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

Originating 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 healthcare 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 is an update of AAPD's "Policy on Use of a Caries-risk Assessment Tool (CAT) for Infants, Children, and Adolescents, Revised 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; and
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 (ie, the number of new cavitated or incipient lesions) during a certain time period[7] 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 (ie, 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 (eg, microflora) or have been shown useful in predicting it (eg, 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 levels[3] 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 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 3 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 6 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 mutans streptococci 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 emergences, these tools can be refined to provide greater predictably of caries in children prior to disease initiation. Furthermore, the evolution of caries-risk assessment tools and

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	Moderate Risk	Protective
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, moderate, or high is based on preponderance of factors for the individual. However, clinical judgment may justify the use of one factor (eg, frequent exposure to sugar containing snacks or beverages, visible cavities) in determining overall risk.

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

Table 2. Caries-risk Assessment Form for 0-5 Year Olds[59,60]

(For Dental Providers)

Factors	High Risk	Moderate Risk	Protective
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 (eg, 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 Olds[60-62]

(For Dental Providers)

Factors	High Risk	Moderate Risk	Protective
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 (eg, 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 (eg, >1 interproximal lesions, low salivary flow) in determining overall risk.

Overall assessment of the dental caries risk: High ❒ Moderate ❒ Low ❒

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 workforce issues.

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

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

Risk Category	Diagnostics	Interventions		Restorative
		Fluoride	Diet	
Low risk	– Recall every 6-12 months – Baseline MS[α]	– Twice daily brushing	Counseling	– Surveillance[χ]
Moderate risk parent engaged	– Recall every 6 months – Baseline MS[α]	– Twice daily brushing with fluoridated toothpaste[β] – Fluoride supplements[δ] – Professional topical treatment every 6 months	Counseling	– Active surveillance[ε] of incipient lesions
Moderate risk parent not engaged	– Recall every 6 months – Baseline MS[α]	– Twice daily brushing with fluoridated toothpaste[β] – Professional topical treatment every 6 months	Counseling, with limited expectations	– Active surveillance[ε] of incipient lesions
High risk parent engaged	– Recall every 3 months – Baseline and follow up MS[α]	– Twice daily brushing with fluoridated toothpaste[β] – Fluoride supplements[δ] – Professional topical treatment every 3 months	Counseling	– Active surveillance[ε] of incipient lesions – Restore cavitated lesions with ITR[φ] or definitive restorations
High risk parent not engaged	– Recall every 3 months – Baseline and follow up MS[α]	– Twice daily brushing with fluoridated toothpaste[β] – Professional topical treatment every 3 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 6-12 months – Radiographs every 12-24 months – Baseline MS[α]	– Twice daily brushing with fluoridated toothpaste[γ]	No	Yes	– Surveillance[χ]
Moderate risk parent engaged	– Recall every 6 months – Radiographs every 6-12 months – Baseline MS[α]	– Twice daily brushing with fluoridated toothpaste[γ] – Fluoride supplements[δ] – Professional topical treatment every 6 months	Counseling	Yes	– Active surveillance[ε] of incipient lesions – Restoration of cavitated or enlarging lesions
Moderate risk parent not engaged	– Recall every 6 months – Radiographs every 6-12 months – Baseline MS[α]	– Twice daily brushing with fluoridated toothpaste[γ] – Professional topical treatment every 6 months	Counseling, with limited expectations	Yes	– Active surveillance[ε] of incipient lesions – Restoration of cavitated or enlarging lesions
High risk parent engaged	– Recall every 3 months – Radiographs every 6 months – Baseline and follow up MS[α]	– Brushing with 0.5% fluoride (with caution) – Fluoride supplements[δ] – Professional topical treatment every 3 months	Counseling	Yes	– Active surveillance[ε] of incipient lesions – Restoration of cavitated or enlarging lesions
High risk parent not engaged	– Recall every 3 months – Radiographs every 6 months – Baseline and follow up MS[α]	– Brushing with 0.5% fluoride (with caution) – Professional topical treatment every 3 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	– Recall every 6-12 months – Radiographs every 12-24 months	– Twice daily brushing with fluoridated toothpaste[μ]	No	Yes	– Surveillance[χ]
Moderate risk patient/parent engaged	– Recall every 6 months – Radiographs every 6-12 months	– Twice daily brushing with fluoridated toothpaste[μ] – Fluoride supplements[δ] – Professional topical treatment every 6 months	– Counseling	Yes	– Active surveillance[ε] of incipient lesions – Restoration of cavitated or enlarging lesions
Moderate risk patient/parent not engaged	– Recall every 6 months – Radiographs every 6-12 months	– Twice daily brushing with toothpastee[μ] – Professional topical treatment every 6 months	– Counseling, with limited expectations	Yes	– Active surveillance[ε] of incipient lesions – Restoration of cavitated or enlarging lesions
High risk patient/parent engaged	– Recall every 3 months – Radiographs every 6 months	– Brushing with 0.5% fluoride – Fluoride supplements[δ] – Professional topical treatment every 3 months	– Counseling – Xylitol	Yes	– Active surveillance[ε] of incipient lesions – Restoration of cavitated or enlarging lesions
High risk patient/parent not engaged	– Recall every 3 months – Radiographs every 6 months	– Brushing with 0.5% fluoride – Professional topical treatment every 3 months	– Counseling, with limited expectations – Xylitol	Yes	– 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.
ε Careful monitoring of caries progression and prevention program.
γ Parental supervision of a "pea sized" amount of toothpaste.
μ Less concern about the quantity of toothpaste.
β Parental supervision of a "smear" amount of tooth paste.
δ Need to consider fluoride levels in drinking water.
φ Interim Therapeutic Restoration.[63]
λ Indicated for teeth with deep fissure anatomy or developmental defects.

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 to, 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 professionally-applied topical fluoride,[41] the Scottish Intercollegiate Guideline Network guideline for

the management of caries in pre-school children,[42] a Maternal and Child Health Bureau Expert Panel,[43] and the CDC's fluoride guidelines.[29] Guidelines for pit and fissure sealants are based on ADA's Council on Scientific Affairs recommendations for the use of pit-and-fissure sealants.[44] Guidelines on diet counseling to prevent caries are based on 2 review papers.[45,46] 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,[47] and 2 evidence-based reviews.[48,49] 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,[50] that caries progression has diminished over recent decades,[51] and that the majority of proximal lesions, even in dentin, are not cavitated.[52]

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.[53] Other fluoride compounds, such as silver diamine fluoride[54] and stannous fluoride[55], 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.[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.

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