Caries Process and Prevention Strategies: Risk Assessment

Marjolijn Hovius, RDH
Continuing Education Units: 1 hour


Disclaimer: Participants must always be aware of the hazards of using limited knowledge in integrating new techniques or procedures into their practice. Only sound evidence-based dentistry should be used in patient therapy.

This is part 10 of a 10-part series entitled Caries Process and Prevention Strategies. This course introduces the dental professional to risk terminology, and methods for identifying caries-causing factors and assessing a patient's risk for developing dental caries. It also outlines a risk protocol that can be used with patients.

Conflict of Interest Disclosure Statement
• The author reports no conflicts of interest associated with this work.

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Overview

This course introduces the dental professional to risk terminology, and methods for identifying caries-causing factors and assessing a patient's risk for developing dental caries. It also outlines a risk protocol that can be used with patients.

Clinical Significance Snapshots

*What is the point of undertaking risk assessment for a patient? Isn’t everyone who has natural teeth at risk of dental caries?*

Dental Caries is a preventable disease. For years it has been treated, after cavitation had occurred by restorative means. Typically, the patient returned later with new lesions and required more restorations. Rather than dealing with all patients in the same way, the process of risk assessment can help identify those patients who are at high risk of developing caries, and those who are at low risk. In making this differentiation, preventive efforts can be focused on the high-risk group, so that their risk is reduced and caries reduced or avoided altogether. Having identified the risk factor in the high-risk group, a treatment plan can be designed to reduce the risk factors, such as dietary modification, use of additional fluoride agents, etc. The high-risk group should be recalled more frequently.

The low-risk group still has some risks, and they should be recalled and examined at appropriate intervals to make sure their risk is not increasing.

*Which are the strongest indicators of risk?*

- Active disease, new lesions in the patient.
- Active disease, new lesions in other family members.
- Frequent sugar intake.
- Irregular oral hygiene and use of fluoride toothpaste.
- Poor quantity or quality of saliva.
- Age (very young, or very old).
- Presence of restored teeth, or teeth having been extracted due to caries.

Learning Objectives

Upon completion of this course, the dental professional should be able to:

- Define risk, risk factor, and risk assessment.
- Identify biological, environmental, sociocultural, and economic factors that increase caries risk.
- Evaluate clues from a patient's medical and dental history to assess caries risk.
- Implement a risk-assessment protocol.
- Conduct a risk-assessment survey.
- Choose individualized intervention strategies based on a risk-assessment survey.
- Understand the additional specialized needs of certain populations, like the elderly or those with dry mouth.
- Describe the Caries Management by Risk Assessment (CAMBRA) system.
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**Glossary**

**risk** – The probability that an event will occur. Teeth erupt free of caries, but from eruption onward they are at risk of developing dental caries, depending upon the risk factors; those that induce the disease and those that prevent the disease.

**risk assessment** – This is the qualitative or quantitative estimation of adverse effects that may result from exposure to specific hazards or absence of biological influences. The importance of risk assessment in clinical dental practice is recognized as relevant by dental insurers. For further information see CAMBRA (Caries Management by Risk Assessment).

**risk factor** – Any factor that will increase or decrease the probability of an event occurring. Risk factors for caries are environmental, biological, or social. Environmental factors include the availability of sugars in the diet, fluoride availability in water, or toothpaste. Biological factors include saliva quantity and quality. Social factors include age and socio-economic status.

**risk survey** – This is a tool, usually a specifically designed form, that captures specific information about key factors that may impact the patient’s oral health. It is used to aid the dental professional in assessing the individual caries risk potential for a patient.

**Introduction**

Dental caries, commonly known as tooth decay, is an oral disease in which the acid generated by specific types of unfriendly bacteria can cause damage to hard tooth structure. It is one of the most common infectious diseases among American children and adults, posing a serious public health issue. Assessment of the patient’s current caries activity and risk of future caries is an important part of dental practice. By identifying the many risk factors involved, more effective, individualized management of caries can be provided. Also, when patients are made aware of their risk of developing new caries or for the progression of existing lesions, this knowledge may encourage them to make healthful caries-reducing changes in their habits and take a more active role in their oral care.

