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Australian Research Centre for Population Oral Health

Caries Risk Assessment for Children: Information for Oral Health Practitioners

There has been a reduction of dental caries experience in Australia over the last half century. It is no longer unusual for children to have no dental caries experience. The use of fluoride in public water supplies, dentifrices and professional products, improvement of oral hygiene practices as well as increased access to dental care have played a major role in this dramatic improvement[1]. However, dental caries still remains one of the most prevalent chronic diseases in children.

The skewed distribution of dental caries underpins the usefulness of caries risk assessment (CRA) both for individuals and groups. Early identification of subjects with different caries risk levels is important for planning appropriate preventive measures for individual needs whereas CRA-driven dental care programs, at population level, may be more efficient and cost-effective.

One of the aims of the CRA for children is to maintain good oral health of the low-risk individuals while trying to improve the oral health of high-risk children by providing targeted oral care usually through more frequent visits.

Why CRA should be used?

Categorising patients by their risk of caries has been advocated as an initial step in determining appropriate preventive and treatment interventions. Identifying and determining risk should be a component in the clinical decision-making process because[2]:

- CRA and clinical examination provide an overview of exposures to potential caries risk/protective factors such as plaque, frequency of sugar intake, and exposure to fluoride while encouraging management strategies developed specifically for the patient.
- CRA is useful to evaluate the degree of the patient's risk of developing caries to determine the intensity of the treatment and frequency of recall appointments or treatments.
- CRA helps in identifying the main aetiological agents that contribute to the disease and/or in determining the type of treatment and in making restorative treatment decisions including whether to intervene or not, preparing cavity designs and selecting dental materials.
- CRA can improve the reliability of the prognosis of the planned treatment and assess the efficacy of the proposed management and preventive treatment plan at recall visits.

CRA models currently involve a combination of risk indicators and protective factors that interplay with a variety of social, cultural, and behavioural factors.

Risk Indicators:

- **Past caries experience:** This has been the most consistent predictive factor observed in caries risk assessment studies[3]. However, it is not particularly useful in young children as determining caries risk before the disease manifests is much important in them. White spot lesions are considered good indicators to predict future caries development in young children[4].
- **Socioeconomic status (SES):** Most dental studies use, low, middle or high socioeconomic advantage as a measure of SES. Research shows an inverse association between caries and SES levels indicating a higher caries experience in both primary and permanent teeth among children who are socioeconomically disadvantaged[5].
- **Sugar consumption:** The quantity of sugar consumption as well as the frequency of sugar intake contributes to dental caries. The relationship between sugar consumption and caries in developed countries has long been viewed as a positively linear one – the more the consumption and the higher the frequency the greater the caries severity. Since the last decade, this linear relationship has been affected by fluoride exposure with most studies reporting a moderate or weak relationship between sugar consumption and caries[6]. However, consumption of beverages with high sugar content such as soda pop or powdered beverage concentrates made with sugar was associated with progression of dental caries[7,8]. Recently, WHO guideline on sugar intake for adults and children concluded that even a small reduction in risk of dental caries due to less consumption of sugar in childhood is of significance in later life[9].
- **Oral hygiene habits:** The available evidence does not demonstrate a clear and consistent relationship between oral hygiene and dental caries prevalence[10]. The reported association with tooth brushing frequency is more likely due to use of fluoridated toothpaste[11].
- **Bacteria:** Streptococcus Mutans and Lactobacilli, the main bacteria that are involved in the caries process, are constituents of the normal flora. Therefore caries is considered as a bacterial ecologic imbalance rather than as an exogenous infection[5]. At a population (group) level, total bacterial count has been weakly associated with caries experience[12] . At the individual level, bacterial count is a poor predictor of future caries[13]. Mutans Streptococci levels and the age of colonization with cariogenic flora are valuable in assessing caries risk, particularly in very young children[14].

- **Saliva:** No variation in a single salivary component in a healthy population has been shown to be a significant predictive factor. Nevertheless decreased salivary function, as manifested by extreme xerostomia, is a consistent predictor of high caries risk[10]. Despite the fact that normal salivary flow is an extremely important intrinsic host factor providing protection against caries, there is little information about the prevalence of low salivary flow in children[15].

