

Addressing Disease Burden through “Preventive”, “Medical” & “Surgical” Oral Health Care

Because dental caries (tooth decay) is so common, reducing children’s overall oral disease burden can be accomplished best by focusing on this disease. Like other diseases, caries can be prevented, managed, or corrected as it progresses along its continuum of destruction. Preventive dental care holds promise for children to avoid decay or keep it from moving on to additional teeth. Medical management of dental caries is a term that encompasses a variety of treatments aimed at stopping or reversing the caries process. Such medical management holds promise to transform a child who is “caries active” and experiencing a progression of disease to one who is “caries inactive” and whose “lesions” stop advancing. Surgical management of dental caries refers to the variety of treatments that remove decayed tooth structure or whole teeth and replace missing tooth structure with fillings or other dental prostheses. Each successive phase is more complex, more demanding of professional resources and facilities, and more expensive.

Using the pediatric medical model of staged interventions, dental caries can be addressed by “risk assessment” to determine which children are most likely to develop disease and therefore need closest attention. Once this is determined for either groups of children or individuals, preventive care that is proportional to risk can be provided through “anticipatory guidance” and “primary prevention” services. If these are not successful in avoiding the disease, it is managed medically through “disease suppression” and “disease arrest” services. Children whose disease advances to the point where teeth need repair must be managed by “surgical” treatments including traditional dental repair.

Background on Dental Caries

Remineralization and Demineralization

Cavities appear as holes in teeth only after a longstanding destructive process removes so much tooth mineral that the tooth surface collapses. This progressively destructive decay process is complex – going through periods of activity and periods of inactivity. Since the oral environment intermittently establishes conditions that “reverse” the decay process, the tooth can “remineralize” until the surface collapses into a cavity. During periods of “remineralization” the damaged tooth surface re-hardens as calcium and other minerals return to the damaged tooth surface. Only when demineralization exceeds remineralization over enough time does a cavity form. Until the tooth surface collapses or the lesion penetrates deeply into the tooth, the tooth does not require “filling” (i.e. “surgical care”) but rather can be treated using “medical” approaches that reduce demineralization and enhance remineralization. To reduce disease burden, “preventive,” “medical,” and “surgical” treatments are necessary: preventive services to avoid disease, medical treatments to control or “arrest” the decay process, and surgical care to repair collapsed tooth surfaces (cavities).

Dental Caries as an Infectious Disease

Although many regard tooth decay as an inevitable part of growing up, dental caries is actually a transmissible infectious disease. The bacteria that cause dental caries can only be acquired after teeth are present in the mouth. Research suggests that the primary “donor” of these “cariogenic bacteria” is the child’s mother and that transmission occurs through direct salivary contact between mother and child. Transmission vectors typically result from normal parenting

behaviors including sharing feeding utensils, licking pacifiers, using saliva to clean a child's mouth, and allowing an infant to place a hand in the mother's mouth and then into his or her own. The level and percentage composition of cariogenic bacteria in the mouth varies considerably among individuals. Mothers who have had extensive problems with tooth decay, with or without repair, are more likely to harbor high levels of these bacteria and thereby put their children at higher risk for early and extensive infection. The earlier a child is infected with cariogenic bacteria, the greater the proportion of the child's total oral flora that will be comprised of these organisms and the more likely that child is to develop decay.

Role of Diet and Fluoride

If a child is infected and also exposed to high frequencies and large quantities of simple sugars, the risk for early tooth decay becomes extreme. The intensity of the caries process can be mitigated by frequent exposure to low levels of fluoride, whether delivered topically (on the teeth) with toothpaste, prescription gels, or varnishes or fluoridated water. Ultimately, an individual's caries activity will depend upon the presence and quantity of cariogenic bacteria, the quantity and frequency of exposure to simple carbohydrates in the diet, and the availability of fluoride to offset the disease. Only after the disease process has been present for a long enough period of time is damage to the teeth visually evident.