**Risk Assessment: Terminology**

To understand the role of the dental healthcare provider in assessing a patient’s risk of caries, it is important to get an overview of appropriate terminology.

**Risk:** This is the probability that an event will occur.¹

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¹ Video 1. Why should a risk assessment for dental caries be conducted?

Click here to view this video on dentalcare.com.
Risk Factor: This is an environmental, biological, behavioral, or social factor confirmed by temporal sequence, which directly increases the probability of a disease occurring if it is present. If this factor is absent or removed, it will reduce the probability of a disease occurring.

Risk Assessment: This is the qualitative or quantitative estimation of adverse effects that may result from exposure to specific hazards or the absence of biologic influences. The importance of risk assessment in clinical dental practice is recognized as relevant by dental insurers.

Risk Survey: An ideal risk assessment tool should not be time consuming or too complex for use in a busy dental practice, and the information must be gathered in an organized, methodical manner that benefits analysis. Estimating the risk, by gathering a broad range of patient data, can result in a composite assessment of factors impacting oral health. This can serve as a guide for selecting preventive measures, as well as provide an inventory of the patient’s current preventive practices to get insight into the patient’s compliance to recommendations.

Risk Assessment: Identifying Biological and Environmental Risk Factors

Step 1: Note the Patient’s Medical History
This should include questions about the patient’s current and past diseases or illnesses, current or past medications, and current or past disease treatments. The reason it is crucial to take note of these is that many diseases and medications can cause dry mouth, a factor linked to increased risk of caries because there is insufficient saliva present in the oral cavity to protect and remineralize teeth during periods of acid attack.

Diseases or conditions that cause dry mouth include Sjögren’s syndrome (an autoimmune condition that causes immune cells to attack mucous-producing cells in the body and presents itself mainly in women in their 40s and 50s), rheumatoid arthritis, diabetes, HIV/AIDS, Parkinson’s disease, Alzheimer’s disease, cystic fibrosis, asthma, hormonal changes related to pregnancy, perimenopause or menopause, lupus, anorexia nervosa, and pancreatic or liver disturbances. Smoking and drug abuse, particularly of alcohol, opiates, and methadone, also cause dry mouth.

Over 400 medications have a side effect of salivary gland hypofunction, and 90% of the most commonly prescribed medications in the United States have been reported to cause dry mouth. These include antidepressants, tranquilizers, hypnotics, antihistamines, anticholinergics, antihypertensives, diuretics, appetite suppressants, muscle relaxants, and expectorants.

Medical treatments that cause dry mouth include chemotherapy because it decreases salivary flow rate, and head-and-neck radiotherapy, which causes damage to salivary acinar cells.

It should be noted that older patients tend to be more prone to dry mouth because their glands tend to be more vulnerable to the damaging effects of medications, and since they tend to be more likely on medications.

Usually the patient is aware that they have a dry mouth because of the discomfort it causes. Dry mouth can also be detected in a clinical examination: The mouth mirror may tend to stick to mucosal surfaces or the saliva will appear frothy.

Step 2: Note the Patient’s Dental History
While the presence of active carious lesions at the times of examination is clear evidence of caries, it is also important to get a sense of previous caries history. A history of multiple restorations will indicate high caries risk, because a history of previous caries is the single best predictor of future caries development.

It is also useful to ask about dramatic changes in caries activity, for example, if there were no dental problems for years and then a sudden increase in infection that led to multiple restorations. This may help the dental practitioner identify the relevant change, such as taking a medication that caused dry mouth.