Protective factors:

- **Fluoride:** The protective effect of water fluoridation has been well documented in major systematic reviews and fluoridated toothpaste has been accepted as a benchmark intervention for the prevention of dental caries[16]. Professional topical fluoride applications and fluoride varnishes are also effective in reducing caries[17].
- **Fissure sealants:** Sealants are universally recognized as an evidence-based method to boost the tooth's resistance to carious lesions in pits and fissures of the teeth. Extensive research has shown a caries protective benefit from fissure sealants[18].

What CRA tools are available in the market?

Currently there are four commonly used CRA tools.

- **Caries Risk Assessment Tool (CAT):** This tool was developed by the American Academy of Paediatric Dentistry (AAPD)[19]. Depending on the age of children CAT incorporates three factors in assessing caries risk, namely, biological as well as protective factors and clinical findings (Table 1).
- **Caries Management by Risk Assessment (CAMBRA):** This has been designed to use with newborns to children aged five years[20]. CAMBRA is essentially based on the same factors as CAT to assess caries risk (Figure 1).
- **Cariogram:** This graphically illustrates as a pie-circle diagram a patient's risk of developing new caries while simultaneously expressing the contribution of different factors on the caries risk for that particular patient[21]. A cariogram is divided into five colour-coded sectors – green, dark blue, red, light blue and yellow – representing factors that of relevance for caries. These factors are assigned a score based on a stipulated scale and entered into an interactive PC-program, which produces a pie-diagram. Table 2 indicates the factors and the relevant information required to create a cariogram. Figure 2 shows an example of a cariogram.
- **Traffic Light Matrix (TLM):** This is a commonly used CRA tool in Australia[22]. TLM is based on 19 criteria in 5 different categories including saliva (6 criteria), plaque (3 criteria), diet (2 criteria), fluoride exposure (3 criteria) and modifying factors (5 criteria) where traffic light colours convey varying risk levels (red=high, yellow=moderate and green=low).
  - Saliva: a) Resting: hydration, viscosity and pH b) Stimulated: quantity/rate, pH and buffering capacity
  - Plaque: pH, maturity and bacteria – Mutans count
  - Diet: number of sugar and acid exposures in between meals/day
  - Fluoride: exposure to fluoride via water/toothpaste/professional treatment
  - Modifying factors: drugs that reduce salivary flow, diseases resulting in dry mouth, fixed/removable appliances, recent active caries and poor compliance

Figure 3 shows a modified form developed by GC Asia Dental Pty Ltd (2007) to assess caries risk using TLM incorporating patient motivation and compliance[22].

Recommendations

- 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 practitioners.
- Oral health practitioners should determine the types and frequency of diagnostic, preventive, and restorative care for their patients. Clinical management of caries should be based on child's age and caries risk level.
- As none of these CRA tools are unequivocally accepted, practitioners are advised to use their own clinical experience and judgement in choosing a tool, assessing caries risk and making clinical decisions.

Table 1. Caries risk assessment form based on CAT[19]

Factors	Risk		
	High	Moderate	Low
Biological			
Mother/primary caregiver has active caries (for child only)	Yes		
Parent/caregiver/patient is of low SES	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/patient has special health care needs		Yes	
Child/patient is a recent immigrant		Yes	
Protective			
Child/patient receives optimally-fluoridated drinking water or fluoride supplements			Yes
Child/patient brushes teeth daily with fluoridated toothpaste			Yes
Child/patient receives topical fluoride from health professional			Yes
Child/patient has regular dental care			Yes
Patient has additional home measures (e.g., xylitol, MI paste, antimicrobial)			Yes
Clinical findings			
Child has >1 decayed/missing/filled surfaces	Yes		
Child/patient has active white spot lesions or enamel defects	Yes		
Child has elevated mutans streptococci levels	Yes		
Child has plaque on teeth		Yes	
Patient has ≥1 interproximal lesions	Yes		
Patient has low salivary flow	Yes		
Patient has defective restorations		Yes	
Patient wearing an intraoral appliance		Yes	

Child= aged <6 years Patient= aged ≥6 years

Overall caries risk assessment: High ☐ Moderate ☐ Low ☐

Figure 1. CAMBRA risk assessment form[20]

