10-1-2015

Children's Oral Health Assessment, Prevention, and Treatment

Christopher Okunseri
Marquette University, christopher.okunseri@marquette.edu

Cesar Gonzalez
Marquette University

Brian D. Hodgson
Marquette University, brian.hodgson@marquette.edu

Accepted version. *Pediatric Clinics of North America*, Vol. 62, No. 5 (October 2015): 1215-1226.

Children's Oral Health Assessment, Prevention, and Treatment

Christopher Okunseri
Department of Clinical Services, School of Dentistry,
Marquette University,
Milwaukee, WI
Cesar Gonzalez
Department of Developmental Sciences, School of Dentistry,
Marquette University,
Milwaukee, WI
Brian Hodgson
Department of Developmental Sciences, School of Dentistry,
Marquette University,
Milwaukee, WI

Keywords: Dental caries, Risk assessment, Prevention, Treatment, Pediatricians

Pediatric Clinics of North America, Vol 62, No. 5 (October 2015): pg. 1215-1226. DOI.

Introduction

This article provides a brief introduction to the oral health of children and the barriers to dental care as well as some discussion on prevention and treatment modalities for dental caries. Also covered is the epidemiology of dental caries, caries risk assessment, and the involvement of pediatricians in advocating for and providing preventive dental care for children. Dental caries, one of the most common dental diseases, is also referred to as tooth decay or cavities by the public.[1] Dental caries is a recognized public health concern that results from the repeated interaction of oral bacteria, primarily mutans streptococci, with fermentable sugars leading to acid production that results in microscopic dissolution of minerals in dental hard tissues and the formation of opaque white (white spot lesions) or brown spots on teeth.

Early childhood caries (ECC) is the presence of 1 or more decayed (noncavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child before the age of 6 years.[2] ECC is considered severe if the smooth surfaces of the teeth are affected in children less than 3 years old.[2] Early and preventive dental care is cost-effective in reducing dental disease burden,[3 and 4] as well as in establishing a dental home as a foundation on which a lifetime of preventive education and oral health care can be built.[5 and 6] Routine or preventive dental visits are important for early diagnosis, prevention, and treatment of dental caries and for establishing and maintaining good oral health and overall well-being[1, 3 and 4]

Barriers to children's oral health

Oral health means more than taking care of the teeth; it refers to the health of the oral cavity and its supporting structures.[1] Oral health is integral to general health and it contributes to overall health and well-being.[1] Despite documented improvement in the oral health of most Americans, access to dental care continues to be a problem in the United States. Inadequate access to dental care cuts across age, gender, and socioeconomic and geographic boundaries. Children from racial and ethnic minorities and low-income families, the uninsured, poor inner-city children, and those with special needs are

Pediatric Clinics of North America, Vol 62, No. 5 (October 2015): pg. 1215-1226. DOI.

disproportionately affected by dental diseases and have the most inadequate access to dental care. This problem to persists even with the many years of research into the cause and prevention of common dental diseases. Oral health care remains one of the most challenging and prevalent unmet health needs among infants, toddlers, adolescents, and young adults in the United States[1] and developing countries.

Barriers to children's oral health exist, especially for Medicaid enrollees. These barriers include workforce maldistribution and/or inadequate numbers of dentists,[7] low Medicaid reimbursement rates, and high administrative burden.[8] In addition, there is a severe shortage of minority dentists to serve the growing racial/ethnic minority Medicaid enrollees. As Okunseri and colleagues[9] have reported, minority dentists are more likely to accept new Medicaid patients. Furthermore, studies have documented that children from low-income families have lower odds of receiving comprehensive dental care and higher odds of having acute dental disease than children from middle-income and upper-income families.[10 and 11] To remedy these problems, professional organizations and government agencies continue to work towards expanding the workforce and developing various alternatives, such as school-based sealant and fluoride varnish application programs. These programs are usually managed by dental professionals, including dental hygienists and assistants. In addition, pediatricians and family physicians conduct oral health risk assessment and provide preventive care that includes anticipatory guidance in their offices.

Epidemiology of dental caries

Most children are susceptible to dental caries throughout their lives. However, with the knowledge of epidemiology, dental care providers and researchers have a better understanding of the distribution and determinants of dental caries in different population groups. They also have the opportunity to engage in anticipatory guidance and risk assessment, and to use different modalities of caries prevention. Although different classifications and indices of caries have been used in epidemiologic studies, the facts related to who is affected and by how much in different populations still remains easy to

Pediatric Clinics of North America, Vol 62, No. 5 (October 2015): pg. 1215-1226. DOI.

comprehend. Understanding dental caries epidemiology is crucial to providing appropriate clinical care and to identifying relevant public health measures to control the disease. However, because of some of the limitations associated with epidemiologic studies, clinicians are encouraged to engage in caries risk assessment.

