

Caries-risk Assessment and Management for Infants, Children, and Adolescents

Review Council

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Purpose

The American Academy of Pediatric Dentistry (AAPD) recognizes that caries-risk assessment and management protocols can assist clinicians with decisions regarding treatment based upon caries risk and patient compliance and are essential elements of contemporary clinical care for infants, children, and adolescents. This guideline is intended to educate health care providers and other interested parties on the assessment of caries risk in contemporary pediatric dentistry and aid in clinical decision making regarding diagnostic, fluoride, dietary, and restorative protocols.

Methods

This guideline was originally developed by the Council on Clinical Affairs and adopted in 2002. This document is an update of AAPD's Policy on Use of a Caries-risk Assessment Tool (CAT) for Infants, Children, and Adolescents, revised in 2006 that includes the additional concepts of dental caries management protocols. The update used electronic and hand searches of English written articles in the medical and dental literature within the last 10 years using the search terms caries risk assessment, caries management, and caries clinical protocols. From this search, 1,909 articles were evaluated by title or by abstract. Information from 75 articles was used to update this document. When data did not appear sufficient or were inconclusive, recommendations were based upon expert and/or consensus opinion by experienced researchers and clinicians.

Background

Caries-risk assessment

Risk assessment procedures used in medical practice normally have sufficient data to accurately quantitate a person's disease susceptibility and allow for preventive measures.¹ Even though caries-risk data in dentistry still are not sufficient to quantitate the models, the process of determining risk should be a component in the clinical decision-making process.² Risk assessment:

1. Fosters the treatment of the disease process instead of treating the outcome of the disease.

2. Gives an understanding of the disease factors for a specific patient and aids in individualizing preventive discussions.
3. Individualizes, selects, and determines frequency of preventive and restorative treatment for a patient.
4. Anticipates caries progression or stabilization.

Caries-risk assessment models currently involve a combination of factors including diet, fluoride exposure, a susceptible host, and microflora that interplay with a variety of social, cultural, and behavioral factors.³⁻⁶ Caries risk assessment is the determination of the likelihood of the incidence of caries (i.e., the number of new cavitated or incipient lesions) during a certain time period⁷ or the likelihood that there will be a change in the size or activity of lesions already present. With the ability to detect caries in its earliest stages (i.e., white spot lesions), health care providers can help prevent cavitation.⁸⁻¹⁰

Caries risk indicators are variables that are thought to cause the disease directly (e.g., microflora) or have been shown useful in predicting it (e.g., socioeconomic status) and include those variables that may be considered protective factors. Currently, there are no caries-risk factors or combinations of factors that have achieved high levels of both positive and negative predictive values.² Although the best tool to predict future caries is past caries experience, it is not particularly useful in young children due to the importance of determining caries risk before the disease is manifest. Children with white spot lesions should be considered at high risk for caries since these are precavitated lesions that are indicative of caries activity.¹¹ Plaque accumulation also is strongly associated with caries development in young children.^{12,13} As a corollary to the presence of plaque,¹⁴ a child's Mutans Streptococci (MS) levels³ and the age at which a child becomes colonized with cariogenic flora^{15,16} are valuable in assessing risk, especially in preschool children.

While there is no question that fermentable carbohydrates are a necessary link in the causal chain for dental caries, a

ABBREVIATIONS

AAPD: American Academy Pediatric Dentistry. **ADA:** American Dental Association. **CDC:** Centers for Disease Control and Prevention. **MS:** Mutans streptococci.

* The 2014 revision was limited to use of toothpaste in young children.

systematic study of sugar consumption and caries risk has concluded that the relationship between sugar consumption and caries is much weaker in the modern age of fluoride exposure than previously thought.¹⁷ However, there is evidence that night-time use of the bottle, especially when it is prolonged, may be associated with early childhood caries.¹⁸ Despite the fact that normal salivary flow is an extremely important intrinsic host factor providing protection against caries, there is little data about the prevalence of low salivary flow in children.^{19,20}