CAMBRA — Caries Risk Assessment Form for Age 0 to 5 Years

Patient Name:_____ ID#_____ Age:_____ Date:_____

Assessment Date:_____ Please circle: BASELINE, three-month follow-up or six-month follow-up

	1	2	3	
NOTE: Any one Yes in Column 1 signifies likely "High Risk" and an indication for bacteria tests	Yes =CIRCLE	Yes =CIRCLE	Yes =CIRCLE	Comments:
1. Risk Factors (Biological Predisposing Factors)				
(a) Mother or primary caregiver has had active dental decay in the past 12 months*	Yes			
(b) Bottle with fluid other than water, plain milk and/or plain formula		Yes		Type of fluid:
(c) Continual bottle use		Yes		
(d) Child sleeps with a bottle, or nurses on demand		Yes		
(e) Frequent (>3 times/day) between-meal snacks of sugars/cooked starch/sugared beverages		Yes		#times/day:
(F) Saliva-reducing factors are present, including: 1. medications (e.g., some for asthma [albuterol] or hyperactivity) 2. medical (cancer treatment) or genetic factors		Yes		
(g) Child has developmental problems/CSHCN (child with special health care needs)		Yes		
(h) Caregiver has low health literacy, is a WIC participant and/or child participates in Free Lunch Program and/or Early HeadStart		Yes		
2. Protective Factors				
(a) Child lives in a fluoridated community or takes fluoride supplements by slowly dissolving or as chewable tablets (note resident ZIP code)			Yes	
(b) Child drinks fluoridated water (e.g., use of tap water)			Yes	
(c) Teeth brushed with fluoridated toothpaste (pea size) at least once daily			Yes	
(d) Teeth brushed with fluoride toothpaste (pea size) at least 2x daily			Yes	
(e) Fluoride varnish in last six months			Yes	
(f) Mother/caregiver chews/dissolves xylitol chewing gum/lozenges 2–4x daily			Yes	
3. Disease Indicators/Risk Factors – Clinical Examination of Child				
(a) Obvious white spots, decalcifications enamel defects or obvious decay present on the child's teeth*	Yes			
(b) Restorations present (past caries experience for the child)*	Yes			
(c) Plaque is obvious on the teeth and/or gums bleed easily		Yes		
(d) Visually inadequate saliva flow		Yes		

Child's Overall Caries Risk* (circle): High Moderate Low

Child: Bacteria/Saliva Test Results: MS: LB: Flow Rate: Ml/min: Date:

Caregiver: Bacteria/Saliva Test Results: MS: LB: Flow Rate: ml/min: Date:

Self-management goals:

1)_____

2)_____

VISUALIZE CARIES BALANCE

*Assessment based on provider's judgment of balance between risk factors/disease indicators and protective factors.

Table 2. Factors and relevant information required to create a cariogram[21]

Factor	Comment	Information needed
Caries experience	Past caries experience, including cavities, fillings and missing teeth because of caries. Several new cavities definitely appearing during preceding year should give a high score even if number of fillings is low	DMFT, DMFS, new caries experience in the past 1 year
Related diseases	General diseases or conditions associated with dental caries	Medical history, medications
Diet, contents	Estimation of the cariogenicity of the food, in particular sugar contents	Diet history, lactobacillus test count
Diet, frequency	Estimation of number of meals and snacks per day, mean for 'normal days'	Questionnaire results, 24- hour recall or dietary recall (3 days)
Mutans streptococci	Estimation of levels of mutans streptococci (Streptococcus mutans, Streptococcus sobrinus) in saliva, for example using Strip mutans test	Strip mutans test or other laboratory tests giving comparable results
Fluoride program	Estimation of to what extent fluoride is available in the oral cavity over the coming period of time	Fluoride exposure, interview patient
Saliva secretion	Estimation of amount of saliva, e.g., using paraffin-stimulated secretion and expressing results as milliliter saliva per minute	Stimulated saliva test – secretion rate
Saliva buffer capacity	Estimation of capacity of saliva to buffer acids, e.g., using the Dentobuff test	Dentobuff test or other laboratory tests giving comparable results
Clinical judgement	Opinion of dental examiner, 'clinical feeling'. Examiners own clinical and personal score for the individual patient	Opinion of dental examiner, 'clinical feeling'. A pre-set score of 1 comes automatically

