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

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Abstract

This best practice reviews caries-risk assessment and patient care pathways for pediatric patients. Presented caries-related topics include caries-risk assessment, active surveillance, caries prevention, sealants, fluoride, diet, radiology, and nonrestorative treatment. Caries-risk assessment forms are organized by age: 0-5 years and ≥6 years old, incorporating 3 factor categories (social/behavioral/medical, clinical, and protective factors) and disease indicators appropriate for the patient age. Each factor category lists specific conditions to be graded "Yes" if applicable, with the answers tallied to render a caries-risk assessment score of high, moderate, or low. The care management pathway presents clinical care options beyond surgical or restorative choices and promotes individualized treatment regimens dependent on patient age, compliance with preventive strategies, and other appropriate strategies. Caries management forms also are organized by age: 0-5 years and ≥6 years old, addressing risk categories of high, moderate, and low, based on treatment categories of diagnostics, preventive interventions (fluoride, diet counseling, sealants), and restorative care. Caries-risk assessment and clinical management pathways allow for customized periodicity, diagnostic, preventive, and restorative care for infants, children, adolescents, and individuals with special needs.

This document was developed through a collaborative effort of the American Academy of Pediatric Dentistry Councils on Clinical Affairs and Scientific Affairs to offer updated information and recommendations regarding assessment of caries-risk and risk-based management protocols.

KEYWORDS: CARIES-RISK ASSESSMENT; CARIES PREVENTION; CLINICAL MANAGEMENT PATHWAYS; DENTAL SEALANTS; FLUORIDE

Purpose

The American Academy of Pediatric Dentistry (**AAPD**) recognizes that caries-risk assessment and management protocols, also called care pathways, can assist clinicians with decisions regarding treatment based upon a child's age, caries risk, and patient compliance and are essential elements of contemporary clinical care for infants, children, and adolescents. These recommendations are 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 evidence- and risk-based diagnostic, fluoride, dietary, and restorative protocols.

Methods

This document was developed by the Council on Clinical Affairs, adopted in 2002[1], and last revised in 2019[2]. To update this document, an electronic search was conducted of publications from 2012 to 2021 that included systematic reviews/meta-analyses or reports from expert panels, clinical guidelines, and other relevant reviews using the terms: *caries risk assessment* AND *diet*, *sealants*, *fluoride*, *radiology*, *nonrestorative treatment*, *active surveillance*, *caries prevention*. Five hundred ninety-two articles met these criteria. Papers for review were chosen from this list and from references within selected articles. 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 generally have sufficient data to accurately quantitate a person's disease susceptibility and allow for preventive measures. However, in dentistry, sufficiently-validated multivariate screening tools to determine which children are at higher risk for dental caries are limited.[3,4] Two caries risk assessment tools, namely the Cariogram[5] and CAMBRA tools[6], have been validated in clinical trials and clinical outcomes studies. Several other published caries-risk assessment tools utilize similar components but have not been clinically validated.[5,7] Nevertheless, caries-risk assessment

1. fosters the treatment of the disease process instead of treating the outcome of the disease.
2. allows 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.

ABBREVIATION
AAPD: American Academy of Pediatric Dentistry.

Caries-risk assessment is part of a comprehensive treatment plan approach based on age of the child, starting with the age 1 visit. 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.[8] Caries-risk assessment is the determination of the likelihood of the increased incidence of caries (ie, new cavitated or incipient lesions) during a certain time period[9,10] 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, noncavitated or white spot lesions), health care providers can help prevent cavitation.[11]

Caries risk factors are variables that are thought to cause the disease directly (eg, microflora) or have been shown useful in predicting it (eg, life-time poverty, low health literacy) and include those variables that may be considered protective factors. The most-used caries-risk factors include low salivary flow, visible plaque on teeth, high frequency sugar consumption, presence of appliance in the mouth, health challenges, sociodemographic factors, access to care, and cariogenic microflora.[11] The presence of caries lesions, either noncavitated or cavitated, also has been shown in numerous studies to be a strong indicator of caries risk. Clinical observation of caries lesions, or restorations recently placed because of such lesions, are best thought of as disease indicators rather than risk factors since these lesions do not cause the disease directly or indirectly but, very importantly, indicate the presence of the factors that cause the disease. Protective factors in caries risk include a child's receiving optimally-fluoridated water, having

Table 1. Caries-risk Assessment Form for 0-5 Years Old

Use of this tool will help the health care provider assess the child's risk for developing caries lesions. In addition, reviewing specific factors will help the practitioner and parent understand the variable influences that contribute to or protect from dental caries.

Factors	High risk	Moderate risk	Low risk
Risk factors, social/behavioral/medical			
Mother/primary caregiver has active dental caries	Yes		
Parent/caregiver has life-time of poverty, low health literacy	Yes		
Child has frequent exposure (>3 times/day) between-meal sugar-containing snacks or beverages per day	Yes		
Child uses bottle or nonspill cup containing natural or added sugar frequently, between meals and/or at bedtime	Yes		
Child is a recent immigrant		Yes	
Child has special health care needs[α]		Yes	
Risk factors, clinical			
Child has visible plaque on teeth	Yes		
Child presents with dental enamel defects	Yes		
Protective factors			
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
Disease indicators[ß]			
Child has noncavitated (incipient/white spot) caries lesions	Yes		
Child has visible caries lesions	Yes		
Child has recent restorations or missing teeth due to caries	Yes		

[α] Practitioners may choose a different risk level based on specific medical diagnosis and unique circumstances, especially conditions that affect motor coordination or cooperation.