Sociodemographic factors have been studied extensively to determine their effect on caries risk. Children with immigrant backgrounds have three times higher caries rates than non-immigrants.²¹ Most consistently, an inverse relationship between socioeconomic status and caries prevalence is found in studies of children less than six years of age.²² Perhaps another type of sociodemographic variable is the parents' history of cavities and abscessed teeth; this has been found to be a predictor of treatment for early childhood caries.^{23,24}

The most studied factors that are protective of dental caries include systemic and topical fluoride, sugar substitutes, and tooth brushing with fluoridated toothpaste. Teeth of children who reside in a fluoridated community have been shown to have higher fluoride content than those of children who reside in suboptimal fluoridated communities.²⁵ Additionally, both pre- and post-eruption fluoride exposure maximize the caries-preventive effects.^{26,27} For individuals residing in non-fluoridated communities, fluoride supplements have shown a significant caries reduction in primary and permanent teeth.²⁸

With regard to fluoridated toothpaste, studies have shown consistent reduction in caries experience.²⁹ Professional topical fluoride applications performed semiannually also reduce caries,³⁰ and fluoride varnishes generally are equal to that of other professional topical fluoride vehicles.³¹

The effect of sugar substitutes on caries rates have been evaluated in several populations with high caries prevalence.³² Studies indicate that xylitol can decrease MS levels in plaque and saliva and can reduce dental caries in young children and adults, including children via their mothers.³³ With regard to toothbrushing, there only is a weak relationship between frequency of brushing and decreased dental caries, which is confounded because it is difficult to distinguish whether the effect is actually a measure of fluoride application or whether it is a result of mechanical removal of plaque.³⁴ The dental home or regular periodic care by the same practitioner is included in many caries-risk assessment models because of its known benefit for dental health.³⁵

Risk assessment tools can aid in the identification of reliable predictors and allow dental practitioners, physicians, and other nondental health care providers to become more actively involved in identifying and referring high-risk children. Tables 1, 2, and 3 incorporate available evidence into practical tools to assist dental practitioners, physicians, and other non-dental health care providers in assessing levels of risk for caries development in infants, children, and adolescents. As new evidence emerges, these tools can be refined to provide greater predictability of caries in children prior

Table 1. Caries-risk Assessment Form for 0-3 Year Olds^{59,60}
(For Physicians and Other Non-Dental Health Care Providers)

| Factors | High Risk | Low Risk |
|---|-----------|----------|
| Biological | | |
| Mother/primary caregiver has active cavities | Yes | |
| Parent/caregiver has low socioeconomic status | Yes | |
| Child has >3 between meal sugar-containing snacks or beverages per day | Yes | |
| Child is put to bed with a bottle containing natural or added sugar | Yes | |
| Child has special health care needs | Yes | |
| Child is a recent immigrant | Yes | |
| Protective | | |
| Child receives optimally-fluoridated drinking water or fluoride supplements | | Yes |
| Child has teeth brushed daily with fluoridated toothpaste | | Yes |
| Child receives topical fluoride from health professional | | Yes |
| Child has dental home/regular dental care | | Yes |
| Clinical Findings | | |
| Child has white spot lesions or enamel defects | Yes | |
| Child has visible cavities or fillings | Yes | |
| Child has plaque on teeth | Yes | |

Circling those conditions that apply to a specific patient helps the health care worker and parent understand the factors that contribute to or protect from caries. Risk assessment categorization of low or high is based on preponderance of factors for the individual. However, clinical judgment may justify the use of one factor (e.g., frequent exposure to sugar containing snacks or beverages, visible cavities) in determining overall risk.

Overall assessment of the child's dental caries risk: High Low

Table 2. Caries-risk Assessment Form for 0-5 Year Olds^{59,60}

(For Dental Providers)

| Factors | High Risk | Moderate Risk | Low Risk |
|---|-----------|---------------|----------|
| Biological | | | |
| Mother/primary caregiver has active caries | Yes | | |
| Parent/caregiver has low socioeconomic status | Yes | | |
| Child has >3 between meal sugar-containing snacks or beverages per day | Yes | | |
| Child is put to bed with a bottle containing natural or added sugar | Yes | | |
| Child has special health care needs | | Yes | |
| Child is a recent immigrant | | Yes | |
| Protective | | | |
| Child receives optimally-fluoridated drinking water or fluoride supplements | | | Yes |
| Child has teeth brushed daily with fluoridated toothpaste | | | Yes |
| Child receives topical fluoride from health professional | | | Yes |
| Child has dental home/regular dental care | | | Yes |
| Clinical Findings | | | |
| Child has >1 decayed/missing/filled surfaces | Yes | | |
| Child has active white spot lesions or enamel defects | Yes | | |
| Child has elevated mutans streptococci levels | Yes | | |
| Child has plaque on teeth | | Yes | |