From "White Spot" to "Dental Abscess"

Initial damage consists of a mineral loss in the tooth's enamel layer, which appears as an opacified or "white spot" lesion. Continued damage to the crystalline structure of the tooth will result in discoloration, loss of surface continuity and integrity, and cavitations (i.e., a "cavity"). Continued loss of tooth structure results in lesion progression into the softer "dentin" layer of the tooth and associated pain. As the lesion (cavity) deepens, it ultimately extends into the vital dental pulp ("nerve"). Invasion of bacteria into the exposed pulp results in its acute inflammation with associated acute pain and ultimately to pulpal death and subsequent infection. As infected material works its way through the length of the tooth to the supporting bone and soft tissues, a "periapical" abscess results. Further extension into the face results in a swelling that is termed "cellulitis." Depending on the location of this cellulitis, it may lead to fluid retention around the eye resulting in its closure, extension of infection behind the nose and up into the skull, swelling of the cheek along the jaw line, or most dangerously swelling under the tongue and chin where it can obstruct breathing. Most chronic infections, however, remain localized and result in pus draining directly into the mouth or, occasionally, through the child's face.

Traditional dental caries management focused on early detection of small cavities and their repair with non-therapeutic restorative agents including silver amalgam and plastic tooth-colored materials. (Since most dental materials are not bioactive—glass ionomers being a notable exception, they can best be considered as "prosthetic" rather than therapeutic.) This common approach focuses on management of the lesion (cavity) rather than management of the underlying disease process that produces the lesion.

Preventive Management of Dental Caries

The goal of "preventive caries management" is to intervene early in the natural history of caries initiation and progression so that cavities are avoided. Avoiding cavities translates into reduced

disease burden for the child, for the population, less need for dental repair, lower oral health care costs, and better health outcomes.

Children are not at equal risk of developing an active caries process. Therefore, it is ideal if an individualized “disease risk assessment” is conducted. Once the assessment is complete, intensity of preventive interventions can be tailored to the child’s disease risk. At the population level, factors that correlate with higher caries experience also correlate with Medicaid and SCHIP eligibility. These include low-income, minority status, low parental education, and residence in inner-city and rural areas. However, even among Medicaid-enrolled children, a sizable proportion of children enjoy relatively good oral health and only occasionally need basic restorative treatment. Data from California’s Medi-Cal program show that eighty percent of Medicaid enrolled children with a reparative (“surgical”) dental visit have only modest treatment needs; roughly fifteen percent require more extensive restorative treatment because they are more severely impacted; and five percent suffer extreme carious destruction, often necessitating treatment under sedation or general anesthesia. Any effort that successfully sorts and manages children by risk can help reduce expenditures while providing individualized intensity of dental health care.

1. Risk Assessment

Although extensive population-level work has been done to identify groups of children at high risk for developing decay, less is known about predicting an individual child’s risk for disease. Key risk factors include mother’s and sibling’s past decay experience, inappropriate use of the feeding bottle or excessive frequency of breast feeding, high frequency ingestion of simple carbohydrates, inadequate exposure to fluoride, and poor oral hygiene. Some experts suggest that any child who demonstrates visibly evident plaque on the four incisors at age 12 months is at extreme risk for cavities. Certainly, past decay experience is the best predictor of a child’s future decay experience simply because past decay experience evidences an underlying caries process sufficiently intense to produce cavities. Other factors that may promote decay in otherwise healthy children are attitudinal. These include low parental values for oral health and an external “locus of control,” which is expressed as a fatalistic attitude concerning eventual loss of teeth. Other factors that promote decay are the result of co-morbidities (i.e., medical conditions or treatments that alter immune function, salivary flow, or bacterial flora). Interestingly, some evidence suggests that an experienced dentist’s “judgment call” about a child’s risk for developing cavities is surprisingly predictive.