In the last 20 years or so, epidemiologic studies have documented an overall decline in dental caries prevalence caused by population exposure to fluoride in water, toothpastes, mouth rinses, and in topical products applied in dental offices. In addition, improved oral hygiene, increased awareness of the relevance of dietary influence on caries, and changing patterns of refined sugar consumption have contributed to this decline.[1] Findings from epidemiologic studies continue to be used to support health care planning and resource allocation as well as in the monitoring of Healthy People 2020 objectives related to oral health.

The National Health and Nutrition Examination Survey (NHANES) 1988 to 1994 and 1999 to 2004 shows that the prevalences of untreated dental caries for children 2 to 5 years old and 6 to 11 years old were 19.1% versus 20.1% and 25.5% versus 25.0% in the primary dentition, respectively.[12] Disparities in dental caries burden persisted in all NHANES surveys. For example, NHANES 2009 to 2010 showed that prevalence of untreated caries was significantly higher among non-Hispanic black children (19%), compared with non-Hispanic white children (11%) aged 3 to 5 years.[13] In terms of poverty status, children aged 3 to 5 years and 6 to 9 years living in families at or below 100% of the federal poverty level had a significantly higher number of untreated dental caries compared with those living above the poverty level.[13]

Caries risk assessment

Risk refers to the probability that some unwanted event might occur. Caries risk assessments are as important as the specific diagnosis of the disease. The identification and mitigation of risk is the foundational component of the nonsurgical management of dental caries.[14] According to the guidelines published by the American Academy of Pediatric Dentistry (AAPD) on caries risk assessment for infants, children, and adolescents, risk assessment is considered a part

Pediatric Clinics of North America, Vol 62, No. 5 (October 2015): pg. 1215-1226. DOI.

of the standard of care for treating children.[15] Recent initiatives to include members of the medical profession in identifying patients at risk for dental caries have greatly assisted in the mitigation of some of the risk factors and it is hoped will lead to better outcomes for the population.[16] Educating medical colleagues in dental caries prevention, risk assessment, and referral is important to overall reduction in caries incidence and achieving excellent oral health in children.

Numerous researchers have identified caries risk factors documented by AAPD.[17, 18, 19 and 20] These risk factors include mother/caregiver with active cavities; parent/caregiver of low socioeconomic status; child with more than 3 between-meal, sugar-containing snacks or beverages per day; child put to bed with a bottle containing natural or added sugar; child with special health care needs; and recent immigrant children.[15] In 1981, Berkowitz and colleagues[20] found similar oral bacteria in a mother and her child, and their research indicated that mothers with high salivary levels of *Streptococcus mutans* were 9 times more likely than mothers with low levels to transmit their oral bacteria to their children. [21] Kohler[21], 1988 showed that children colonized by *S mutans* at an age younger than 2 years had significantly more decayed, filled surfaces (decayed, filled surface of 5.0 vs decayed, filled surface of 0.3) than children who were not colonized at that age. [22] Southward and colleagues[22] showed that parents with abscessed teeth were significantly more likely to have children with urgent oral care needs. Thitasomakul and colleagues[23] also showed that mothers with greater than or equal to 10 decayed teeth had children with higher incidences of cavities.

Parents/caregivers from low socioeconomic backgrounds have consistently been associated with dental caries.[23, 24, 25, 26 and 27] Low socioeconomic status can lead to poorer food choices high in sugar content.[28 and 29] The classic Vipeholm caries studies[30, 31 and 32] show that the frequency and not necessarily the total amount of sugar consumption is more predictive of having dental caries, thus supporting that children with greater than 3 between-meal sugar-containing snacks or beverages per day are at increased risk for dental caries. In addition, putting a child to bed with a bottle containing natural or added sugar has been documented as a risk factor for dental caries. The sugar consumed through a bottle when a child is put to bed tends to remain on the teeth for prolonged periods of time,

Pediatric Clinics of North America, Vol 62, No. 5 (October 2015): pg. 1215-1226. DOI.

which allows an extended period of bacterial acid generation with limited oral clearance and poor salivary buffering. The result is a greater amount of mineral dissolution from the teeth, eventually leading to cavity formation.

The AAPD's 2007 symposium on patients with special health care needs enumerates many reasons why children with special health care needs are considered to be at higher risk for dental caries.[33] These reasons include increased focus on the intensive medical attention required for their overall general health, limited oral muscle coordination and retention of foods in the oral cavity longer than healthy children, difficulty of parents/caregivers in providing adequate oral hygiene, and the requirement for special dietary formulations resulting in more frequent feedings.

Prevention of dental caries

Following caries risk assessment, the treatment of clinically evident dental caries involves both nonsurgical and surgical management. Greater emphasis is placed on nonsurgical management methods before surgical intervention when lesions are not cavitated,[34] which has great potential not only to reduce morbidities associated with the delivery of dental care (local anesthesia, removal of both diseased and sound tooth structure, possible sedation/general anesthesia) but also to reduce the risk of future disease, something that surgical restoration alone does not do.

