in the 1990s. While helpful, varnish alone cannot prevent the development of tooth decay in children who are heavily colonized and have other risk factors. For these children the simple application of topical 10 percent PVP-iodine prior to fluoride varnish application appears, based on research by researchers at the University of Rochester, UCSF, and University of Washington, to provide greater protection. The procedure is simple: the teeth are dried with cotton gauze, the teeth are painted with iodine with gentle pressure, and the excess iodine is wiped off. Then the fluoride varnish is applied as usual. For maximum safety the amount of iodine applied to the teeth should be limited to the amount that will saturate a 5 mm diameter cotton ball.

Except for the small number of children who might be sensitive to iodine, the treatment carries little risk and is inexpensive to add to the standard varnish regimen. The iodine takes mutans streptococci levels to zero; they gradually increase again over two to three months. As with xylitol, the use of topical PVP-iodine is complementary to the use of fluorides in varnish or toothpaste.

Ages 4 to 5: Arrest Tooth Decay

Dental interventions aimed at children in Head Start, a school readiness program for low-income children, are often well-intentioned but may not use scarce resources optimally. Children who are going to get cavities already have them by the time they appear in Head Start classrooms. The focus of efforts at this age should be arresting existing tooth decay and establishing good toothbrushing habits that can be carried forward to help protect the permanent dentition when the child is older. The primary candidate therapy for arresting tooth decay is diammine silver fluoride (also called silver diamine fluoride or silver fluoride).

Diammine silver fluoride is used outside the United States and is highly effective, even with a single application to a decayed tooth, allowing the tooth to be exfoliated normally even if a definitive restoration cannot be placed. It is compatible with the interim restorative treatment (IRT) or alternative restorative treatment (ART) restorations with glass ionomer materials. There appear to be no adverse effects from the use of diammine silver fluoride other than staining of carious tooth structure. Researchers at the Northwest Center to Reduce Oral Health Disparities are working with industry to make diammine silver fluoride available in the United States under grant funding from the Small Business Innovation Research program of the National Institute of Dental and Craniofacial Research.

Without diammine silver fluoride, the continued use of PVP-iodine along with fluoride varnish is helpful, if only partially effective, in arresting decay in this population. However, children at high risk with existing decayed teeth will continue to experience new decay if fluoride varnish is the only strategy employed.

An additional innovation is the Hall crown technique developed in Scotland. The technique makes the application of stainless-steel crowns easier and less resource intensive and is acceptable to both clinicians and parents. It takes advantage of the healing potential of the tooth pulp. In this technique, decayed teeth — that would in the United States require pulpotomies and crowns or multisurface restorations — are crowned without tooth preparation. Orthodontic spacers are placed interproximally to open space and then the crowns are cemented with glass ionomer cement. No anesthesia is required and children can tolerate the rapid procedure without having to be sedated or hospitalized. The primary occlusion adjusts as it does with all treatments in the transitional dentition. Ample evidence exists to show that this procedure is effective. If the tooth abscesses subsequently, the pulp treatment can be done through the crown. Instructional material on Hall crowns is available without charge on the Internet (www.scottishdental.org/index.aspx?o=2802).

Ages 6 to 7: Protect First Permanent Molars

Strategies in elementary school should include protection of erupting first permanent molars with glass ionomer sealants, required twice daily supervised toothbrushing with fluoridated toothpaste at school, use of xylitol, and application of PVP-iodine and fluoride varnish. Diammine silver fluoride could also be of use if available. Programs should always include screening for, and treatment of, abscesses in primary molars.

The primary strategy to protect first permanent molars ought to be the application of glass ionomer sealants in erupting teeth. Ample evidence exists to show that much of the tooth decay in the
occlusal surfaces of molars begins when the tooth is erupting.\textsuperscript{30} Such sealants can be placed in the presence of moisture and are not as technique-sensitive as resin-based sealants that cannot be used easily in erupting teeth. In spite of good clinical evidence to the contrary, American dentists are unlikely to seal an erupted tooth with suspicion of decay and thus many unnecessary fillings are placed in the teeth most likely to require protection.\textsuperscript{31} If the teeth are protected during eruption, the necessity to seal or fill them later will be reduced markedly. Many scarce resources are being used to place resin-based plastic sealants and fillings.