[ß] While these do not cause caries directly or indirectly, they indicate presence of factors that do.

Instructions: *Circle "Yes" that corresponds with those conditions applying to a specific patient. Use the circled responses to visualize the balance among risk factors, protective factors, and disease indicators. Use this balance or imbalance, together with clinical judgment, to assign a caries risk level of low, moderate, or high based on the preponderance of factors for the individual. Clinical judgment may justify the weighting of one factor (eg, heavy plaque on the teeth) more than others.*

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

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teeth brushed daily with fluoridated toothpaste, receiving topical fluoride from a health professional, and having regular dental care.[11,12]

Some limitations with the risk factors include the following.

- Past caries experience is not particularly useful in young children, and activity of lesions may be more important than number of lesions.
- Low salivary flow is difficult to measure and may not be relevant in young children.[13]
- Frequent sugar consumption is hard to quantitate.
- Sociodemographic factors are just a proxy for various exposures/behaviors which may affect caries risk.
- Predictive ability of various risk factors across the life span and how risk changes with age have not been determined.[14]
- Genome-level risk factors may account for substantial variations in caries risk.

Risk assessment tools can aid in the identification of specific behaviors or risk factors for each individual and allow dentists and other health care professionals to become more actively involved in identifying and referring high-risk children. Tables 1 and 2 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

Table 2. Caries-risk Assessment Form for ≥6 Years Old[25]

(For Dental Providers)

Use of this tool will help the health care provider assess the child's risk for developing caries lesions. In addition, reviewing specific factors will help the practitioner and patient/parent understand the variable influences that contribute to or protect from dental caries.

Factors	High risk	Moderate risk	Low risk
Risk factors, social/behavioral/medical			
Patient has life-time of poverty, low health literacy	Yes		
Patient has frequent exposure (>3 times/day) between-meal sugar-containing snacks or beverages per day	Yes		
Child is a recent immigrant		Yes	
Patient uses hyposalivatory medication(s)		Yes	
Patient has special health care needs[α]		Yes	
Risk factors, clinical			
Patient has low salivary flow	Yes		
Patient has visible plaque on teeth	Yes		
Patient presents with dental enamel defects	Yes		
Patient wears an intraoral appliance		Yes	
Patient has defective restorations		Yes	
Protective factors			
Patient receives optimally-fluoridated drinking water			Yes
Patient has teeth brushed daily with fluoridated toothpaste			Yes
Patient receives topical fluoride from health professional			Yes
Patient has dental home/regular dental care			Yes
Disease indicators[ß]			
Patient has interproximal caries lesion(s)	Yes		
Patient has new noncavitated (white spot) caries lesions	Yes		
Patient has new cavitated caries lesions or lesions into dentin radiographically	Yes		
Patient has restorations that were placed in the last 3 years (new patient) or in the last 12 months (patient of record)	Yes		

[α] Practitioners may choose a different risk level based on specific medical diagnosis and unique circumstances, especially conditions that affect motor coordination or cooperation.

[ß] While these do not cause caries directly or indirectly, they indicate presence of factors that do.

Instructions: *Circle "Yes" that corresponds with those conditions that apply to a specific patient. Use the circled responses to visualize the balance among risk factors, protective factors, and disease indicators. Use this balance or imbalance, together with clinical judgment, to assign a caries risk level of low, moderate, or high based on the preponderance of factors for the individual. Clinical judgment may justify the weighting of one factor (eg, heavy plaque on the teeth) more than others.*

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

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greater predictably of caries in children prior to disease initiation. Furthermore, the evolution of caries-risk assessment tools and care pathways 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.

Care pathways for caries management

Care pathways are documents designed to assist in clinical decision making; they provide criteria regarding diagnosis and treatment and lead to recommended courses of action.[15] The pathways are based on evidence from current peer-reviewed literature and the considered judgment of expert panels, as well as clinical experience of practitioners. Care pathways for caries management in children aged 0-2 and 3-5 years old were first introduced in 2011.[16] Care pathways are 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. 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 arrest or progression.