As part of the nonsurgical approach, dentists have traditionally engaged in the distribution of written information to their patients in the form of brochures/pamphlets, or public dental advertising in magazines, radio, and even television. Some providers also show videos in their offices in an attempt to educate both parents and children. This traditional approach has the expectation of altering the behavior of both parents and children, mostly within the high-risk populations. However, this approach relies on a 1-way communication from the expert (provider) to the patient and has sometimes proved to be unsuccessful.[35, 36 and 37]

A different approach has shown promising results: brief counseling. This approach involves brief motivational interviewing with

Pediatric Clinics of North America, Vol 62, No. 5 (October 2015): pg. 1215-1226. DOI.

follow-up by phone. This approach relies on a 2-way communication and tries to engage the parent in a healthy discussion. It has been reported that, when the counselor does most of the talking, counseling usually fails.[38] Clinical studies involving brief counseling have reported a potential benefit with the use of this technique.[39 and 40] Weinstein and colleagues,[41] in a 2004 study, compared traditional health education (pamphlet and video) with a brief motivational interview counseling intervention (pamphlet and video plus 1 counseling session and 6 follow-up telephone calls from a lay health counselor). Results after 1 and 2 years showed a positive impact for the brief counseling group. At 1 year, children in the counseling group had 0.71 new carious lesions compared with 1.91 in the traditional group. The data were similar for the second year.[40] Motivational interviewing is an approach that has shown promising results in the improvement of the oral health of those children at risk. In 2002, a survey of dental schools in Canada and the United States concluded that instruction in interpersonal communications skills was not adequate.[41] However, some dental schools are already teaching counseling skills similar to motivational interviewing.[41]

Other preventive approaches used both at the dental office and home include pit-and-fissure sealants, fluoride varnish, amorphous calcium phosphates, and xylitol. Sealants are a thin plastic coating placed on the chewing surfaces of posterior teeth and are considered safe, cost-effective, and easy to apply.[42, 43 and 44] As long as they remain intact, they have been shown to reduce caries on these surfaces by 40% to 100%, especially in high-risk populations.[43, 45, 46 and 47] The American Dental Association (ADA) has published recommendations on the use of sealants as both a preventive and therapeutic service on noncavitated and inactive carious lesions.[48]

Despite strong evidence-based reports about the effectiveness of this caries preventive technique, pit-and-fissure sealants continue to be under prescribed, particularly among those at high risk for experiencing caries. That population include children from lower-income families and certain racial and ethnic groups.[49] The national oral health objectives for dental sealants, as stated in Healthy People 2010, includes increasing the proportion of children who have received dental sealants on their molar teeth to 50%.[27] However, national data collected from 1999 to 2002 indicated that sealant prevalence on

Pediatric Clinics of North America, Vol 62, No. 5 (October 2015): pg. 1215-1226. DOI.

permanent teeth among children aged 6 to 11 years was only 30.5%.[28]

Another nonsurgical approach is fluoride application from various sources. Once dietary issues have been adequately addressed, fluoride stabilizes the apatite mineral, has bactericidal properties,[50 and 51] and results in the remineralization of new tooth minerals, making it significantly more resistant to further decay. The mineral apatite is the base mineral in the structure of teeth. It can exist in multiple forms, but in the human body chiefly exists in 3 forms: carbonated apatite, hydroxyapatite, and hydroxyfluorapatite. The major apatite present in a newly erupted tooth is carbonated apatite, which has a critical pH (the pH at which the mineral is saturated with respect to the solution) of approximately 6.5. The normal pH of the saliva is close to the normal physiologic pH of the body: between 7 and 7.4. On fermentation of carbohydrates, the cavity-causing families of bacteria (mutans streptococci and lactobacilli) cause a shift in the plaque pH to less than 4.5, resulting in dissolution of the tooth mineral. Hydroxyapatite is a much more stable crystal than carbonated apatite at pHs of less than 6.5. This process results in a preferential reformation of hydroxyapatite mineral. Hydroxyapatite's critical pH is approximately 5.5. Thus, this maturation of the enamel, the replacement of carbonate ions with hydroxide ions, results in a mineral that requires 10 times as much acid to dissolve it than the original mineral.

Fluoride's ability to replace other ions in the hydroxyapatite mineral of which teeth are composed results in increased resistance to the dissolution of the teeth in the oral cavity.[50] Fluoride incorporation into the tooth structure, either pre-eruptively or post-eruptively greatly helps in reducing the risk of caries in individuals, but post-eruptive fluoride incorporation seems to provide the greatest benefit.[50] However, if the fluoride ion is present in the plaque and saliva, the substitution of hydroxide with fluoride is a significantly more stable mineral than hydroxyapatite, and hydroxyfluorapatite is preferentially reformed in the tooth. The critical pH of hydroxyfluorapatite is approximately 4.8. Therefore, with fluoride incorporation, it takes almost 100 times more acid to dissolve the hydroxyfluorapatite than the original carbonated apatite.[51] With the demineralization and remineralization process continuing throughout the day, the

Pediatric Clinics of North America, Vol 62, No. 5 (October 2015): pg. 1215-1226. DOI.

