

Feature Article

Paradigm Shift

The Paradigm Shift in the Etiology, Prevention, and Management of Dental Caries: Its Effect on the Practice of Clinical Dentistry

Ray E. Stewart, DMD, MS, and Kevin J. Hale, DDS

Ray E. Stewart, DMD, MS, is in private practice of pediatric dentistry in Salinas, Calif. He is a past president of the California Society of Pediatric Dentistry and currently serves the trustee of the Western Society of Pediatric Dentistry for the 10 western states in the American Academy. He is an associate professor of pediatric dentistry at the University of California at San Francisco School of Dentistry.

Kevin J. Hale, DDS, is in private practice of pediatric dentistry in Brighton, Mich. He is also a faculty member in the Department of Pediatric Dentistry at the University of Michigan.

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abstract

Treatment of dental caries as an infectious disease will require a paradigm shift in the way dentists and other health care professionals approach prevention and management of the disease. Prevention of dental caries has relied upon patient cooperation and often requires significant lifestyle changes that are at best difficult to implement and maintain or at worst ignored. This paradigm shift in the etiology, prevention, and treatment of dental caries demands that clinicians redirect their energies and emphasis from the "surgical" approach to dental caries to a "medical" strategy that focuses on early (prenatal if possible) risk assessment of the mother and implementation of appropriate therapeutic intervention including use of antimicrobials, early risk assessment of infants at 6 months of age, and a reduction in the levels of caries-producing bacteria. This revolution in how dentists practice and think will require that they develop strategies and curriculum to "retrain" practicing dentists and to train current and future dental students and residents as well as other medical colleagues on the essentials of the paradigm shift.

The fact that dental caries is an infectious and transmissible disease has been known but not widely acknowledged for more than four decades.¹ Dental caries arises from an overgrowth of specific organisms that are part of normally occurring human dental flora.² The mutans streptococci group, which includes *Streptococcus mutans* and *Streptococcus sobrinus*, as well as several lactobacilli species are considered to be the principal groups of bacteria that are acidogenic (acid producing) as well as aciduric (acid tolerant) and are responsible for dental caries. Human dental flora is site-specific; and an infant is most readily colonized with normal dental flora after the eruption of the primary dentition, which usually occurs from 6 to 30 months of age.^{3,4} However, recent studies have shown that some colonization occurs even

before teeth erupt. The vertical transmission of *S. mutans* from mother to infant is well-documented.^{5,6} In one study, it was shown that genotypes of *S. mutans* in infants matched those present in mothers in approximately 71 percent of mother-infant pairs.⁷ Furthermore, another study has suggested that there may be a window of infectivity between about 18 and 36 months of age during which much of the *S. mutans* colonization occurs.⁸ Later studies have shown transmission before and after this age range, and also from child to child as well as from adult to adult.

The significance of this information becomes apparent when considering three points. First, high caries index patterns run in families⁹ and are passed vertically from mother to child from generation to generation. The children of high-caries-index mothers are at a higher risk of decay.¹⁰ Secondly, approximately 70 percent of caries is found in 30 percent of our nation's children.¹¹ Lastly, the modification of the mother's dental flora at the time of inoculation of the child can significantly affect the child's caries index.¹²⁻¹⁴

Treatment of dental caries as an infectious disease will require a paradigm shift in the way dentists and other health care professionals approach prevention and management of the disease. Prevention of dental caries has relied upon patient cooperation and often requires significant lifestyle changes (e.g., rigorous oral hygiene, attention of dietary habits, attention to infant feeding practices) that are at best difficult to implement and maintain or at worst ignored.

The historical approach to the management of dental caries, once demineralization and cavitations have occurred, consists of the removal of the diseased tissue (enamel and dentin) and replacing it with a restorative material such as amalgam, precious metal, or one of the newer composite materials. In extreme cases where bacterial necrosis of the dental pulp has occurred, the method of treatment becomes surgical removal of the tooth or endodontic therapy followed by prosthetic restoration.

In all of these classical restorative approaches to caries management, the basic cause of the disease -- the specific acidogenic bacteria in the plaque biofilm on the remainder of the teeth in the mouth -- remains intact and capable of creating new areas of decalcification and eventual cavitation should the enabling environmental modifiers be present.

Dentists are justifiably proud of and proficient in the art and science of restorative dentistry and of their ability to deliver these services in a relatively comfortable and safe fashion to the very young or apprehensive patient.

This paradigm shift in the etiology, prevention, and treatment of dental caries demands that clinicians redirect their energies and emphasis from the "surgical" approach to dental caries to a "medical" strategy that focuses on:

- * Early (prenatal if possible) risk assessment of the mother and implementation of appropriate therapeutic intervention including use of antimicrobials;
- * Early risk assessment of infants at 6 months of age; and
- * A reduction in the levels of caries-producing bacteria.