Care pathways 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 3 and 4). Such clinical pathways yield greater probability of success, fewer complications, and more efficient use of resources than less standardized treatment.[15]

Table 3. Example of Caries Management Pathways for 0-5 Years Old

Risk category	Diagnostics	Preventive interventions			Restorative interventions
		Fluoride	Dietary counseling	Sealants	
Low risk	– Recall every 6 to 12 months – Radiographs every 12 to 24 months	– Drink optimally-fluoridated water – Twice daily brushing with fluoridated toothpaste	Yes	Yes	– Surveillance
Moderate risk	– Recall every 6 months – Radiographs every 6 to 12 months	– Drink optimally-fluoridated water (alternatively, take fluoride supplements with fluoride-deficient water supplies) – Twice daily brushing with fluoridated toothpaste – Professional topical treatment every 6 months	Yes	Yes	– Active surveillance of non-cavitated (white spot) caries lesions – Restore cavitated or enlarging caries lesions
High risk	– Recall every 3 months – Radiographs every 6 months	– Drink optimally-fluoridated water (alternatively, take fluoride supplements with fluoride-deficient water supplies) – Twice daily brushing with fluoridated toothpaste – Professional topical treatment every 3 months – Silver diammine fluoride on cavitated lesions	Yes	Yes	– Active surveillance of non-cavitated (white spot) caries lesions – Restore cavitated or enlarging caries lesions – Interim therapeutic restorations (ITR) may be used until permanent restorations can be placed

Notes for caries management pathways table:

Twice daily brushing: Parental supervision of a "smear" amount of fluoridated toothpaste for children under age 3, pea-size amount for children ages 3 through 5.

Surveillance: Periodic monitoring for signs of caries progression; active surveillance: active measures by parents and oral health professionals to reduce cariogenic environment and monitor possible caries progression.

Silver diammine fluoride: Use of 38% silver diammine fluoride to assist in arresting caries lesions; informed consent: particularly highlighting expected staining of treated lesions.

Sealants: The decision to seal primary and permanent molars should account for both the individual-level and tooth-level risks.

Table 4. Example of a Caries Management Pathways for ≥6 Years Old

Risk category	Diagnostics	Preventive interventions			Restorative interventions
		Fluoride	Dietary counseling	Sealants	
Low risk	– Recall every 6 to 12 months – Radiographs every 12 to 24 months	– Drink optimally-fluoridated water – Twice daily brushing with fluoridated toothpaste	Yes	Yes	– Surveillance
Moderate risk	– Recall every 6 months – Radiographs every 6 to 12 months	– Drink optimally-fluoridated water (alternatively, take fluoride supplements with fluoride-deficient water supplies) – Twice daily brushing with fluoridated toothpaste – Professional topical treatment every 6 months	Yes	Yes	– Active surveillance of non-cavitated (white spot) caries lesions – Restore cavitated or enlarging caries lesions
High risk	– Recall every 3 months – Radiographs every 6 months	– Drink optimally-fluoridated water (alternatively, take fluoride supplements with fluoride-deficient water supplies) – Brushing with 0.5% fluoride gel/paste – Professional topical treatment every 3 months – Silver diammine fluoride on cavitated lesions	Yes	Yes	– Active surveillance of non-cavitated (white spot) caries lesions – Restore cavitated or enlarging caries lesions – Interim therapeutic restorations (ITR) may be used until permanent restorations can be placed

Notes for caries management pathways table:

Twice daily brushing: Parental supervision of a pea-size amount of fluoridated toothpaste for children 6 years of age.

Surveillance: Periodic monitoring for signs of caries progression; active surveillance: active measures by parents and oral health professionals to reduce cariogenic environment and monitor possible caries progression.

Silver diammine fluoride: Use of 38% silver diammine fluoride to assist in arresting caries lesions; informed consent: particularly highlighting expected staining of treated lesions.

Sealants: Although studies report unfavorable cost/benefit ratio for sealant placement in low caries-risk children, expert opinion favors sealants in permanent teeth of low-risk children based on possible changes in risk over time and differences in tooth anatomy. The decision to seal primary and permanent molars should account for both the individual-level and tooth-level risks.

Content of the present caries management protocol is based on results of systematic reviews and expert panel recommendations that provide better understanding of and recommendations for diagnostic, preventive, and restorative treatments. Recommendations for the use of fluoridated toothpaste are based on 4 systematic reviews[17-20], dietary fluoride supplements are based on the Centers for Disease Control and Prevention's fluoride guidelines[21], professionally-applied and prescription strength home-use topical fluoride are based on 2 systematic reviews[19,22], the use of silver diammine fluoride to arrest caries lesions also is based on 2 systematic reviews[23,24]. Radiographic diagnostic recommendations are based on the uniform guidelines from national organizations.[25] Recommendations for pit-and-fissure sealants are based on 2 systematic reviews[26,27], with only the American Dental Association/AAPD review addressing sealants for primary teeth. Dietary interventions are based on a systematic review of strategies to reduce sugar-sweetened beverages.[28] Caries risk is assessed at both the individual level and tooth level. Treatmentof caries with interim therapeutic restorations is based on the AAPD policy and recommended best practices.[29,30] 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,[31] and that caries can arrest without treatment.[32]

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 care pathways.

Recommendations

1. Dental caries-risk assessment, based on a child's age, social/behavioral/medical 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 and disease indicators will enable a more evidence-based approach to medical provider referrals, as well as establish periodicity and intensity of diagnostic, preventive, and restorative interventions.

3. Care pathways, based on a child's age and caries risk, provide health providers with criteria and protocols for determining the types and frequency of diagnostic, preventive, and restorative interventions for patient-specific management of dental caries.

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