maintenance of low levels of fluoride in the plaque and oral fluids throughout the day has the greatest effect at reducing caries incidence. If the patient lives in a location with nonfluoridated public water supplies (either municipally provided or via a private well) the AAPD and the American Academy of Pediatrics (AAP) recommend supplementation with fluoride tablets.[52 and 53]

Xylitol is another product routinely prescribed in dental offices for caries prevention. Xylitol is a natural sweetener that is obtained from birch wood, corn stalks, and other sources. Multiple studies have suggested that this sugar alcohol assists in the arrestment of the caries process and can reduce the transmissibility of mutans streptococci. Difficulties in compliance with the required daily dosage (5–10 g/d in 3–5 divided doses) contribute to the lack of effectiveness with this product. In addition, concerns with osmotic diarrhea also reduce the frequency of recommendation. Dosages of up to 45 g/d for children 7 to 16 years old resulted in no significant increase in gastrointestinal disturbances compared with no xylitol consumption.[54] Compliance with the dental benefits of 5 to 10 g/d has a very low risk of gastrointestinal distress.

Amorphous calcium phosphates have been shown to both decrease demineralization and increase remineralization of early carious lesions, most likely because of the common ion effect on the equilibrium of the apatite crystal.[55] Other reports indicate that the calcium phosphopeptide–amorphous calcium phosphate (CPP-ACP) also affects the bacteria related to dental caries.[56] However, a more recent report indicates that long-term low levels of fluoride are more effective at caries prevention than CPP-ACP.[57]

Treatment of dental caries

It is sometimes challenging to prevent all carious lesion so restoring carious teeth seems to be the ideal approach to improving the oral health of children. The surgical methods for the treatment of carious lesions have changed little since the nineteenth century, with removal of carious tissues with either hand or rotary instruments followed by the placement of a filling material to restore the tooth to anatomic and morphologic shape and function. When the caries process was less clearly understood, the philosophic approach

Pediatric Clinics of North America, Vol 62, No. 5 (October 2015): pg. 1215-1226. DOI.

espoused by Dr G. V. Black (considered the father of restorative dentistry) was to err on the side of surgical intervention because of the high frequency of small lesions rapidly progressing to large lesions. This philosophy was dominant for the larger part of the twentieth century. With the introduction of fluoride as a preventive agent, both in municipal water supplies and in over-the-counter oral products, the rate of progression of dental diseases decreased precipitously. Despite this slowing of the disease process, the philosophic model of aggressive surgical intervention did not rapidly dissipate. However, the second half of the twentieth century saw recommendations to rethink the aggressive surgical model and promote a more conservative approach.[58]

The invasiveness of surgical treatment varies from minimally invasive (limited removal of affected tooth structure) to traditional techniques (removal of all caries-affected tissues). One of the least invasive treatments for non-cavitated carious lesion is sealant placement, but there is much hesitance on the part of dental practitioners to place a sealant over an active cavitated lesion.[57] Studies have shown that there is a significant reduction or elimination of viable bacteria in sealed, actively carious lesions.[59, 60 and 61] Teeth affected by dental caries resulting in cavitated lesions have 2 layers of dentin that have been identified: a superficial, denatured, and highly bacterially contaminated layer that cannot be repaired, and a deeper affected layer that has been demineralized but not yet highly infected with bacteria.[62] This deeper affected dentin layer has been clinically shown to be remineralizable (healable) if it is effectively sealed from any further source of fermentable carbohydrate. The inner, healable layer of dentin is normally not sensitive to palpation with instruments because of the occlusion of the distal dentinal tubules that results from the advancement of the caries process.[63 and 64] Restorative techniques that purposefully retain this healable layer of dentin often do not require the administration of local anesthetics because of the retention of the dentinal tubule–occluded layer.[65] The purposeful retention of carious dentin underneath restorations has been recognized for several years and is referred to as an indirect pulp cap procedure. Research has shown that in teeth with a healthy pulp, indirect pulp cap–restored teeth have better long-term outcomes than teeth in which total caries removal was completed and a pulpotomy (removal of the coronal portion of the nerve only) performed.[66]

Pediatric Clinics of North America, Vol 62, No. 5 (October 2015): pg. 1215-1226. DOI.

