**Background**

Dental caries in adults and children continues to be a major health problem facing our country, especially amongst populations at or near poverty.\(^1\) Dental caries remains to be the most common chronic disease in children.\(^1\) Approximately 25 percent of the children and adolescents ages 5 to 17, account for 80 percent of the dental caries.\(^1\) Ninety four percent of all adults 18 and over have evidence of treated or untreated coronal caries.\(^1\) Dental caries is caused by the interrelationship of multiple factors over time.\(^2\) Dental caries is now recognized as an infectious, transmissible, multifactorial disease of bacterial origin.\(^3\) The cause of dental caries is related to a number of factors that are categorized into host susceptibility, microorganisms, and substrate.\(^2\) All of these factors must intersect during a defined period of time, along a continuum, for caries to occur.\(^2\) The dental hygienist plays a pivotal role in the prevention of dental caries through fluoride application, dietary counseling, as well as oral hygiene education and instruction.

**Etiology**

Dental caries is caused by mutans streptococci (a group that includes *Streptococcus mutans* and *Streptococcus sobrinus* species) and lactobacilli (*Lactobacillus* species) that live in the biofilm that attach to teeth.\(^4\) These bacteria metabolize dietary fermentable carbohydrates (sugars and cooked starch) to produce acids.\(^4\) These acids diffuse into the tooth structures and dissolve the calcium and phosphate minerals (carbonated hydroxyapatite), a process called demineralization.\(^4\) If the acid attacks are infrequent and of short duration, saliva can help repair the damage by neutralizing the acid and replacing minerals and fluoride lost from the tooth, a process called remineralization.\(^4\) When the flow of saliva is low and the bacterial level is high along with increased frequency of cariogenic snacks, the dental caries process is initiated.\(^4\)

The resulting acid environment created when the bacterial plaque acts on fermentable carbohydrates results in a substantial change in the plaque pH.\(^4\) At rest, the pH of plaque is neutral. When fermentable carbohydrates are ingested, the plaque pH drops rapidly to create an acidic environment
conducive to demineralization. Demineralization occurs when the pH drops from neutral 7.0 to 5.5 or lower; this is the critical pH. After the ingestion of fermentable carbohydrates stops, the pH generally returns to neutral in 30 to 60 minutes. A variety of factors mediate the return to a neutral pH. Saliva plays a key role in that it neutralizes acids and provides minerals and proteins that protect the teeth.

Once calcium and phosphate are lost from the tooth structure and the pH in the adjacent environment returns to neutral, the area experiences remineralization. Minerals in the saliva and minerals precipitated out of the tooth are available to redeposit on the tooth surface. The deposition of minerals remineralizes the weakened tooth structure, which repairs the initial carious lesion. This ongoing process of destruction and repair occurs with each carbohydrate challenge.

**Assessment**

Due to the multifactorial nature of caries disease, assessment of caries risk status should be incorporated in the initial diagnostic caries screening. Caries risk assessment is a systematic process based on the patient’s past and present caries experience and known risk factors or indicators for disease. Longitudinal assessment, which includes multiple measures of an existing carious lesion and evaluation of risk factors over time, is mandatory to determine carious activity. Longitudinal assessment is the most indicative and reflective measure of carious activity. The rationale for using a longitudinal risk assessment approach is to accommodate appropriate management and prevention strategies to the individual patient.

There are multiple caries risk assessment models available for dental health professionals to implement. Examples of caries risk assessment models include, but are not limited to the Cariogram, Caries Risk Assessment Tool (CAT), and Caries Management by Risk Assessment (CAMBRA). Cariogram is a computer program showing a graphic picture that illustrates a possible overall caries risk scenario. CAT is broad approach to risk assessment, considering the effects of both systemic disease and behavioral factors in determining caries risk. CAMBRA is a system of protocols for the clinical
management of caries by risk factor level of an individual patient. These caries risk assessment models take into consideration a thorough assessment of the patient’s medical, dental, social, and preventative history; dietary screening; clinical determinants of caries status and history; salivary function assessment; fluoride exposure; and tooth morphology.

A patient’s history review (medical, dental, dietary, and preventative) is an essential part of the responsible assessment in order to prepare appropriate caries management, intervention and prevention treatment plans. Dental health care professionals should pay special attention to the medical conditions that might impact oral health status and affect patient’s caries risk. The use of dietary assessment relative to dental caries control has proven to be helpful to many people. Components of a dietary assessment can include clinical evaluation, food frequency checklist, and food record.