Circling those conditions that apply to a specific patient helps the practitioner and parent understand the factors that contribute to or protect from caries. Risk assessment categorization of low, moderate, or high is based on preponderance of factors for the individual. However, clinical judgment may justify the use of one factor (e.g., frequent exposure to sugar-containing snacks or beverages, more than one dmfs) in determining overall risk.

Overall assessment of the child's dental caries risk: High Moderate Low

Table 3. Caries-risk Assessment Form for ≥6 Years Olds⁶⁰⁻⁶²

(For Dental Providers)

| Factors | High Risk | Moderate Risk | Low Risk |
|--|-----------|---------------|----------|
| Biological | | | |
| Patient is of low socioeconomic status | Yes | | |
| Patient has >3 between meal sugar-containing snacks or beverages per day | Yes | | |
| Patient has special health care needs | | Yes | |
| Patient is a recent immigrant | | Yes | |
| Protective | | | |
| Patient receives optimally-fluoridated drinking water | | | Yes |
| Patient brushes teeth daily with fluoridated toothpaste | | | Yes |
| Patient receives topical fluoride from health professional | | | Yes |
| Additional home measures (e.g., xylitol, MI paste, antimicrobial) | | | Yes |
| Patient has dental home/regular dental care | | | Yes |
| Clinical Findings | | | |
| Patient has ≥1 interproximal lesions | Yes | | |
| Patient has active white spot lesions or enamel defects | Yes | | |
| Patient has low salivary flow | Yes | | |
| Patient has defective restorations | | Yes | |
| Patient wearing an intraoral appliance | | Yes | |

Circling those conditions that apply to a specific patient helps the practitioner and patient/parent understand the factors that contribute to or protect from caries. Risk assessment categorization of low, moderate, or high is based on preponderance of factors for the individual. However, clinical judgment may justify the use of one factor (e.g., ≥1 interproximal lesions, low salivary flow) in determining overall risk.

Overall assessment of the dental caries risk: High Moderate Low

to disease initiation. Furthermore, the evolution of caries-risk assessment tools and protocols can assist in providing evidence for and justifying periodicity of services, modification of

third-party involvement in the delivery of dental services, and quality of care with outcomes assessment to address limited resources and work-force issues.

Table 4. Example of a Caries Management Protocol for 1-2 Year Olds

| Risk Category | Diagnostics | Interventions | | Restorative |
|----------------------------------|---|---|---------------------------------------|---|
| | | Fluoride | Diet | |
| Low risk | – Recall every six to 12 months – Baseline MS ^α | – Twice daily brushing with fluoridated toothpaste ^β | Counseling | – Surveillance ^χ |
| Moderate risk parent engaged | – Recall every six months – Baseline MS ^α | – Twice daily brushing with fluoridated toothpaste ^β – Fluoride supplements ^δ – Professional topical treatment every six months | Counseling | – Active surveillance ^ε of incipient lesions |
| Moderate risk parent not engaged | – Recall every six months – Baseline MS ^α | – Twice daily brushing with fluoridated toothpaste ^β – Professional topical treatment every six months | Counseling, with limited expectations | – Active surveillance ^ε of incipient lesions |
| High risk parent engaged | – Recall every three months – Baseline and follow up MS ^α | – Twice daily brushing with fluoridated toothpaste ^β – Fluoride supplements ^δ – Professional topical treatment every three months | Counseling | – Active surveillance ^ε of incipient lesions – Restore cavitated lesions with ITR ^φ or definitive restorations |
| High risk parent not engaged | – Recall every three months – Baseline and follow up MS ^α | – Twice daily brushing with fluoridated toothpaste ^β – Professional topical treatment every three months | Counseling, with limited expectations | – Active surveillance ^ε of incipient lesions – Restore cavitated lesions with ITR ^φ or definitive restorations |