Assessment of the vitality of the pulpal (nerve) tissues inside the teeth is crucial to the treatment planning of any type of restorative procedure on a caries-affected tooth. The nerve remains vital for an extended period of time during the caries process but, as the lesion approaches the pulp, the degree of injury and inflammation in the pulpal tissue increases. Pain and sensitivity elicited by food or drink, which resolves quickly after the removal of the stimulus and that can be controlled with over-the-counter analgesics, are all subjective findings that point to the diagnosis of reversible pulpitis, an inflammatory condition of the pulp that can resolve if further caries progress is arrested. Pain that is spontaneous, prolonged, and cannot be adequately controlled with over-the-counter analgesics is an ominous sign for the long-term health of the pulp. These symptoms indicate either irreversible pulpitis (inflammation that cannot be resolved by the body) and/or necrosis of the pulpal tissues. Treatments for irreversible pulpitis/pulpal necrosis involve complete root canal therapy or extraction of the affected tooth/teeth.[66]

As the size of the caries lesion increases, the mechanical properties of the tooth and the restorative materials used to restore the tooth become less advantageous for long-term retention of the tooth. Large fillings in primary teeth often result in fracture of the remaining tooth structure, the filling, or both. Full coverage of these teeth is then recommended, most often with prefabricated stainless steel crowns. These crowns are some of the most highly successful restorations that can be placed on primary teeth and are often the best choice for restoring large cavities and/or teeth that have received direct pulpal therapy.[67] A recently introduced procedure of placing stainless steel crowns, the Hall technique, has been introduced, this combines the benefits of sealing cavities to arrest their progression with the strength and durability of the stainless steel crown.[68] These crowns are cemented without any mechanical tooth preparation and can be placed without the need for local anesthetics. Placement of these crowns depends heavily on an accurate diagnosis of the pulpal tissues, and they should not be placed when a diagnosis of irreversible pulpitis or pulpal necrosis has been made. Current research indicates that these crown procedures have similar outcomes to traditional crown placement that involves local anesthesia, mechanical removal of the decay, preparation of the tooth, and cementation of the crown.[69]

Pediatric Clinics of North America, Vol 62, No. 5 (October 2015): pg. 1215-1226. DOI.

When too much tooth structure has been lost, or an abscess is present that cannot be resolved with pulpal therapy, the extraction of the tooth is the only possible remaining treatment. The loss of primary incisor teeth does not result in space loss issues, but may lead to speech delays.[70] Premature loss of posterior teeth can lead to significant spacing issues in the permanent dentition caused by mesial drifting of the unsupported posterior teeth. Placement of space-maintaining devices is recommended for the premature loss of posterior teeth.[71] Access to dental care continues to be a problem because many public health clinics are overwhelmed with children with ECC and/or dental emergencies.[72] The traditional standard of care involving restoring teeth has proved to be insufficient to stop the caries process.[73 and 74] Untreated tooth decay causes pain, discomfort, and suffering, and ultimately leads to problems with eating, speaking, socializing, and attending to learning.

Involvement of pediatricians

Tooth decay is a chronic and infectious disease that is avoidable with early preventive measures, sustainable home care, and appropriate periodic dental visits. The AAPD emphasizes the importance of initiating professional oral health intervention in infancy and continuing through adolescence and beyond.[6] The involvement of pediatricians has facilitated the promotion and prevention of dental caries, especially for young children who otherwise would not readily go to a dental office. In addition, many states now have policies that allow pediatricians to be reimbursed for the provision of fluoride varnish treatment to children's teeth. Furthermore, *Bright Futures in Practice: Oral Health*, developed by the Maternal and Child Health Bureau and Health Resources and Services Administration, provides information regarding practice guidelines for pediatricians performing activities such as dental screening, anticipatory guidance, and referral.[75 and 76] Overall, advances in the understanding of the nature and clinical course of dental caries is leading to a maturation of the profession, with early detection as well as medical intervention and treatment of the lesion before surgical intervention.

Pediatric Clinics of North America, Vol 62, No. 5 (October 2015): pg. 1215-1226. DOI.

References

[1] US Department of Health and Human Services. *Oral health in America: a report of the Surgeon General.* US Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institutes of Health, Rockville (MD) (2000)

[2] American Academy of Pediatric Dentistry. *Policy on early childhood caries (ECC): classifications, consequences, and preventive strategies. Reference manual* 36: 6:14/15. Available at: http://www.aapd.org/media/Policies_Guidelines/P_ECCClassifications.pdf. Accessed January10, 2015.

[3] M.F. Savage, J.Y. Lee, J.B. Kotch, *et al.* Early preventive dental visits: effects on subsequent utilization and costs. *Pediatrics*, 114 (4) (2004), pp. e418–e423

[4] J.Y. Lee, T.J. Bouwens, M.F. Savage, *et al.* Examining the cost-effectiveness of early dental visits. [review] *Pediatr Dent*, 28 (2) (2006), pp. 102–[105] [discussion: 192–8]

[5] American Academy of Pediatric Dentistry. Policy on the dental home. *Pediatr Dent,* 30 (suppl) (2008), pp. 22–23

[6] *Guideline on periodicity of examination, preventive dental services, anticipatory guidance/counseling, and oral treatment for infants, children, and adolescents*. Adopted 1990, Revised 1992, 1996, 2000, 2003, 2007, 2009. Available at: http://www.aapd.org/media/Policies_Guidelines/G_Periodicity.pdf. Accessed August 20, 2009.

