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Caries Risk Assessment: A Novel Tool to Shed the Global Burden of Dental Caries

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Abstract—*Worldwide, Dental Caries poses a huge disease burden to human health, and it is especially true for less-developed countries. Related strategies have been discussed and advocated by WHO to incorporate its preventive measures into general prevention programs for non-communicable diseases. Epidemiological investigations have yielded alarming data on caries prevalence worldwide; suggestive of a large number of patients in need of dental care. Hence, Caries Risk Assessment & its management protocol given by American Academy of Pediatric Dentistry (AAPD) proves to be tool to 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. These guideline are intended to educate healthcare providers on the assessment of caries risk in contemporary pediatric dentistry and aid in clinical decision making.*

Introduction

Dental caries has long been a significant oral health issue globally. Significant advances have been made in recent years in tackling this issue. However, as dental caries has become less endemic to the population as a whole, it is now increasingly concentrated within a high risk segment. There are a number of effective preventive interventions that can be targeted to those at higher risk. Clinical guidelines recommend the practice of assessing an individual's caries risk and implementing an appropriate prevention plan. Unfortunately, the translation of clinical guidelines to routine clinical practice is inconsistent throughout healthcare; including dentistry. This inconsistency of practice is increasingly being identified as an unnecessary cost to the healthcare services, potentially causing patients to receiving suboptimal care and potentially irreversible harm. Therefore, efforts are being targeted at interventions that improve the consistent translation of best evidence to routine practice.

The caries process involves a combination of factors including diet, a susceptible host, and microflora that interplay with a variety of social, cultural and behavioural factors [1-5]. Most young children appear to acquire some cariogenic microbes i.e. mutans streptococci (MS) from their mothers or primary caregivers [6-7]. Traditionally, multifactorial caries-risk studies have focused on evaluation of biological, demographic and dietary factors and have used cavitation of a carious lesion (prevalence & incidence) as the outcome variable [8].

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 period [9]. It also involves 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 [10-12].

Strategies for managing caries increasingly have emphasized the concept of risk assessment [13-19]. In 2002, the AAPD took a first step towards incorporating available evidence into a framework for classifying caries risk in infants, children and adolescents [20]. This tool was based on a set of physical, environmental and general health factors and intended to be a dynamic instrument that would be evaluated and revised periodically as new evidence warranted [21-24]. Currently, this tool has been updated in 2014 to include the additional concepts of dental caries management protocols [25].

Since the etiology of caries is multi-factorial, it has been suggested that risk assessment should be directed at the evaluation of all the factors involved with the disease [26,27]. Studies have indicated that for the success of a caries-risk assessment model, 1 or more social, behavioural, microbiologic, environmental and clinical variables should be included [28-30].

A systematic review of literature concerning caries risk indicators concluded that for caries prediction in primary teeth, previous caries experience was the best predictor [31],

followed by level of parental education [32] and socioeconomic status [33].

Early childhood caries (ECC) is an infectious process that too frequently requires expensive and extensive intervention. While previous caries experience may be the best indicator of future disease, using it to identify children at high risk comes too late to prevent caries initiation. Another important risk factor in young children is the age of MS colonization. The earlier in infancy that high levels of MS colonization occur, the more severe the caries in the primary dentition [34-36]. Vertical transmission of MS from mother to infant is well documented [37]. The higher the levels of maternal salivary MS, the greater the risk of the infant being colonized [38].

Caries Risk Assessment

Caries risk assessment is the process of collecting data regarding various factors (e.g. bacterial level) and indicators (e.g. previous caries experience) to predict caries activity in the immediate future [39].

It has been described as a four-step process[40]:

1. Identification of measurable risk factors;
2. Development of a multifactorial tool;
3. Risk assessment to determine a patient's risk profile; and
4. Application of preventive measures tailored to the risk profile.

For the past thirty years, researchers have focused on developing an instrument that is easy to administer, simple, quick and accurate. The risk assessment tool should estimate caries risk, identify the primary etiological factors, provide an inventory of the patient's current preventive practices, and serve as a guide for selecting specialized preventive care tailored to that individual's needs[41].

Caries Risk Assessment may be valuable in the clinical management of caries by helping dental clinicians to[42]:

1. Categorize the level of the patient's risk of developing caries to control the intensity of treatment rendered.
2. Pinpoint main etiological factors that contribute to the development of decay and thus determine appropriate form of therapy.
3. Assist in restorative treatment decisions (e.g. choice of restorative material).
4. Improve prognosis of planned therapeutic care.
5. Provide information on what additional diagnostic tests and screening are required.
6. Educate and motivate patients to improve and maintain optimum oral health.
7. Guide timing of subsequent recall appointments.