Table 5. Example of a Caries Management Protocol for 3-5 Year Olds

| Risk Category | Diagnostics | Interventions | | | Restorative |
|----------------------------------|---|---|---------------------------------------|-----------------------|--|
| | | Fluoride | Diet | Sealants ^λ | |
| Low risk | – Recall every six to 12 months – Radiographs every 12 to 24 months – Baseline MS ^α | – Twice daily brushing with fluoridated toothpaste ^γ | No | Yes | – Surveillance ^χ |
| Moderate risk parent engaged | – Recall every six months – Radiographs every six to 12 months – Baseline MS ^α | – Twice daily brushing with fluoridated toothpaste ^γ – Fluoride supplements ^δ – Professional topical treatment every six months | Counseling | Yes | – Active surveillance ^ε of incipient lesions – Restoration of cavitated or enlarging lesions |
| Moderate risk parent not engaged | – Recall every six months – Radiographs every six to 12 months – Baseline MS ^α | – Twice daily brushing with fluoridated toothpaste ^γ – Professional topical treatment every six months | Counseling, with limited expectations | Yes | – Active surveillance ^ε of incipient lesions – Restoration of cavitated or enlarging lesions |
| High risk parent engaged | – Recall every three months – Radiographs every six months – Baseline and follow up MS ^α | – Brushing with 0.5 percent fluoride (with caution) – Fluoride supplements ^δ – Professional topical treatment every three months | Counseling | Yes | – Active surveillance ^ε of incipient lesions – Restoration of cavitated or enlarging lesions |
| High risk parent not engaged | – Recall every three months – Radiographs every six months – Baseline and follow up MS ^α | – Brushing with 0.5 percent fluoride (with caution) – Professional topical treatment every three months | Counseling, with limited expectations | Yes | – Restore incipient, cavitated, or enlarging lesions |

Table 6. Example of a Caries Management Protocol for ≥6 Year-Olds

| Risk Category | Diagnostics | Interventions | | | Restorative |
|--|--|---|--|-----------------------|---|
| | | Fluoride | Diet | Sealants ^λ | |
| Low risk | <ul style="list-style-type: none"> – Recall every six to 12 months – Radiographs every 12 to 24 months | <ul style="list-style-type: none"> – Twice daily brushing with fluoridated toothpaste^μ | No | Yes | <ul style="list-style-type: none"> – Surveillance^χ |
| Moderate risk patient/parent engaged | <ul style="list-style-type: none"> – Recall every six months – Radiographs every six to 12 months | <ul style="list-style-type: none"> – Twice daily brushing with fluoridated toothpaste^μ – Fluoride supplements^δ – Professional topical treatment every six months | – Counseling | Yes | <ul style="list-style-type: none"> – Active surveillance^ε of incipient lesions – Restoration of cavitated or enlarging lesions |
| Moderate risk patient/parent not engaged | <ul style="list-style-type: none"> – Recall every six months – Radiographs every six to 12 months | <ul style="list-style-type: none"> – Twice daily brushing with toothpaste^μ – Professional topical treatment every six months | – Counseling, with limited expectations | Yes | <ul style="list-style-type: none"> – Active surveillance^ε of incipient lesions – Restoration of cavitated or enlarging lesions |
| High risk patient/parent engaged | <ul style="list-style-type: none"> – Recall every three months – Radiographs every six months | <ul style="list-style-type: none"> – Brushing with 0.5 percent fluoride – Fluoride supplements^δ – Professional topical treatment every three months | <ul style="list-style-type: none"> – Counseling – Xylitol | Yes | <ul style="list-style-type: none"> – Active surveillance^ε of incipient lesions – Restoration of cavitated or enlarging lesions |
| High risk patient/parent not engaged | <ul style="list-style-type: none"> – Recall every three months – Radiographs every six months | <ul style="list-style-type: none"> – Brushing with 0.5 percent fluoride – Professional topical treatment every three months | <ul style="list-style-type: none"> – Counseling, with limited expectations – Xylitol | Yes | <ul style="list-style-type: none"> – Restore incipient, cavitated, or enlarging lesions |

Legends for Tables 4-6

α Salivary mutans streptococci bacterial levels.