[7] E.A. Mertz, K. Grumbal. Identifying communities with low dentist supply in California. *J Public Health Dent,* 61 (2001), pp. 172–177

[8] United States General Accounting Office. Oral health: dental disease is a chronic problem among low-income populations. United States General Accounting Office (GAO), report to congressional requester. Washington, DC: GAO/HEHS-00–72, Washington, DC: 2000. Available at: http://www.gao.gov/new.items/he00072.pdf. Accessed February 1, 2015.

[9] C. Okunseri, R. Bajorunaite, A. Abena, *et al.* Racial/ethnic disparities in the acceptance of Medicaid patients in dental practices. *J Public Health Dent,* 68 (3) (2008), pp. 149–153

[10] W.E. Mouradian, E. Wehr, J.J. Crall. Disparities in children's oral health and access to dental care. *JAMA*, 284 (2000), pp. 2625–2631

[11] B.L. Edelstein. Disparities in oral health and access to care: findings of national surveys. *Ambul Pediatr,* 1 (Suppl) (2000), pp. 141–147

[12] B.A. Dye, S. Tan, V. Smith, *et al.* Trends in oral health status: United States, 1988-1994 and 1999-2004. *Vital Health Stat,* 11 (248) (2007), pp. 1–92

Pediatric Clinics of North America, Vol 62, No. 5 (October 2015): pg. 1215-1226. DOI.

[13] B.A. Dye, X. Li, G. Thornton-Evans. Oral health disparities as determined by selected Healthy People 2020 oral health objectives for the United States, 2009–2010. *NCHS data brief, no 104.* National Center for Health Statistics, Hyattsville (MD) (2012)

[14] J. Berg. Medical management of dental caries. *J Calif Dent Assoc,* 42 (7) (2014), pp. 443–447

[15] AAPD. *Guideline on caries-risk assessment and management for infants, children, and adolescents*. Available at: http://www.aapd.org/media/Policies_Guidelines/G_CariesRiskAssessment.pdf. Accessed January 19, 2014.

[16] K.J. Hale, American Academy of Pediatrics, Section on Pediatric Dentistry. Oral health risk assessment timing and establishment of the dental home. *Pediatrics*, 111 (2003), pp. 1113–1116

[17] R.J. Berkowitz, H. Jordan. Similarity of bacteriocins of *Streptococcus mutans* from mother and infant. *Arch Oral Biol,* 20 (1975), pp. 725–730

[18] A.L. Davey, A.H. Rogers. Multiple types of the bacterium *Streptococcus mutans* in the human mouth and their intra-family transmission. *Arch Oral Biol,* 29 (1984), pp. 453–460

[19] R.J. Berkowitz, P. Jones. Mouth-to-mouth transmission of the bacterium *Streptococcus mutans* between mother and child. *Arch Oral Biol,* 30 (1985), pp. 377–379

[20] R.J. Berkowitz, J. Turner, P. Green. Maternal salivary levels of *Streptococcus mutans* and primary oral infection in infants. *Arch Oral Biol,* 26 (1981), pp. 147–149

[21] B. Köhler, I. Andréen, B. Jonsson. The earlier the colonization by mutans streptococci, the higher the caries prevalence at 4 years of age. *Oral Microbiol Immunol*, 3 (1988), pp. 14–17

[22] L.H. Southward, A. Robertson, B.L. Edelstein, *et al.* Oral health of young children in Mississippi Delta child care centers: a second look at early childhood caries risk assessment. *J Public Health Dent*, 68 (4) (2008), pp. 188–195

[23] S. Thitasomakul, S. Piwat, A. Thearmontree, *et al.* Risks for early childhood caries analyzed by negative binomial models. *J Dent Res,* 88 (2) (2009), pp. 137–141

[24] C.M. Vargas, J.J. Crall, D.A. Schneider. Sociodemographic distribution of pediatric dental caries: NHANES III, 1988-1994. *J Am Dent Assoc,* 129 (9) (1998), pp. 1229–1238

[25] B.A. Dye, O. Arevalo, C.M. Vargas. Trends in paediatric dental caries by poverty status in the United States, 1988–1994 and 1999–2004. *Int J Paediatr Dent,* 20 (2) (2010), pp. 132–143

[26] M. Tellez, W. Sohn, B.A. Burt, *et al.* Assessment of the relationship between neighborhood characteristics and dental caries severity

among low-income African-Americans: a multilevel approach. *J Public Health Dent,* 66 (1) (2006), pp. 30–36

[27] V.E. Dos Santos Junior, R.M.B. de Sousa, M.C. Oliveira, *et al.* Early childhood caries and its relationship with perinatal, socioeconomic and nutritional risks: a cross-sectional study. *BMC Oral Health,* 14 (2014), p. 47

[28] D.L. Chi, E.E. Masterson, A.C. Carle, *et al.* Socioeconomic status, food security, and dental caries in US children: mediation analysis of data from the National Health and Nutrition Examination Survey, 2007-2008. *Am J Public Health,* 104 (2014), pp. 860–864

[29] J.A. Mello, K.M. Gans, P.M. Risica, *et al.* How is food insecurity associated with dietary behaviors? An analysis with low-income, ethnically diverse participants in a nutrition intervention study. *J Am Diet Assoc,* 110 (12) (2010), pp. 1906–1911