Figure 2. Example of a cariogram indicating high caries risk[21]

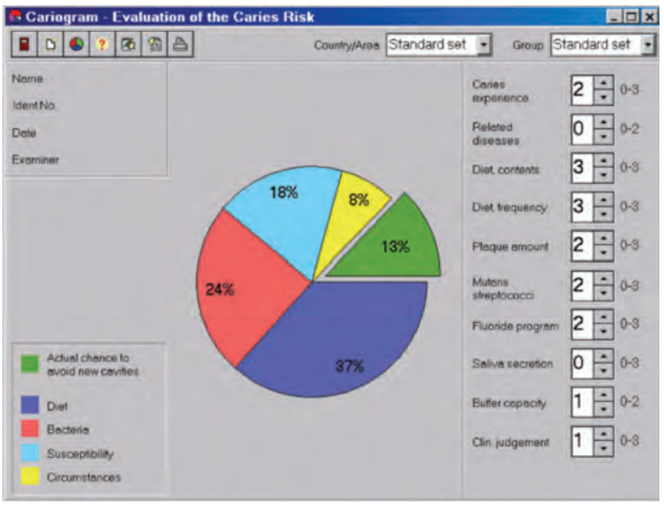
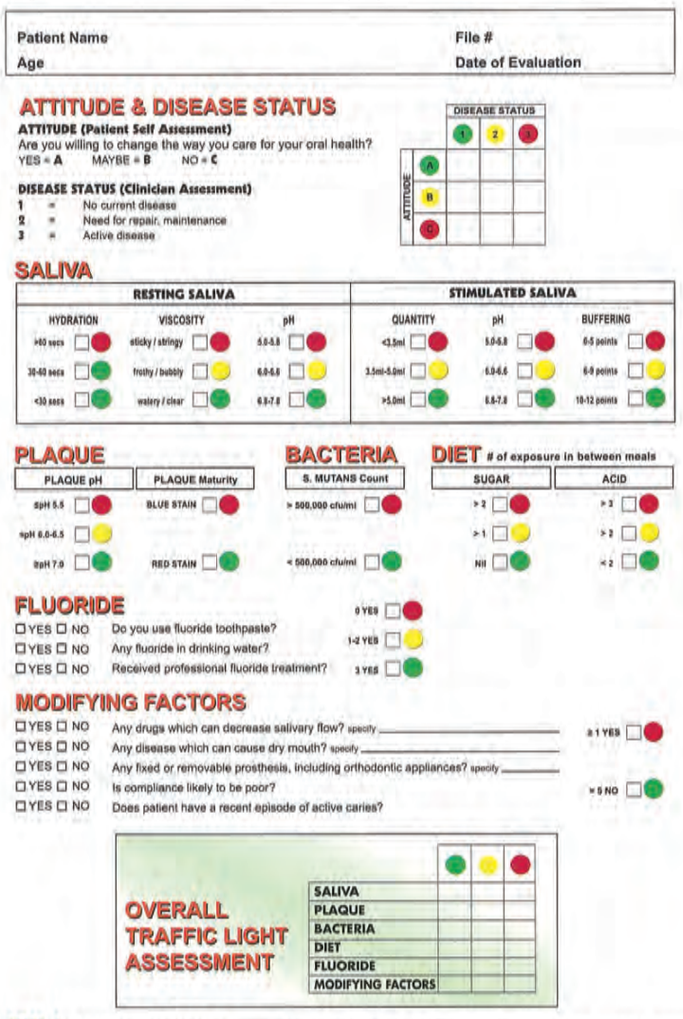


Figure 3. TLM form for assessing caries risk[22] (adapted from GC Asia Dental Pty Ltd 2007)



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Diep Ha, Najith Amarasena, Ratilal Lalloo, Karen Peres.
Australian Research Centre for Population Oral Health (ARCPOH),
School of Dentistry, Faculty of Health Sciences, The University of Adelaide.

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For further enquiries

Dental Practice Education Research Unit
ARCPOH, School of Dentistry
The University of Adelaide, SA 5005

Phone: +61 8 8313 4235
Enquiries: dperu@adelaide.edu.au
Web: adelaide.edu.au/arcpoh/dperu

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