χ Periodic monitoring for signs of caries progression.

β Parental supervision of a “smear” amount of toothpaste.

δ Need to consider fluoride levels in drinking water.

ε Careful monitoring of caries progression and prevention program.

φ Interim therapeutic restoration.⁶³

γ Parental supervision of a “pea sized” amount of toothpaste.

λ Indicated for teeth with deep fissure anatomy or developmental defects.

μ Less concern about the quantity of toothpaste.

Caries management protocols

Clinical management protocols are documents designed to assist in clinical decision-making; they provide criteria regarding diagnosis and treatment and lead to recommended courses of action. The protocols are based on evidence from current peer-reviewed literature and the considered judgment of expert panels, as well as clinical experience of practitioners. The protocols should be updated frequently as new technologies and evidence develop.

Historically, the management of dental caries was based on the notion that it was a progressive disease that eventually destroyed the tooth unless there was surgical/restorative intervention. Decisions for intervention often were learned from unstandardized dental school instruction, and then refined by clinicians over years of practice. Little is known about the criteria dentists use when making decisions involving restoration of carious lesions.³⁶

It is now known that surgical intervention of dental caries alone does not stop the disease process. Additionally, many lesions do not progress, and tooth restorations have a finite longevity. Therefore, modern management of dental caries should be more conservative and includes early detection of

noncavitated lesions, identification of an individual's risk for caries progression, understanding of the disease process for that individual, and active surveillance to apply preventive measures and monitor carefully for signs of arrestment or progression.

Caries management protocols for children further refine the decisions concerning individualized treatment and treatment thresholds based on a specific patient's risk levels, age, and compliance with preventive strategies (Tables 4, 5, 6). Such protocols should yield greater probability of success and better cost effectiveness of treatment than less standardized treatment. Additionally, caries management protocols free practitioners of the necessity for repetitive high level treatment decisions, standardize decision making and treatment strategies,³⁶⁻³⁸ eliminate treatment uncertainties, and guarantee more correct strategies.³⁹

Content of the present caries management protocol is based on results of clinical trials, systematic reviews, and expert panel recommendations that give better understanding of and recommendations for diagnostic, preventive, and restorative treatments. The radiographic diagnostic guidelines are based on the latest guidelines from the American Dental Association (ADA).⁴⁰ Systemic fluoride protocols are based on the Centers

for Disease Control and Prevention's (CDC) recommendations for using fluoride.²⁹ Guidelines for the use of topical fluoride treatment are based on the ADA's Council on Scientific Affairs' recommendations for use of fluoride toothpaste in young children⁴¹ and professionally applied and prescription strength home-use topical fluoride,⁴² and the CDC's fluoride guidelines.²⁹ Guidelines for pit and fissure sealants are based on the ADA's Council on Scientific Affairs recommendations for the use of pit-and-fissure sealants.⁴³ Guidelines on diet counseling to prevent caries are based on two review papers.^{44,45} Guidelines for the use of xylitol are based on the AAPD's oral health policy on use of xylitol in caries prevention,³² a well-executed clinical trial on high caries-risk infants and toddlers,⁴⁶ and two evidence-based reviews.^{47,48} Active surveillance (prevention therapies and close monitoring) of enamel lesions is based on the concept that treatment of disease may only be necessary if there is disease progression,⁴⁹ that caries progression has diminished over recent decades,⁵⁰ and that the majority of proximal lesions, even in dentin, are not cavitated.⁵¹

Other approaches to the assessment and treatment of dental caries will emerge with time and, with evidence of effectiveness, may be included in future guidelines on caries-risk assessment and management protocols. For example, there are emerging trends to use calcium and phosphate remineralizing solution to reverse dental caries.⁵² Other fluoride compounds, such as silver diamine fluoride⁵³ and stannous fluoride⁵⁴, may be more effective than sodium fluoride for topical applications. There has been interest in antimicrobials to affect the caries rates, but evidence from caries trials is still inconclusive.^{55,56} However, some other proven methods, such as prescription fluoride drops and tablets, may be removed from this protocol in the future due to attitudes, risks, or compliance.^{57,58}