This revolution in how dentists practice and think will require that they develop strategies and curriculum to "retrain" practicing dentists and to train current and future dental students and

residents as well as other medical colleagues on the essentials of the paradigm shift.

The nature of early childhood caries with its early onset and rapid progression should make it intuitive to health care practitioners that this disease is not exclusively a "dental" problem. Indeed, if dentists are to have any measurable effect on the reduction in the numbers of early childhood caries cases, it is essential that they enlist the assistance and collaboration of their colleagues in medicine. Because pediatricians, pediatric nurse practitioners, and other pediatric health care professionals are far more likely to encounter new mothers and infants than are dentists, it is essential that they be aware of the infectious pathophysiology and associated risk factors of early childhood caries to make appropriate decisions regarding timely and effective intervention. Dentists must educate them as to the scientific and rationale validity of the paradigm shift and encourage them to acquire the knowledge that will enable them to administer an oral health risk assessment and perform an infant oral exam beginning at 6 months of age for those patients who are at moderate to high risk for caries and to direct the parent to establish a dental home for the infant by 1 year of age.

Primary Prevention and Management of Dental Caries

Once the infectious disease paradigm for the etiology of dental caries is accepted, the medical approach to the management of the caries process, which focuses on the prevention, becomes obvious. The medical strategy for preventing dental decay consists of the systematic application of the following practices:

- * Assessing the caries risk of the intimate care provider (usually the mother) and the infant;
- * Conducting an infant oral screening examination; and
- * Delaying or reducing bacterial colonization of the infant by lowering levels of cariogenic/acidogenic bacteria in the colonization source (mother or caregiver) as well as in the infant.

Caries Risk Assessment

All health care professionals who treat infants and children must be capable of conducting a caries risk assessment of the infant and mother or other intimate caregiver.

The primary thrust of caries risk assessment is to determine the virulence and/or caries expression of the dental bacterial clone set of the mother/infant pair. For any assessment tool to be widely adopted and used, it must be user-friendly, quick, and easy to interpret. Furthermore, it must meet these criteria in a variety of settings, e.g., dental offices; school screenings; pediatricians' offices; Women, Infants, and Children Program centers; community health centers; etc. Several caries risk assessment tools have been published. This issue of the *Journal of the California Dental Association* includes a caries risk consensus statement and a series of forms and instructions developed by a group brought together in April 2002 specifically to update and review the literature and develop these practical tools. These forms and instructions provide a template for use in clinical practice. A simple assessment of the mother's caries history can be performed by obtaining a dental history and examining her dentition. Mothers with active decay and/or multiple fillings in multiple quadrants of the mouth are at higher risk than those who have never experienced decay or have but one or two restorations.

Regardless of the parent's caries activity, it is generally agreed that infants who fall into one of the following categories should be considered high risk and referred to a dental home by age 1.

- * Children who are medically compromised;
- * Children of mothers with a high caries rate;
- * Children with demonstrable caries, plaque, demineralization, and/or staining;
- * Children who sleep with a bottle or at the breast all night;
- * Later -- older siblings of a parent with mildly to moderately high caries rate; and
- * Children in families of low socioeconomic status.

Infant Oral Screening Exam

It is essential that both dental and nondental health professionals who see infants and children be trained and capable of doing oral health risk assessment and dental screening examinations as part of the infant's pediatric health care visit. This oral screening examination should be a matter of routine, starting at about 6 months of age or after the maxillary incisors have erupted.

Prior to the eruption of the primary incisors, the usual information discussed in neonatal anticipatory guidance -- such as teething, fluoride topical sources/fluoride therapy, and non-nutritive sucking -- should be reviewed.

Once the maxillary incisors have erupted, it is important to include examinations of these structures as part of the routine periodic physical examination. The examination can conveniently be done on the examining table or in the "knee to knee" position with the parent and practitioner sitting facing one another with knees touching. The parent holds the infant facing her and slowly and gently lowers the child's head onto the examiner's lap, while restraining the baby's legs under his or her arms and holding the baby's hands. In this position, the infant will be well-stabilized and firmly supported with his or her face and mouth clearly visible to the examiner. To properly examine the infant's mouth and teeth, there should be a good light source, a disposable mouth mirror, and a soft-bristled toothbrush. The infant's reaction to the examination can vary and it is not unusual for them to cry and resist the procedure, so parents should be assured beforehand that this is a normal response.

The practitioner should lift the upper lip and examine the teeth, checking for the presence of plaque; "white lesions" or cavitations; and abnormal tooth structure (enamel hypoplasia, fusion/germination), tooth eruption, or soft tissues.