Questions about a patient’s dental history should also gather information about current oral hygiene practices and proficiency, including...
how often teeth are cleaned, what type of brush and interdental cleaning aids are used, which toothpaste is used and how it is cleared from the mouth, and if the patient's water supply is fluoridated. Asking a patient about their diet is especially important if he or she presents with active carious lesions or a history of multiple restorations. This way, it is possible to uncover caries-causing habits, such as frequent sipping of sugary drinks, swishing soda in the mouth, or frequent snacking on sugary or sticky candies.2

Step 3: Note what is Happening in the Oral Cavity
Besides looking for present and previous carious activity, it is important to note other factors that increase caries risk. Tooth morphology and alignment—such as areas that are crowded, teeth that are pitted or rough, or teeth that are physically difficult to clean—can play a role in increasing caries risk. Restorations with faulty margins can also increase caries risk because they provide a perfect physiologic niche that can harbor cariogenic bacteria.2

Risk Assessment: Identifying Social, Cultural, and Economic Factors
There are specific dental habits that can be incorporated through enculturation and social norms. For example, in some cultures, allowing an infant to fall asleep while sucking on sugared liquids is not only acceptable, but encouraged. In some social groupings, edentulism (tooth loss) is thought of as the natural progression in the aging process, and toothaches are normal. A patient living in poverty may not have access to dental care or toothpaste and other oral healthcare aids. These types of habits, practices, and situations need to be identified, acknowledged, and modified if possible.2

Step 1: Conduct a Risk Assessment Survey
Employing a survey similar to this can help a dental practitioner identify caries risk factors in an organized, methodical way (Table 1):

Another option for conducting a Risk Assessment Survey is to access and download the appropriate Caries Risk Assessment form from the ADA website. The ADA provides two different forms, one designed for patients 0-6 years, and the other for patients over the age of 6. These forms have been designed to aid the dental health practitioner in determining the level of risk present in each individual patient and can serve as an aid in both the initial assessment of risk, as well as tracking the implementation and progress against an intervention program.

Step 2: Consider Individualized Non-operative Strategies for Caries Control
Cleaning: The dental healthcare provider can start by reiterating simple oral hygiene tips for plaque control in the whole mouth, such

<table>
<thead>
<tr>
<th>At Risk</th>
<th>Not At Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical history: Any conditions, medications, or habits that cause dry mouth?</td>
<td></td>
</tr>
<tr>
<td>Dental history: Presence of active caries?</td>
<td></td>
</tr>
<tr>
<td>Dental history: Prior DMFS (decayed, missing, filled surfaces)?</td>
<td></td>
</tr>
<tr>
<td>Dental history: Diet that increases caries risk?</td>
<td></td>
</tr>
<tr>
<td>Dental history: Poor oral hygiene?</td>
<td></td>
</tr>
<tr>
<td>Dental history: Low levels of fluoride exposure?</td>
<td></td>
</tr>
<tr>
<td>Oral cavity factors: Tooth morphology and alignment prone to caries?</td>
<td></td>
</tr>
<tr>
<td>Oral cavity factors: Restorations with faulty margins?</td>
<td></td>
</tr>
<tr>
<td>Additional risk factors: Any cultural or social norms that increase caries risk?</td>
<td></td>
</tr>
<tr>
<td>Additional risk factors: Economic hardship?</td>
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</tbody>
</table>
as brushing teeth twice a day and flossing in between teeth (interdental cleaning).7

However, showing the patient where the lesions are (whether it is with the use of a radiograph or by showing them the lesion itself with the help of a mirror) has been found to help the patient become more involved in their treatment and more compliant with instructions. Teaching the patient to clean the diseased site before cleaning the rest of the mouth is also very useful, and discussing ways to do that most effectively has been found to ward off caries progression.2 Suggestions might include using a different angle than usual when brushing to reach the diseased area, using a different design of brush, or switching from dental floss to an interdental cleaner with a handle to better reach carious-lesion areas in the back of the mouth.2,8