[30] J.R. Sharkey, C. Nalty, C.M. Johnson, *et al.* Children's very low food security is associated with increased dietary intakes in energy, fat, and added sugar among Mexican-origin children (6-11 y) in Texas border *Colonias. BMC Pediatr,* 12 (2012), p. 16

[31] B.E. Gustafsson, C.E. Quensel, L. Swenander Lanke, *et al.* The Vipeholm Dental Caries Study. The effects of different levels of carbohydrate intake in 436 individuals observed for five years. *Acta Odontol Scand,* 11 (1954), pp. 232–364

[32] M.S. Duggal, K.J. Toumba, B.T. Amaechi, *et al.* Enamel demineralisation in situ with varying frequency of carbohydrate consumption with and without fluoride toothpaste. *J Dent Res,* 80 (2001), pp. 1721–1724

[33] D. Arcella, L. Ottolenghi, A. Polomeni, *et al.* The relationship between frequency of carbohydrates intake and dental caries: a cross-sectional study in Italian teenagers. *Public Health Nutr,* 5 (4) (2002), pp. 553–560

[34] American Academy of Pediatric Dentistry. Symposium on lifetime oral health care for patients with special needs. *Pediatr Dent,* 29 (2) (2007), pp. 92–152

[35] P. Tsang, F. Qi, W. Shi. Medical approach to dental caries: fight the disease, not the lesion. *Pediatr Dent,* 28 (2) (2006), pp. 188–191

[36] D.C. Johnsen. Characteristics and backgrounds of children with nursing caries. *Pediatr Dent,* 4 (1982), pp. 218–224

[37] C. Benitez, D. O'Sullivan, N. Tinanoff. Effect of a preventive approach for the treatment of nursing bottle caries. *J Dent Child,* 61 (1994), pp. 46–49

[38] N. Tinanoff, N.S. Daley, D.M. O'Sullivan, *et al.* Failure of intense preventive efforts to arrest early childhood and rampant caries: three case reports. *Pediatr Dent,* 21 (1999), pp. 160–163

[39] W.R. Miller, S. Rollnick. *Motivational interviewing: preparing people for change.* (2nd edition) Guilford Press, New York (2002)

[40] R. Harrison, T. Wong. An oral health program for an urban minority population of preschool. *Community Dent Oral Epidemiol,* 31 (2003), pp. 392–399

[41] P. Weinstein, R. Harrison, T. Benton. Motivating parents to prevent caries in their young children*. J Am Dent Assoc,* 135 (2004), pp. 731–738

[42] T. Yoshida, P. Milgrom, S. Coldwell. How do U.S. and Canadian dental schools teach interpersonal communication skills? *J Dent Educ,* 66 (11) (2002), pp. 1281–1288

[43] R.J. Simonsen. Pit and fissure sealant: review of the literature. *Pediatr Dent,* 24 (5) (2002), pp. 393–414

[44] S.O. Griffin, P.M. Griffin, B.F. Gooch, *et al.* Comparing the costs of three sealant delivery strategies. *J Dent Res,* 81 (9) (2002), pp. 641–645

[45] R.B. Quiñonez, S.M. Downs, D. Shugars, *et al.* Assessing cost-effectiveness of sealant placement in children. *J Public Health Dent,* 65 (2) (2005), pp. 82–89

[46] D.L. Chi, D.N. Van der Goes, J.P. Ney. Cost-effectiveness of pit-and-fissure sealants on primary molars in Medicaid-enrolled children. *Am J Public Health,* 104 (3) (2014), pp. 555–561

[47] A. Ahovuo-Saloranta, H. Forss, T. Walsh, *et al.* Sealants for preventing dental decay in the permanent teeth. *Cochrane Database Syst Rev* (3) (2013) CD001830

[48] R.J. Feigal, K.J. Donly. The use of pit and fissure sealants. *Pediatr Dent,* 28 (2006), pp. 143–150

[49] J. Beauchamp, P.W. Caufield, J.J. Crall, *et al.* Evidence-based clinical recommendations for the use of pit-and-fissure sealants. *J Am Dent Assoc,* 139 (3) (2008), pp. 257–267

[50] Centers for Disease Control and Prevention. *Oral health: preventing cavities, gum disease, and tooth loss*. 2007. Available at: www.cdc.gov/nccdphp/publications/aag/oh.htm. Accessed January 8, 2008.

[51] J.D.B. Featherstone. The science and practice of caries prevention. *J Am Dent Assoc,* 131 (2000), pp. 887–899

[52] O. Fejerskov, E. Kidd. *Dental caries. The disease and its clinical management.* (2nd edition) Blackwell Munksgaard, Oxford (United Kingdom) (2008)

[53] AAPD. *Guideline on fluoride therapy*. 2014. Available at: http://www.aapd.org/media/Policies_Guidelines/G_FluorideTherapy.pdf. Accessed January 26, 2015.