A patient’s caries history is considered a central indicator of caries risk. The assessment of caries status and history should incorporate the assessment of number of past restorations; current lesions; stage of the lesions (enamel/dentin); and history of extraction of teeth because of caries. There are various methods for the detection of carious lesions in dentistry. The diagnosis of carious lesions has been primarily a visual process, based on clinical inspection and review of radiographs for years. However, a number of studies have concluded that the use of dental explorer is not adequate for detecting early occlusal caries due to false negative and false positive diagnoses, depending on dentists’ interpretation. Furthermore, radiographs are not as efficient in detection of occlusal lesions, until they are well advanced. Currently emerging diagnostic tools for caries detection may offer a more “objective” assessment of early caries lesions. Some of the newest diagnostic methods include fiber optic transillumination (FOTI), laser fluorescence and digital radiography. FOTI is an examination tool that uses visible light to illuminate the approximal surface from which a lesion is observed through the marginal ridge. One of the most well-tested laser fluorescence devices is DIAGNOdent (KaVo America Corp, Lake Zurich, Ill). DIAGNOdent is based on red laser light induced fluorescence and is used for detection of approximal and occlusal caries as an effective adjunct to the conventional methods.
However, the presence of plaque and debris worsens the performance of the laser fluorescence method. Amalgam restorations can also interfere with a correct DIAGNOdent reading. In addition, the increased likelihood of false-positive diagnoses compared to conventional methods limits DIAGNOdent usefulness as a principal diagnostic tool. Digital radiographs are very comparable in their quality to the conventional radiographs. The ability to enhance digital images and alter display ratios of image sizes can result in better diagnostic validity. Although the diagnosis of dental caries can be enhanced by emerging diagnostic tools, such as DIAGNOdent, a combination of visual-tactile examination and either conventional or digital radiography still identifies the majority of carious lesions.

Salivary assessment (hyposalivation) should be based on patient’s current medications and social habits review. The following questions can be asked during xerostomia screening: Does your mouth feel dry when eating a meal? Do you have difficulty swallowing food and/or do you have to aid swallowing process? Is the amount of saliva in your mouth “too little” most of the time? Tooth morphology should also be taken into consideration during the clinical examination, as deep and retentive pits and fissures on occlusal surfaces and exposed root surfaces relate to caries risk.

Caries risk assessment and reassessment provided by oral health professionals must be an integral component of long-term patient care. Patient’s caries risk level assignment aids in determination of appropriate caries management, intervention and prevention procedures.

**Management/Intervention**

Science is advancing caries management beyond restorative dentistry and moving it towards evidence-based methods to measure the disease process. Today, managing the caries process goes beyond placing dental restorations. Dental professionals should create a comprehensive caries management plan along with the treatment plan for patients. An assessment tool using caries management by risk assessment (CAMBRA) can determine the risk factor level. The caries management plan determines the use of antimicrobials, fluoride, and sealants. It also aids in determining the frequency
of radiographs and periodic oral exams. According to CAMBRA, the levels of caries risk include low, moderate, high and extreme high risk.\textsuperscript{3,6}

A low risk patient is someone who may have dental knowledge and likely maintains good oral hygiene and regular dental visits.\textsuperscript{3} This patient tends to use the resources of fluoride found in water and toothpaste. New carious lesions have been absent for at least a year. Any demineralized areas appear a chalky white; they are remineralized and hardened.\textsuperscript{3} If this patient has sealants placed previously, they may be visible in the pits and fissures and previous restorations are intact.\textsuperscript{3} The recommendation for bite-wing radiographs for a low risk patient is every 24-26 months.\textsuperscript{23}

A medium risk patient is one who has some risk factors identified and may not maintain regular dental visits.\textsuperscript{6} Their oral hygiene usually is not maintained on a daily basis; there are signs of demineralization in the proximal areas and gingival margins that may be detected. More aggressive recommendations and motivation need to be implemented with this type of patient. The patient would benefit from professionally applied fluoride treatment.\textsuperscript{3} It is also recommended that a prescription for fluoride is given to the patient for home use.\textsuperscript{6} Additionally, a patient can be placed under medium risk if there has been a presence of the carious disease in the past year, has several previous restorations or has orthodontic appliances.\textsuperscript{3} The recommendation for bite-wing radiographs for the medium risk patient is 18-24 months.\textsuperscript{23} This type of patient has the potential to move to the high risk class and needs to be monitored more than a patient in low risk category.\textsuperscript{3}

The high risk and extreme high risk class have similar characteristics. The extreme risk would be a special needs patient or a patient high risk with severe xerostomia.\textsuperscript{6} The risk assessment discloses that this patient could have poor oral hygiene, irregular dental visits, inadequate fluoride use, the use of smokeless tobacco and habits of snacking on cariogenic foods. The high risk patient has had two or more carious lesions in the past year and there is evidence of active carious lesions which could mean an elevation of \textit{Streptococcus mutans} as well as \textit{Lactobacillus} in the saliva.\textsuperscript{3} Chlorhexidine can be applied in a varnish form. The evidence shows chlorhexidine will reduce the \textit{Streptococcus mutans}.\textsuperscript{3} Fluoride should
be dispensed professionally in the office and the patient should be applying it twice a day at home. The recommendation for bite-wing radiographs is every six-twelve months. The high risk patient should be seen for a periodic exam every three to six months and reevaluated frequently.