Use of Fluoride: All patients should be encouraged to brush with over-the-counter, fluoride containing toothpaste at least twice per day. Fluoride-containing toothpastes are regulated by the U.S. Food and Drug Administration (FDA) and are required to contain a clinically proven level of fluoride. Fluoridated toothpaste is low-cost, very easy for most patients to use, and is quite effective, being linked with a 24% decrease in caries in permanent dentition.9 Fluoridated toothpaste can also be used therapeutically by asking the patient to apply a dab of paste with a finger or brush directly to a cleaned active lesion immediately before going to bed. This will allow an increased concentration of fluoride in the vicinity of the lesion at a time of day when salivary output is naturally low. For patients with active caries who may not be able to clean their teeth adequately with a fluoride toothpaste, a 0.05% NaF fluoride rinse taken once per day, or a 0.02% NaF rinse taken twice per day should be recommended.6

For patients with high caries activity, it may be necessary to recommend a high-dose prescription fluoride dentifrice, gel, rinse, or supplement tablet for at-home use. Fluoride can also be professionally applied in the form of a varnish after plaque removal by the dentist. This form of application has been linked to a 46% reduction in caries in the permanent dentition.9

Note that acidulated phosphate fluoride is contraindicated in patients with porcelain or composite restorations, as it can cause pitting and etching. Instead, a neutral sodium fluoride should be recommended to these patients.2

Diet Modification: In a patient with no active caries, the dental professional should review the role of risk factors in dental caries and remind the patient of how any changes in diet might cause them to get caries. The dentist or hygienist can counsel the patient to watch out for times in life when their diet can change to one that may increase caries risk, such as pregnancy, unemployment, divorce, retirement, and bereavement. A simple check regarding any significant changes in status can then be made at subsequent visits.

In a patient with active lesions, an analysis of the diet will help uncover possible caries culprits. One method is to ask a patient to recall all they have consumed, such as food, drinks, and medication, in the last 24 hours; another method is for a patient to record all they consume over a 3-day period. The data collected can help the dental professional work with the patient to devise some practical strategies for reducing the intake or frequency of sugary foods and drinks. One word of caution: Because these methods of collecting data on dietary habits rely on full patient cooperation and honesty, and may not reflect the diet consumed over a much longer period, data should be interpreted with caution.7

Recalling the Patient: Recalls should be scheduled according to the patient's individual needs. For patients without active caries, recalling the patient once or twice annually typically suffices. However, in higher-risk patients who for some reason may not master plaque control themselves or who have decreased salivary secretion due to certain medical conditions, medications, or deleterious habits, it is recommended that a dentist encourage the patient to return more often for professional tooth cleaning. The interval at the beginning should be short, such as every 2 to 3 weeks, until the patient has reached an acceptable level of plaque control. The interval between appointments may then be extended as the dentist sees fit: A
CAMBRA System

The CAMBRA system was developed as an evidence-based approach to the prevention, reversal, and treatment of patients with dental caries. The emphasis is on the whole disease process and employs the caries balance method, taking account of all factors that contribute to the development of dental caries (attacking factors) and all factors that research has shown to be protective from dental caries (defense factors). The assessment of this balance not only helps establish risk but suggests the correct strategies to prevent or reverse the process.

The tool assigns patients to low, moderate, high, or extreme risk and offers two formats, one for patients aged 0-5 years, and one for 6 years onward.

Step 3: Consider Additional Strategies for Special Patients

One group of patients that need additional attention are those with dry mouth. In addition to brushing, interdental cleaning, use of fluoride, and compliance with commonly recommended diet modification tips, patients with dry mouth can benefit from sipping water all day long, and restricting intake of substances that increase dry mouth such as caffeine-containing drinks. Most will also benefit from saliva substitutes in the form of sprays, lozenges, or mouthwashes, some of which contain fluoride.