[54] AAP. *Oral health policies*. 2015. Available at: http://www2.aap.org/oralhealth/pact/ch6_sect3b.cfm. Accessed January 26, 2015.

[55] H.K. Akerblom, T. Koivukangas, R. Puukka, *et al.* The tolerance of increasing amounts of dietary xylitol in children. *Int J Vitam Nutr Res,* 22 (1982), pp. 53–66

[56] P. Shen, F. Cai, A. Nowicki, *et al.* Remineralization of enamel subsurface lesions by sugar-free chewing gum containing casein phosphopeptide-amorphous calcium phosphate. *J Dent Res,* 80 (12) (2001), pp. 2066–2070

[57] M.L. Pukallus, K.A. Plonka, T.F. Holcombe, *et al.* A randomized controlled trial of a 10 percent CPP-ACP cream to reduce mutans streptococci colonization. *Pediatr Dent,* 35 (7) (2013), pp. 550–555

[58] H. Meyer-Lueckel, R.J. Wierichs, T. Schellwien, *et al.* Remineralizing efficacy of a CPP-ACP cream on enamel caries lesions in situ. *Caries Res,* 49 (2015), pp. 56–62

[59] W.R. Hume. Need for change in standards of caries diagnosis–perspective based on the structure and behavior of the caries lesion. [review] *J Dent Educ,* 57 (6) (1993), pp. 439–443

[60] M.K. Chapko. A study of the intentional use of pit and fissure sealants over carious lesions. *J Public Health Dent,* 47 (3) (1987), pp. 139–142

[61] F.C. Besic. The fate of bacteria sealed in dental cavities. *J Dent Res,* 22 (5) (1943), pp. 349–354

[62] E.M. Oong, S.O. Griffin, W.G. Kohn, *et al.* The effect of dental sealants on bacteria levels in caries lesions. *J Am Dent Assoc,* 139 (3) (2008), pp. 271–278

[63] T. Fusayama. Two layers of carious dentin; diagnosis and treatment. *Oper Dent,* 4 (2) (1979), pp. 63–70

[64] I.A. Mjor (Ed.), *Reaction patterns in human teeth*, CRS Press, Boca Raton (FL) (1983), pp. 86–103

[65] J.E. Frencken. The state-of-the-art of ART restorations. *Dent Update,* 41 (3) (2014), pp. 218–220 222–4

[66] J.A. Coll. Indirect pulp capping and primary teeth: is the primary tooth pulpotomy out of date? *Pediatr Dent,* 30 (2008), pp. 230–236

[67] AAPD. *Guideline on management of the developing dentition and occlusion in pediatric dentistry*. Available at: http://www.aapd.org/media/Policies_Guidelines/G_DevelopDentition.pdf. Accessed January 20, 2015.

[68] L.B. Messer, N.J. Levering. The durability of primary molar restorations: II. Observations and predictions of success of stainless steel crowns. *Pediatr Dent,* 10 (2) (1988), pp. 81–85

[69] N.P. Innes, D.J.P. Evans, D.R. Stirrups. The Hall technique; a randomized controlled clinical trial of a novel method of managing carious primary molars in general dental practice: acceptability of the technique and outcomes at 23 months. *BMC Oral Health*, 7 (2007), p. 18

[70] K.H. Ludwig, M. Fontana, L.A. Vinson, *et al.* The success of stainless steel crowns placed with the Hall technique: a retrospective study. *J Am Dent Assoc,* 145 (12) (2014), pp. 1248–1253

[71] G.A. Riekman, H.E. ElBadrawy. Effect of premature loss of primary maxillary incisors on speech. *Pediatr Dent,* 7 (1985), pp. 119–122

[72] AAPD. *Pulp therapy for primary and young permanent teeth*. Available at: http://www.aapd.org/media/Policies_Guidelines/G_Pulp.pdf. Accessed January 26, 2015.

[73] M. Raadal, I. Espelid, I. Mejare. The caries lesion and its management in children and adolescents. G. Koch, S. Poulsen (Eds.), *Pediatric dentistry: a clinical approach*, Munksgaard, Copenhagen (Denmark) (2001), pp. 173–212

[74] M. Raadal. Management of early carious lesions in primary teeth. A. Hugoson (Ed.), *et al.*, Consensus conference on caries in the primary dentition and its clinical management, The Institute for Postgraduate Dental Education, Jönköping (Sweden) (2002), pp. 48–57

[75] Maternal and Child Health Bureau, Health Resources and Services Administration. Bright futures in practice: oral health 1996. Available at: http://www.brightfutures.org/oralhealth/about.html. Accessed February 1, 2015.

[76] K.M. Pierce, R.G. Rozier, W.F. Vann Jr. Accuracy of pediatric primary care providers' screening and referral for early childhood caries. *Pediatrics*, 109 (2002), p. E82

Pediatric Clinics of North America, Vol 62, No. 5 (October 2015): pg. 1215-1226. DOI.