Using a soft-bristled toothbrush, the practitioner should brush the teeth using a circular scrubbing motion to remove any plaque. Following plaque removal, any white spots, stains, decay, or pitted enamel should be noted. Using a mouth mirror to see, the practitioner should similarly clean and inspect the posterior surface.

If significant plaque is present on any of the teeth or they are noted to have white lesions or areas of decalcification, the infant should be considered at high risk for caries. As such, the infant should be referred to a dental home where he or she will be seen by a dentist who treats infants and toddlers.

If no abnormalities are present and the teeth are free of plaque or white lesions, the infant is at lower risk of the development of caries. The parents should be instructed to brush the child's

teeth daily. They should be encouraged to have the child initiate regular visits with the family's dentist or a pediatric dentist by about 1 year of age so the responsibility for periodic risk assessment and oral screening can be assumed by dental personnel.

If no dentist can be identified who will see the child before 3 or 4 years of age, the pediatrician, family physician, or appropriately trained personnel should assume the responsibility for the risk assessment and screenings as part of the periodic preventive health care visits. In these circumstances, these nondental personnel must be trained to implement intervention strategies such as the application of antimicrobials, fluoride therapy, etc.

Delay Bacterial Colonization

The goal of the third tier of caries prevention is to delay colonization of the infant by the cariogenic bacteria while lowering the levels of these organisms in the colonization source (mother or caregiver). Delay of colonization can be accomplished by cautioning the parent to avoid bacterial inoculation practices (e.g., sharing toothbrushes, sharing eating utensils, cleaning pacifier with saliva, etc.).¹⁵ Limiting the levels of acidogenic/cariogenic flora in the mother prior to and during the colonization process in the infant can have a significant positive impact on the child's caries rate.^{12,13} Strategies include:

- * Removal of all active caries and reducing the levels of cariogenic flora in the remainder of the mouth through the use of appropriate therapeutic measures including restorative procedures and antimicrobials;
- * Administration of meticulous oral hygiene;
- * Judicious administration of fluorides;
- * Avoidance of simple sugars between meals in a frequent and/or protracted fashion; and
- * Utilization of xylitol chewing gum, four times a day.¹⁴

Restorative Dentistry

Only carious lesions that are active, frank, and cavitated require the surgical intervention of operative dentistry. Carious lesions that are not active, frank, and cavitated -- such as "white spot lesions" and/or incipient lesions -- are best addressed using the medical approach. This medical management of caries is similar to current medical management of other diseases. The clinician may rely on visual and microbiological diagnosis such as CRT (Caries Resistance Test) by Vivadent (Amherst, N.Y.) to assess the level of bacterial challenge. In concert with the diagnosis, remineralization can be achieved through pharmacotherapeutic interventions such as professionally applied high-concentration fluoride products (foam, varnish, or gel) and home-use topical fluoride products (toothpaste, rinses). In the case of high bacterial challenge, chlorhexidine can be used to control the infection.

Summary and Recommendations

There are five recommendations as to how dentists might speed acknowledgment and acceptance of the paradigm shift among their peers:

- * The paradigm shift -- the concept of early childhood caries as an infectious and preventable

disease that is contagious and transmitted to the child from the mother or other close caregiver who harbors high levels of cariogenic flora -- must be aggressively promoted and taught to all medical and dental providers who have contact with mothers (pre- and postnatal) and infants.

* Educational and teaching tools in various media formats appropriate for a variety of health care professionals must be developed. These materials must focus on the infectious and transmissible nature of early childhood caries, the methods and rationale of oral health risk assessment, infant oral examination, anticipation guidance, and early intervention including the use of antimicrobials and agents that enable the remineralization of early white lesions.

* Every child should receive an oral health risk assessment and oral examination by age 6 months from a qualified, appropriately trained health care professional (dentist, pediatrician, family practice physician, physician's assistant). Infants who fall into one of the following categories should automatically be placed in the high-risk group.

* Children who are medically compromised or have developmental disabilities;

* Children who have mothers or close caregivers at high risk for caries (active decay);

* Children with demonstrable plaque, caries;

* Children who sleep with a nursing bottle or at the breast;

* Children with older siblings with history of early childhood caries; and

* Children from families of low socioeconomic status.

* The American Academy of Pediatrics should be encouraged to support the concept of the a first dental visit by age 1 year and the establishment of a dental home as an independent and specialized primary care provider similar to the medical home concept promoted by the Academy.

* Last but not least, there needs to be a coincidental paradigm shift within the insurance industry and among the governmental agencies, which are responsible for establishing health care policy and regulations. Practitioners should be compensated for the provision of preventive services such as early caries risk assessment and anticipatory guidance to increase these practices.

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To request a printed copy of this article, please contact: Ray E. Stewart, DMD, MS, 631 E. Alvin Drive, Salinas, CA 93906 and drstewart@aol.com.