Recommendations

1. Dental caries-risk assessment, based on a child's age, biological factors, protective factors, and clinical findings, should be a routine component of new and periodic examinations by oral health and medical providers.
2. While there is not enough information at present to have quantitative caries-risk assessment analyses, estimating children at low, moderate, and high caries risk by a preponderance of risk and protective factors will enable a more evidence-based approach to medical provider referrals, as well as establish periodicity and intensity of diagnostic, preventive, and restorative services.
3. Clinical management protocols, based on a child's age, caries risk, and level of patient/parent cooperation, provide health providers with criteria and protocols for determining the types and frequency of diagnostic, preventive, and restorative care for patient specific management of dental caries.

References

1. Lauer MS, Fontanarosa BP. Updated guidelines for cholesterol management. *JAMA* 2001;285(19):2486-97.
2. Zero D, Fontana M, Lennon AM. Clinical applications and outcomes of using indicators of risk in caries management. *J Dent Educ* 2001;65(10):1126-32.
3. Litt MD, Reisine S, Tinanoff N. Multidimensional causal model of dental caries development in low-income preschool children. *Public Health Reports* 1995;110(4):607-17.
4. Nicolau B, Marcenes W, Bartley M, Sheiham A. A life course approach to assessing causes of dental caries experience: The relationship between biological, behavioural, socio-economic and psychological conditions and caries in adolescents. *Caries Res* 2003;37(5):319-26.
5. Featherstone JD. The caries balance: Contributing factors and early detection. *J Calif Dent Assoc* 2003;31(2):129-33.
6. Featherstone JD. The caries balance: The basis for caries management by risk assessment. *Oral Health Prev Dent* 2004;2(Suppl 1):259-64.
7. Reich E, Lussi A, Newbrun E. Caries-risk assessment. *Int Dent J* 1999;49(1):15-26.
8. Ismail AI, Nainar SM, Sohn W. Children's first dental visit: Attitudes and practices of US pediatricians and family physicians. *Pediatr Dent* 2003;25(5):425-30.
9. Tsang P, Qi F, Shi W. Medical approach to dental caries: Fight the disease, not the lesion. *Pediatr Dent* 2006;28(2):188-98.
10. Crall JJ. Development and integration of oral health services for preschool-age children. *Pediatr Dent* 2005;27(4):323-30.
11. Vadiakas G. Case definition, aetiology and risk assessment of early childhood caries (ECC): A revisited review. *European Arch Paed Dent* 2008;9(9):114-25.
12. Alaluusua S, Malmivirta R. Early plaque accumulation – A sign for caries risk in young children. *Community Dent Oral Epidemiol* 1994;22(10):273-6.
13. Roeters J, Burgesdijk R, Truin GJ, van 't Hof M. Dental caries and its determinants in 2- to 5-year old children. *ASDC J Dent Child* 1995;62(6):401-8.
14. Lee C, Tinanoff N, Minah G, Romberg E. Effect of Mutans streptococcal colonization on plaque formation and regrowth in young children – A brief communication. *J Public Health Dent* 2008;68(1):57-60.
15. Thibodeau EA, O'Sullivan DM, Tinanoff N. Mutans streptococci and caries prevalence in preschool children. *Community Dent Oral Epidemiol* 1993;21(5):288-91.
16. Grindefjord M, Dahllöf G, Nilsson B, Modér T. Prediction of dental caries development in 1-year old children. *Caries Res* 1995;29(5):343-8.
17. Burt BA, Satishchandra P. The relationship between low birthweight and subsequent development of caries: A systematic review. *J Dent Ed* 2001;65(10):1017-23.