School programs of mandatory supervised toothbrushing using fluoridated toothpaste are effective.\textsuperscript{32} Twice-daily brushing is more effective than once per day and supervision increases effectiveness further.

The habitual chewing of xylitol gum has been shown to reduce tooth decay in elementary school children.\textsuperscript{33} The effective dose is 5 to 8 grams per day divided into three doses. There is currently no evidence for an effective single dose of xylitol. Studies are being conducted by Case Western Reserve University using gummy bear confections sweetened with xylitol and the results should be available soon.

Additional Considerations: Children With Special Health Care Needs

Many, but not all children with special health care needs (CSHCN) are at increased risk for tooth decay. This is reflected in the American Academy of Pediatric Dentistry updated guideline on caries risk assessment.\textsuperscript{34} Factors that predispose some CSHCN to poor oral health include the inability to cooperate during toothbrushing at home because of behavioral problems, diets high in fermentable carbohydrates, and medications to treat chronic health conditions that lead to dry mouth. A major part of the problem is inadequate access to earlier first dental
visits and regular preventive dental care, especially for children with intellectual or developmental disabilities and severe chronic health conditions.35-38 Contrary to anecdotal evidence, children with chronic health conditions under age 6 are not more likely than those without chronic health conditions to require dental treatment under general anesthesia.39 Thus, the caries prevention and management strategies outlined in the previous sections apply equally to young CSHCN. This includes early first dental visits followed by regular prevention-oriented dental visits, in- tide and topical fluoride applications up to four times per year, regular use of xylitol syrups and fluoride toothpaste at home, di- ammine silver fluoride to halt caries followed by IRT-based treatment, and glass ionomer sealants applied to the erupting permanent first molars.

Implementation of Resource-Optimizing Strategies in Clinical Public Health Practice

All of the resource-optimizing strategies outlined in this paper are based on evidence in the literature. However, there is a lag in the diffusion of many of these evidence-based strategies into private practice and public health (e.g., community health centers, Indian Health Service [IHS] clinics, federally qualified health centers) settings, which is common in medicine and dentistry.38 These strategies can be easily incorporated into a busy clinical practice, as the materials are commercially available and easy to use. A rate-determining step in the dissemination and implementation of these caries prevention and management strategies is clinician motivation.

Clinicians must rethink their current practice patterns and shift from a treatment-oriented philosophy to one that is truly prevention-oriented. This approach is the only viable option in the long-term given scarce resources and will lead to improved oral health for larger segments of the child population.

Relevance to Health Policy and Policymakers

The reimbursement structure in the United States for health care services, including dental care, is based on the surgical model rather than primary care model.39 Perverse financial incentives exist to restore teeth with fillings and crowns rather than prevent the disease. While this approach may work for subgroups of children who do not experience recurrent dental disease, it is not a viable model for children who get caught in a recurring cycle of treatment. Health policies that provide incentives for dental health professionals to prevent dental disease are needed. One example is reimbursement for implementation of a caries management system (CMS), a risk-based, minimally invasive system aimed at arresting and remineralizing early carious lesions in children.40 CMS could easily incorporate fair market value reimbursement for treatments such as fluoride, chlorhexidine, and diammine silver fluoride. Of course, preventive strategies included in a viable CMS would need to be supported by studies that demonstrate scientific as well as cost effectiveness. Another is to prohibit dental insurance companies from denying dental benefits to children younger than age 3 – a practice based on outdated clinical guidelines – or to arbitrarily limit the number of preventive dental visits that are paid for in a given year without considering the child’s level of risk. If we are to move away from a model based on surgical intervention and toward one that is truly prevention-oriented, health policies need to reflect such a commitment.

Conclusions

It is imperative that dentistry moves away from a surgical model of care, where the focus is on treating disease, to a prevention-oriented model of care, where child-centered strategies are used to prevent dental disease and use scarce resources more wisely. There are a number of promising evidence-based strategies that make this possible. For infants and children at increased risk for dental caries and poor oral health, evidence-based clinical strategies include the application of xylitol, PVP-iodine and fluoride, di- ammine silver fluoride, and glass ionomer-based sealants on erupting permanent molars. To make the most of scarce resources in dentistry, it is critical that we align our clinical practices and health policies with the most up-to-date scientific evidence on caries prevention and management. Adopting these strategies has the potential to lower the overall costs associated with dental treatment, make dental care available to more children, and improve the oral health as well as the general health of our nation’s children.

References


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