Another group of patients that need additional attention are those who cannot care for themselves, due to illness or age. Many may have a diet that increases caries risk: For example, they may eat soft foods for easier chewing and swallowing, receive medications that come in the form of syrups containing sugar, or they may not frequently consume tooth-helping nutrients such as calcium and vitamin C. In addition, they may have caregivers who are not very oral-hygiene aware, or they may not want or be able to ask their caregivers for help in cleaning their mouths. One study found that only 5% of elderly occupants in residential homes asked their caregiver for help in cleaning their mouths.

Other patients who may need slightly different strategies than the general population include those with tooth sensitivity due to dentin exposure who may need toothpaste for sensitive teeth. Those who have hardened calculus deposits (tartar) may need additional help with tartar control.

A key benefit of CAMBRA is that it forces both the dental professional and the patient (or their caregiver) to consider all the factors relevant to the patient’s risk and disease state, shifting the focus away from the traditional restorative approach of cavitation and restoration toward the cause of the disease and the need to modify the causes wherever possible. It also allows for greater communication and understanding between all members of the dental team.

A patient with dry mouth should return every 2 to 3 months, while a patient without dry mouth whose caries activity appears under control may only need to be seen every 6 or 12 months. During recalls, the mouth should be examined for signs of patient compliance, plaque control, and caries arrest or progression. New radiographs may also need to be taken. Depending on what the dentist finds, he or she may feel the need to remind the patient about oral hygiene instruction and diet, discuss possible changes to current non-operative strategies, or apply a sealant to active non-cavitated lesions.
Conclusion
In an attempt to reduce caries prevalence in the population and improve the oral health of patients, it is increasingly the responsibility of the dental professional to assess risk of new caries and caries progression. To assess risk of caries, a dental professional can collect useful information from a patient’s medical and dental history, consider sociocultural and economic factors that can influence a patient’s oral hygiene, and analyze a patient’s diet. To assess risk, dentists can use a simple, methodical protocol that includes conducting a risk assessment survey, recommending non-operational strategies (such as proper dental cleaning, use of fluoride, and diet modification) and recommending additional strategies for patients with special needs.

Figure 1. Caries Lesion Initiation and Progression - Pellicle Formation.
Figure 2. Caries Lesion Initiation and Progression - Biofilm Formation.

- Biofilm builds on the pellicle layer
- Key stages of biofilm formation are (1) attachment and colonization (2) growth and proliferation (3) maturation and detachment
- Gram positive Cocci, mainly Streptococci are the early colonizers

Figure 3. Caries Lesion Initiation and Progression - Dietary Sugars Diffuse into the Biofilm.

Acidogenic bacteria convert sucrose to dextran – a polysaccharide that helps form the sticky biofilm matrix.
Figure 4. Caries Lesion Initiation and Progression - Fermentation Produces Acid Leading to Demineralization.

Figure 5. Caries Lesion Initiation and Progression - Demineralization and Remineralization.
**Figure 6.** Caries Lesion Initiation and Progression - Cavitation and Progression into Dentin.

**Figure 7.** Caries Lesion Initiation and Progression - Progression Toward Pulp.
Course Test Preview
To receive Continuing Education credit for this course, you must complete the online test. Please go to: www.dentalcare.com/en-US/dental-education/continuing-education/ce377/ce377-test.aspx

1. **Which of the following is the definition of risk factor?**
   a. The probability that an event will occur.
   b. The qualitative estimation of adverse effects that may result from exposure to specific hazards.
   c. An environmental, biological, behavioral or social factor that directly increases the probability of a disease occurring if it is present.
   d. None of the above.

2. **When taking the patient’s medical history, why is it important to look for clues that could lead to dry mouth?**
   a. Dry mouth is a factor linked to increased risk of caries because there is insufficient saliva present in the oral cavity to remineralize teeth in an acid attack.
   b. Dry mouth causes oral cancer.
   c. Dry mouth is always a sign of serious illness.
   d. All of the above.