Caries Risk Assessment tools screen people based on risk factors and predictors and classify patients into one of three risk categories- low, moderate, or high[42]. Ordinarily, if new caries have developed since the last examination, the patient is categorized as either moderate or high risk depending on the interval since the last examination, and the number and severity of carious lesions. If, however, the patient is caries-free since the last examination, his/her risk level would be designated as low or moderate risk depending on his/her oral hygiene status, fluoride exposure, and microbiological count.

Although dental caries has long been established to be a disease of multifactorial etiology, many of the traditional caries prediction models have focused on individual factors associated with high caries activity. More recently, the multifactorial etiology of caries points in the direction of constructing a more promising risk assessment model that includes the various factors that contribute to the development of caries as no single test can simultaneously measure the three principal components of dental caries: host resistance, cariogenicity of the diet, and microbial pathogens.

The following are two examples of multifactorial caries risk assessment instruments:

Firstly, the Cariogram is a widely available tool that has been validated [43] and has received much attention in the discipline of cariology. It has been used extensively to identify caries risk factors for a variety of populations globally [44-50].

Secondly, the caries-risk assessment Tool (CAT) from American Academy of Paediatric Dentistry (AAPD).

Cariogram

The Cariogram, developed in 1996, was originally conceived as an educational model aiming to demonstrate the multifactorial etiology of dental caries in a simple manner. It is a graphical picture illustrating the interactions of caries-related factors and the overall risk profile of the patient. In the beginning, the pie chart presentation included three components: diet, bacteria and susceptibility. Based on this model, an interactive computer program was developed in 1997. Changes made to the program included the addition of two more sections to the pie chart- 'circumstances' and 'chance of avoiding caries'. The circumstances sector included factors that did not participate directly in the development of caries but were risk predictors of dental caries, such as past caries experience and systemic diseases.

The program prompts the clinician to enter a weight (0 to 3, with '0' representing a low risk and '3' representing a high risk) for nine risk factors (caries experience, related general diseases, dietary contents, dietary frequency, plaque amount, *Streptococcus mutans*, fluoride, saliva secretion, and saliva buffering capacity) and a clinical judgement score.60 An algorithm was constructed such that all the factors entered into the model could be weighed and the patient's chance of

avoiding caries could be calculated. This was represented as the final pie piece in the diagram. With this interactive program, it is possible to demonstrate to the patient how their caries risk can change as a result of various actions. Additionally, the patient's risk profile can be saved or printed and the program offers recommendations for preventive measures that should be adopted to avoid new caries activity [43].

Caries-Risk Assessment Tool (CAT)

First adopted in 2002, and after revisions in 2006, the American Academy of Pediatric Dentistry (AAPD) had its document "Policy on Use of a Caries-risk Assessment Tool (CAT) for Infants, Children, and Adolescents, Revised 2006" publicized and made accessible on line. As a component in the clinical decision making process, the CAT does not render a diagnosis but only assists the child health professional in estimating an individual child's caries risk from information gained during the history taking and clinical examination. Use of the tool requires clinical presentation of dental caries and factors related to caries initiation and progression. Each child's ultimate risk classification is determined by the highest risk category in which a risk indicator exists.

In addition, the AAPD and the American Academy of Pediatrics (AAP) have agreed on having cooperation between dental personnel and primary child healthcare professionals, such as physicians and other non-dental health care providers, to work together for determination of caries risk at various time points. The latter usually have better access to young children and have proved able to screen infants to determine caries risk and can provide timely referrals to dental professionals [51].

Several indicators for children at risk for ECC have been identified for group screening and an infant is recommended referral to a dentist if one of the following risk indicators is present at as early as 6 months of age and no later than 6 months after the first tooth erupts or 12 months of age, whichever comes first. These are children:

- With special healthcare needs
- From low socioeconomic and ethno-cultural groups
- With suboptimal exposure to topical or systemic fluoride
- With poor dietary and feeding habits
- Whose caregivers and/or siblings have caries
- With visible caries, white spots, plaque, or decay

Recently, AAPD in 2014 published a new *Guideline on Caries-risk Assessment and Management for Infants, Children, and Adolescent.* As an update of the 2006 version, this new guideline includes the additional concepts of dental caries management protocols, and CAT is no longer regarded as an independent/separate caries risk assessment tool. As indicated in the document's title, the current version is an age-defined risk assessment tool. It has three separate caries-risk assessment forms: one for physicians and other non-dental health care providers on children 0-3 years old; two for dental providers, for use on children 0-5 years old and over 6 years old respectively. Another major change in the AAPD guideline is that a child's ultimate risk classification is determined by a minimum of two highest risk category indications that are not in the clinician's judgment to be countered by protective factors [25].

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. 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. 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, eliminate treatment uncertainties, and guarantee more correct strategies [52-55].

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