2. Anticipatory Guidance

The concept of anticipatory guidance maintains that disease can be prevented by anticipating the conditions under which disease occurs and guiding parents to avoid those conditions. For example, since transmission of cariogenic bacteria cannot occur until teeth are present, and since teeth generally appear at six to 12 months, the period prior to tooth eruption can be used to instruct parents how to prevent salivary transmission of cariogenic bacteria. The intensity of such guidance can be proportional to the mother’s own past decay experience. Therefore, mothers who put their children at greatest risk can be instructed in prevention transmission. Anticipatory guidance also helps parents understand the role various foods play in the transmission of cariogenic bacteria. Therefore, parents can be advised about the relationships between frequency of simple carbohydrate exposure and decay. Anticipatory guidance also includes early instruction in appropriate use of the bottle feeding or frequency and duration of breast feeding.

3. Primary Prevention

In order for a child to remain at low risk for developing decayed teeth, primary prevention strives to maintain a healthy balance among normal bacterial flora (including a subset of cariogenic organisms), potentially cariogenic dietary exposures, and age-appropriate fluoride. Modalities that can be used for primary prevention include effective oral hygiene practices, application of topical fluoride in the form of varnish, control of dietary exposures, and regulation of systemic fluoride exposure. Restoring diseased teeth in mothers prior to the eruption of primary teeth in infants also might be considered a form of primary prevention.

Medical Management of Dental Caries

4. Disease Suppression

For children who have already developed an active caries process, disease suppression interventions are those that attempt to reduce the load of cariogenic organisms in the mouth. These interventions utilize tailored fluoride or antimicrobial regimens to reduce acid production and enhance dental tissue resistance and intensive dietary and hygienic counseling. The use of salivary cultures to track a child's cariogenic flora can be very useful in measuring the effectiveness of disease suppression efforts.

5. Disease Arrest

Although "white spot" lesions or cavities may be visually evident, intensive efforts to reduce cariogenic activity in a child's mouth can arrest lesion progression and reverse lesions through "remineralization" of "demineralized" areas. If cariogenic activity is not reduced, however, even the finest dental repair is subject to failure as new lesions form in teeth that have already experienced repair. Arresting caries, as a precursor to dental repair, has a number of advantages to the teeth, the child, and the parent. The teeth will require less extensive repair. The child will find treatment less imposing. And the parent will find the experience more satisfying and less costly.

An adjunct to arresting caries or "caries control" is atraumatic restorative technique (ART). During this technique, the damaged tooth structure, which is softened by decay, is gently scooped out of the tooth without use of local anesthesia. Then, the tooth is treated with an adhesive restorative material that slowly releases fluoride directly into the surrounding tooth structure. If successful, this technique can help control caries until children are mature enough to undergo traditional restorative care, thereby potentially avoiding hospitalization and general anesthesia with its associated risks and expense.

Surgical Management of Dental Caries

6. Dental Repair

Even if successfully arrested, a cavity almost always needs to be "surgically" repaired by removing the diseased tissue and filling the defect with a prosthetic material that reshapes the tooth and allows it to regain normal chewing and tooth-alignment functions. Neither prevention

nor medical management of dental caries can replace the need for repair if the disease has progressed to the point of cavitation. Surgical treatments include a host of specific dental procedures such as fillings made of composite plastic, dental amalgam, or glass ionomers, plastic and stainless steel crowns, root canal treatments of various types, and extractions and placement of space maintainers. For the most part, these materials do not affect the underlying caries process that necessitated repair.

Matching Health Care Providers to Levels of Caries Management

Risk assessment, anticipatory guidance, primary prevention, disease suppression, and surgical repair of lesions constitute a continuum of care. Each level requires greater training and professional credentials. The following chart identifies providers who can appropriately deliver these services.

Prevention and disease management are highly advantageous in terms of cost and relative implementation ease, but are not substitutes for surgical reparative treatment for those children who experience advanced disease.