18. Reisine S, Douglass JM. Psychosocial and behavioral issues in early childhood caries. *Community Dent Oral Epidemiol* 1998;26(1 Suppl):45-8.
19. Cataldo WL, Oppenheim FG. Physical and chemical aspects of saliva as indicators of risk for dental caries in humans. *J Dent Ed* 2001;65(10):1054-62.
20. Vanobbergen J, Martens L, Lesaffre E, Bogaerts K, Declerck D. The value of a baseline caries risk assessment model in the primary dentition for the prediction of caries increment in the permanent dentition. *Caries Res* 2001;35(6):442-50.
21. Nunn ME, Dietrich T, Singh HK, Henshaw MM, Kreslin NR. Prevalence of early childhood caries among very young urban Boston children compared with U.S. Children. *J Public Health Dent* 2009;69(3):156-62.
22. Vargas CM, Crall JJ, Schneider DA. Sociodemographic distribution of pediatric dental caries: NHANES III, 1988-1994. *J Am Dent Assoc* 1998;129(9):1229-38.
23. Southward LH, Robertson A, Edelstein BL, 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* 2008;68(4):188-95.
24. Thitasomakul S, Piwat S, Thearmontree A, Chankanka O, Pithpornchaiyakul W, Madyusoh S. Risks for early childhood caries analyzed by negative binomial models. *J Dent Res* 2009;88(2):137-41.
25. Weatherell J, Deutsch D, Robinson C, Hallsworth AS. Assimilation of fluoride by enamel throughout the life of the tooth. *Caries Res* 1977;11(2):85-115.
26. Backer Dirks O, Houwink B, Kwant GW. The results of 6 years of artificial fluoridation of drinking water in The Netherlands – The Tiel Cumemborg experiment. *Arch Oral Biol* 1961;5(12):284-300.
27. Singh KA, Spencer AJ, Armfield JM. Relative effects of pre- and post-eruption water fluoride on caries experience of permanent first molars. *J Pub Health Dent* 2003;63(1):11-9.
28. Murray JJ, Naylor MN. Fluorides and dental caries. In: Murray JJ, ed. *Prevention of Oral Disease*. Oxford University Press, Oxford; 1996:32-67.
29. CDC. Recommendations for using fluoride to prevent and control dental caries in the United States. *MMWR Recomm Rep* 2001;50(RR14):1-42.
30. Ripa LW. A critique of topical fluoride methods (dentifrice, mouthrinses, operator- and self-applied gels) in an era of decreased caries and increased fluorosis prevalence. *J Pub Health Dent* 1991;51(1):23-41.
31. Beltrán-Aguilar ED, Goldstein JW, Lockwood SA. Fluoride varnishes: A review of their clinical use, cariostatic mechanism, efficacy and safety. *J Am Dent Assoc* 2000;131(5):589-96.
32. American Academy of Pediatric Dentistry. Policy on use of xylitol in caries prevention. *Pediatr Dent* 2010;32 (special issue):36-8.
33. Ly KA, Milgrom P, Rothen M. Xylitol, sweeteners, and dental caries. *Pediatr Dent* 2006;28(2):154-63.
34. Reisine ST, Psoter W. Socioeconomic status and selected behavioral determinants and risk factor for dental caries. *J Dent Ed* 2001;65(10):1009-16.
35. Nowak AJ, Casamassimo PS. The dental home. A primary care oral health concept. *J Am Dent Assoc* 2002;133(1):93-8.
36. Bader JD, Shugars DA. What do we know about how dentists make caries-related treatment decisions? *Community Dent Oral Epidemiol* 1997;25(1):97-103.
37. Anusavice K. Management of dental caries as a chronic infectious disease. *J Dent Ed* 1998;62(10):791-802.
38. Benn DK, Clark TD, Dankel DD, Kostewicz SH. Practical approach to evidence-based management of caries. *J Am Coll Dent* 1999;66(1):27-35.
39. White BA, Maupome G. Clinical decision-making for dental caries management. *J Dent Ed* 2001;65(10):1121-5.
40. American Dental Association Council on Scientific Affairs. The use of dental radiographs. Update and recommendations. *J Am Dent Assoc* 2006;137(9):1304-12.
41. American Dental Association Council on Scientific Affairs. Fluoride toothpaste use for young children. *J Am Dent Assoc* 2014;145(2):190-1.
42. American Dental Association Council on Scientific Affairs Expert Panel on Topical Fluoride Caries Preventive Agents. Topical fluoride for caries prevention: Executive summary of the updated clinical recommendations and supporting systematic review. *J Am Dent Assoc* 2013;144(11):1279-91.
43. American Dental Association Council on Scientific Affairs. Evidence-based clinical recommendations for the use of pit-and-fissure sealants. *J Am Dent Assoc* 2008;139(4):257-67.
44. Tinanoff N. Association of diet with dental caries in pre-school children. *Dental Clin North Am* 2005;49(4):725-7.
45. Burt BA, Pai S. Sugar consumption and caries risk: A systematic review. *J Dent Ed* 2001;65(10):1017-23.
46. Milgrom P, Ly KA, Tut OK, et al. Xylitol pediatric topical oral syrup to prevent dental caries. *Arch Pediatr Adolesc Med* 2009;163(7):601-7.
47. Maguire A, Rugg-Gunn AJ. Xylitol and caries prevention – Is it a magic bullet? *British Dent J* 2003;194(8):429-36.
48. Hayes C. The effect of non-cariogenic sweeteners on the prevention of dental caries: A review of the evidence. *J Dent Ed* 2001;65(10):1106-9.
49. Parker C. Active surveillance: Toward a new paradigm in the management of early prostate cancer. *Lancet Oncol* 2004;5(2):101-6.
50. Warren JJ, Levy SM, Broffitt B, Kanellis MJ. Longitudinal study of non-cavitated carious lesion progression in the primary dentition. *J Public Health Dent* 2006;66(2):83-7.