**Prevention**

Prevention of dental caries includes measures to prevent the occurrence, arrest the progress and reduce the consequences of the disease. There are three prevention phases that can categorize all patients, with the goal being to prevent caries lesions from forming. These phases are called the primary, secondary and tertiary phases of prevention. Primary prevention is aimed toward preventing the initial occurrence. This would include counseling at the earliest possible time to encourage healthy habits that would lead to the decreased risk of caries development. Secondary prevention is directed to early detection and intervention, along with preventing the disease progression. This phase is considered the non-operative phase. In addition to administering fluoride to aid in remineralization, treatment would also incorporate counseling. The final phase is the tertiary prevention phase, which addresses the alleviation of disability and loss of function. This is considered the operative phase which includes the restorative treatment. The dental hygienist’s objective in addressing dental caries is to prevent the process entering the tertiary phase. This is accomplished by modifying harmful risk factors, and promoting healthy behaviors.

All three phases of prevention can benefit from the use of fluoride. Caries remineralization therapy can effectively arrest or reverse the progression of incipient proximal caries lesions. Remineralization of tooth structure can be accomplished via a series of topical fluoride applications over time using a combination of both in-office and at-home fluoride agents.

Fluoride therapy has been the cornerstone of caries preventative strategies since the introduction of water fluoridation over 5 decades ago. Fluoride inhibits the initiation and progression of carious lesions. Intensive laboratory and epidemiological research on the mechanism of action of fluoride in preventing caries indicates that the predominant effect of fluoride is topical. This occurs mainly through
promotion of remineralization of early carious lesions and by reducing demineralization in sound tooth enamel.\textsuperscript{27} The use of topically applied fluorides has increased over recent decades.\textsuperscript{28} Fluoride containing dentifrices, mouthrinses, gels and varnishes are widely used both alone or in different combinations.\textsuperscript{28} Fluoride gels and varnishes are typical methods of professional topical fluoride application.\textsuperscript{28} Fluoride mouthrinses and dentifrices are the main forms of self-applied fluoride therapy.\textsuperscript{28}

Dietary modification is another important aspect of dental caries prevention. The first approach to treating dental caries as an infectious disease is to eliminate as many causative factors as possible.\textsuperscript{7} Fermentable carbohydrate exposures should be eliminated between meals and at the completion of meals.\textsuperscript{7} Furthermore, concentrated sweets and highly acidic foods should be limited to occasional exposure.\textsuperscript{7} Patients should be encouraged to select snacks from noncarbohydrate food groups.\textsuperscript{7}

The daily use of dental floss and other interdental aids are also important in the prevention process. The effective use of these aids contributes to oral health by removing dental biofilm.\textsuperscript{7} Combined with dietary risk factors, this biofilm accumulated in the concavities and proximal surfaces allows for the caries process to begin.

The studies on the role of sugar substitutes such as sorbitol and xylitol have indicated that they decrease the rate of dental caries development.\textsuperscript{29} Sorbitol slows down the process, while xylitol has shown the greatest reduction of caries formation.\textsuperscript{29} Xylitol has demonstrated that it reduces the levels of \textit{Streptococcus mutans}.\textsuperscript{29} Furthermore, chewing gum with xylitol may decrease the incidence of dental caries.\textsuperscript{29}

Dental sealants are a simple, cost effective preventative measure to manage dental caries.\textsuperscript{30} The utilization of dental sealants can be increased through public awareness, consumer education, and by establishing reimbursement by insurance companies.\textsuperscript{30} Many schools in high risk areas are offering sealant programs to eliminate the barrier of insurance coverage.\textsuperscript{30}

Prevention of dental caries requires a multidirectional approach. Dental hygienists need to evaluate all risk factors and provide evidence-based direction for the patient. This would include dietary
modification, administering fluoride and healthy home care habits. Since the infectious disease of dental caries is preventable, dental hygienists can play a pivotal role in the prevention process.

**Conclusion**

As dental caries remains to be one of the most prevalent oral diseases, the dental hygienists need to work together on a national and state level to increase the awareness of the devastating lifelong effects of dental caries. Collaborating efforts with the dentists, legislators, state dental boards and other health care professionals is an important step towards reducing the gap between the low risk and high risk individuals. There is a strong need for management of caries by individual risk assessment, specifically directed to high-risk groups and populations. Dental hygienists play a preventative role in reducing these numbers by utilizing their clinical skills, evidence-based knowledge and expertise to arrest the occurrence of dental caries.
References