3. ____________ is a condition that leads to dry mouth.
   a. Diabetes
   b. Sjögren's Syndrome
   c. Hormonal changes in menopause
   d. All of the above.

4. ____________ medications are NOT linked to dry mouth?
   a. Analgesic
   b. Antidepressant
   c. Antihistamine
   d. Antihypertensive

5. **Why are patients undergoing radiotherapy at risk for dry mouth?**
   a. Radiotherapy reduces moisture levels in the body.
   b. Radiotherapy causes an autoimmune reaction that dries the body’s tissues.
   c. Radiotherapy causes damage to the salivary acinar cells, thereby hindering saliva production.
   d. None of the above.

6. **How can a dentist tell if a patient has dry mouth?**
   a. Ask the patient if he or she is experiencing discomfort because the mouth feels dry.
   b. Check to see if saliva is frothy.
   c. Look to see if the mouth mirror sticks to mucosal surfaces.
   d. All of the above.

7. **From a patient’s dental history, which of the following will indicate high caries risk?**
   a. A history of multiple restorations.
   b. History of a trauma that chipped a tooth.
   c. Teeth with white enamel stains.
   d. A history of using whitening toothpaste.
8. What is common information to gather when collecting a patient’s dental history?
   a. What toothpaste is used.
   b. How often the teeth are cleaned.
   c. What their caries-causing dietary habits are.
   d. All of the above.

9. During the clinical exam, which of the following is a site that is more likely to have caries?
   a. A front tooth that has a white enamel discoloration.
   b. Front teeth with a gap in between.
   c. Restorations with faulty margins.
   d. A tooth that is smooth.

10. Which of the following might help a patient with cleaning carious lesions?
    a. Suggesting a different angle for brushing the diseased area.
    b. Showing the patient where the lesion is with a radiograph and/or help of a mirror.
    c. Saying they should listen to you because you are a professional.
    d. A and B

11. What is the typical amount of fluoride recommended for toothpaste?
    a. 500 ppm to 1000 ppm
    b. 850 ppm to 1150 ppm
    c. 2000 ppm to 2500 ppm
    d. 2500 ppm to 3000 ppm

12. In a patient with active lesions, how can a dentist determine what dietary factors or habits are caries culprits?
    a. Ask the patient to recall all they have consumed in a 24-hour period.
    b. The dentist can tell a lot from just looking at the caries lesions.
    c. Ask the patient to take a detailed record of all they consume over a 3-day period.
    d. A and C

13. Which of the following is true regarding recalling the patient after a dentist visit?
    a. Patients without active caries should return to the dentist once or twice a year.
    b. Patients at higher risk for caries and who do not have mastery over their plaque control may need to return every 2 to 3 weeks until plaque control has reached an acceptable level.
    c. Patients without dry mouth whose caries activity appears under control may need to be seen every 6 to 12 months.
    d. All of the above.

14. Which of the following is NOT a tip that can help patients with dry mouth?
    a. Sip water frequently.
    b. Use a saliva substitute.
    c. Drink caffeinated beverages.
    d. None of the above.

15. ______ percent of elderly occupants in residential homes asked their caregivers to help clean their mouths?
    a. 50
    b. 5
    c. 80
    d. 100
References

About the Author

Marjolijn Hovius, RDH

For more than 38 years, Ms Hovius has been the director of a baccalaureate dental hygiene program with more than 350 students in Amsterdam, the Netherlands.

Ms. Hovius work has been published extensively, and she has conducted many continuing education programs. She has lectured extensively at home and abroad.

She has been the editor-in chief of the International Journal of Dental Hygiene, associate editor of ACTA Quality Practice for Dental Hygienists and is a past president of the International Federation of Dental Hygienists.

Right now she represents the Dutch Dental Hygienists’ Association (NVM) in developing the new guidelines for infection prevention in the dental and dental hygiene offices and is a member of the international dental hygiene advisory board from P&G.

She is an honorary member of the NVM.