51. Anusavice KJ. Present and future approaches for the control of caries. *J Dent Ed* 2005;69(5):538-54.
52. Hicks J, García-Godoy F, Flaitz C. Biological factors in dental caries: Role of remineralization and fluoride in the dynamic process of demineralization and remineralization. *J Clin Ped Dent* 2004;28(1):203-14.
53. Rosenblatt A, Stamford TCM, Niederman R. Silver diamine fluoride: A caries “silver-fluoride bullet”. *J Dent Res* 2009;88(2):116-25.
54. Tinanoff N. Progress regarding the use of stannous fluoride in clinical dentistry. *J Clinical Dent* 1995;6(Special issue):37-40.
55. Twetman S. Prevention of early childhood caries (ECC). Review of literature published 1998-2007. *Eur Archives Paed Dent* 2008;9(1):12-8.
56. Caufield PW, Desanayke AP, Li Y. The antimicrobial approach to caries management. *J Dent Ed* 2001;65(10):1091-5.
57. Ismail AI, Hassen H. Fluoride supplements, dental caries and fluorosis. A systematic review. *J Am Dent Assoc* 2008;139(11):1457-68.
58. Tinanoff N. Use of fluorides. In: Berg J, Slayton RL, eds. *Early Childhood Oral Health*. Wiley-Blackwell: Ames, Iowa; 2009:92-109.
59. Ramos-Gomez FJ, Crall J, Gansky SA, Slayton RL, Featherstone JDB. Caries risk assessment appropriate for the age 1 visit (infants and toddlers). *J Calif Dent Assoc* 2007;35(10):687-702.
60. American Dental Association Councils on Scientific Affairs and Dental Practice. Caries Risk Assessment Form (Ages 0-6). American Dental Association: Chicago, Ill.; 2008. Available at: “http://www.ada.org/sections/professionalResources/docs/topics_caries_under6.doc”. Accessed July 3, 2010.
61. American Dental Association Councils on Scientific Affairs and Dental Practice. Caries Risk Assessment Form (Age >6). American Dental Association: Chicago, Ill.; 2008. Available at: “http://www.ada.org/sections/professionalResources/docs/topics_caries_over6.doc”. Accessed July 3, 2010.
62. Featherstone JDB, Domejean-Orliaguet S, Jenson L, Wolff M, Young DA. Caries risk assessment in practice for age 6 through adult. *J Calif Dent Assoc* 2007;35(10):703-13.
63. American Academy of Pediatric Dentistry. Policy on interim therapeutic restorations. *Pediatric Dent* 2009;31 (special issue):38-9.