MASTEROPPGAVE
Caries Risk Assessment
- Why, When and How?

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Abstract

This literature study reviewed papers on caries risk assessment on patients` above 18 years published between 2000 and 2010. In the present study three different methods are discussed: The Cariogram, CAMBRA (Caries Management By Risk Assessment) and the UIT – method (University of Tromsø). The purpose of caries risk assessments are to find out which risk level the patient has and try to lower the risk. By evaluating the protective and pathologic factors involved in the carious disease the dentist finds the appropriate risk for each patient. This makes it easier to give the right individual treatment.

These methods are good ways to find the causes of the carious disease which today has an increasing focus. Treating the cause is a cost – effective approach. Both dentist and patients will benefit from doing a caries risk assessment.

Caries risk assessment
– why, when and how?

Introduction

There has been a dramatic decline in the caries prevalence in the last 30 years, but caries treatment still remains one of the most common and important aspects of dental practice (1).

Several factors play an important role in the development and prevention of caries and it is important to understand how these factors affect the disease process. The caries risk tells us the patients` risk of developing new caries lesions or progression of existing lesions at the time of the assessment. If any of the factors change, the risk will also change. Traditionally, the treatment of caries was mainly symptomatically, but today more and more interest has been focused on treatment of the cause, caries prevention and minimal invasive dentistry. Consequently, a caries risk assessment and detecting and monitoring early lesions should be done in a modern management of caries (2). Many patients don`t care if they get a caries lesion because the dentist can always fix it. And then the patient feels that their caries problem is gone. The dentist should however make the patient understand how very important it is to keep the healthy tooth healthy. A risk factor is a behavioral, biological and environmental factor,that, if present, increases the probability of a disease occurring, and if absent or removed reduces the probability. Assessing all the risk factors helps to find the etiology of the disease and gives a more accurate analysis of the risk of developing caries in a particular patient. This helps us to give the patient the best possible treatment. Most dentists today assess the caries risk in each patient automatically, but it is not certain how and if dentists systematically use this information in their treatment decisions. Anyway, "as dentists we have to look at the patient as a whole. People have caries; teeth have lesions" (3).

Caries risk assessment is an interesting topic because it is a part of the daily life of being a dentist. Caries can affect the patient through life and is the most common chronic disease world – wide. It is important to find people with risk of getting caries as early as possible to prevent lesion development and need for operative treatment. For prevention to be possible, the dentist has to make sure that the patient understands why caries develops in his/her teeth and the factors that play an important role for this particular patient. The dentist can motivate and instruct the patient in how to prevent caries, but the patient has to do the main work at home by himself/herself. At the clinic we can also help with local fluoride and antimicrobial treatment and continuous control of the oral hygiene. In addition, bitewing radiographs show the progression of existing lesions. This can be shown to the patients and help motivate them to stop the disease. There are different ways in which we can inform the patient of how important the various factors are and how to reduce the caries risk. Examples of such tools are the Cariogram, developed in Sweden, and CAMBRA (Caries Management by Risk Assessment) developed in USA. These systems can stimulate both dentists and patients to apply existing knowledge.

Caries was established as an epidemic disease of massive proportions in most of the economically developed countries by the end of the nineteenth century. This led to the organization of public dental services, which first appeared in the Scandinavian countries. Large costs were inflicted on the society and the individual who was affected in many ways: economically, esthetically, functionally and the quality of life was impaired by severe dental caries. In the 1960`s and 70`s fluoride toothpaste, tablets, gels and varnishes were introduced. This had a dramatic impact on prevalence and severity of dental caries throughout the world. The fluoride toothpaste has been shown to be the main reason for the complete change in the pattern of dental diseases in many parts of Europe. It has given the individual a simple and cost effective way to prevent and stop caries lesions (4).

Dental caries is a dynamic "dietobacterial" disease (5). There are more than 700 different bacterial species in the oral micro flora (6). Some of these are cariogenic, in particular Mutans Streptococcus (MS) and Lactobacillus Spp (LBC). Bacteria live in a biofilm on the tooth surface and produce acid from fermentable carbohydrates in the diet. The acid reduces the pH and this disturbs the balance in the biofilm leading to a demineralization of the tooth surface. Acids diffuse in to the enamel and dentine and dissolve mineral crystals

consisting of hydroxyapatite. Ca 2+ - and PO3- ions dissolves from the tooth mineral and a subsurface lesion is formed. These ions can together with fluoride ions diffuse back in to the tooth mineral again and create a protecting shell on the damaged apatite crystals in a lesion without cavitation. The incorporated fluoride ions makes the crystal surface more resistant against acids. These processes happens in cycles every day and depending on the balance between protective and pathological factors, a lesion progresses, becomes arrested or does not develop at all. Protective factors are good oral hygiene, saliva, fluoride, antibacterial substances, protective factors in the diet and non - cariogenic sweeteners. Pathologic factors are acidogenic bacteria in plaque, reduced salivary flow, poor oral hygiene and available fermentable carbohydrates (Figure 1). Carious lesions are divided into active and arrested lesions. Active lesions are divided in non-cavitated lesions, cavitated lesions and recurrent lesions. Active non – cavitated lesions always require professional non – operative management to prevent progression and transform the lesion into an arrested stage. Cavitated lesions can contain both active and arrested areas. Arrested lesions are in most cases not treated operatively (7).
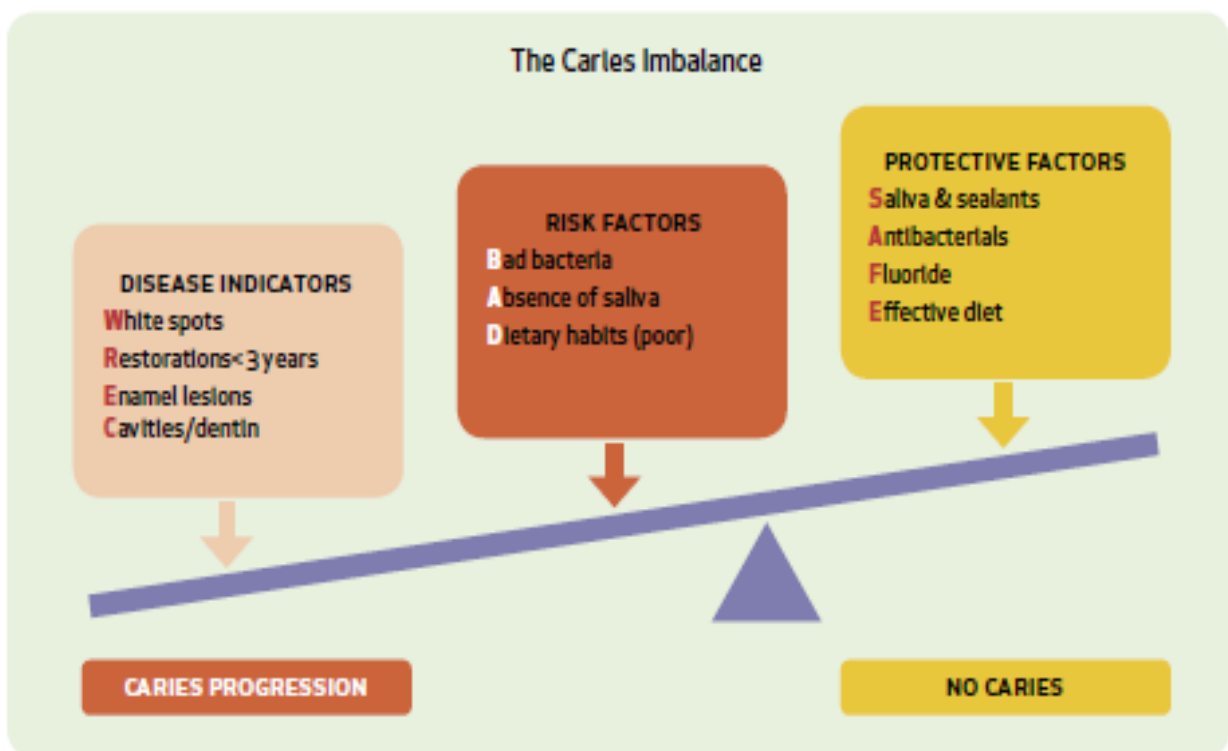

Figure 1 (8).

Aim

In this literature study we want to investigate why a dentist should do a caries risk assessment and when one should evaluate a patients` risk of getting caries. We also want to find out how to assess the risk of developing caries for the individual patient above 18 years. We will present some methods for caries risk assessment and try them out on some of our own patients.

Material and method

We have done a study of the literature from the last 10 years. Articles were found by searching at Pubmed with the search words "Caries risk assessment", and "CAMBRA - Caries Management by Risk Assessment". Without limitations we got a result of 663 articles, many of which were not relevant. With limitations to the last 10 years and only studies on people more than 18 years of age, the result was 511 articles, and from these we have tried to find the most relevant papers. We have also used the cariology book "Dental caries – the disease and its clinical management" (Ole Fejerskov and Edwina Kidd). Other books we have studied are "Caries risk - a practical guide for assessment and control" (Bo Krasse), "On caries risk profile and prevention in an adult Saudi population" (Helal Sonbul), "Karies – diagnostik, riskbedömning och icke – invasiv behandling"(SBU – statens beredning för medicinsk utvärdering), "Assessing caries risk – using the Cariogram model" (Gunnel Hänsel Petersson), "Diagnosis and risk prediction of dental caries" (Per Axelsson) and "Pediatric dentistry – a clinical approach"(Koch and Poulsen)**.**

We have also done caries risk assessments on five patients, comparing different methods for finding the causes and make a treatment plan.

Results

Population based caries prevention

In todays society there is an increasing focus on general health, including oral health. Promotion of oral health is important because poor oral health can limit social opportunities and personal choices. Oral health affects the whole person and has a multidimensional nature. Several diseases have common risk factors with caries, such as diabetes, cancer and

heart disease. The prevention of oral diseases should be part of a common risk factor approach to control the risks shared by a number of chronic diseases (9).

It is important to understand and have interest in health promotion, to improve general living conditions and health of patients, including prevention of new caries lesions and to detect and arrest early initial lesions (10). Thus, you have to know the causes of the disease to be able to prevent it as early as possible. The factors affecting dental caries are influenced by individual action and national, regional or local societal circumstances. This includes for example industry, media, politics, economics and infrastructure. These affect the social environment that people live in, such as material wealth, the psychosocial environment, workplace, home and school. The social environment has an effect on behaviors, beliefs and values of individuals. Because of this, a change of unwanted behaviours in the environment is necessary if one wants to change peoples` behaviors. Some people think they are in control of their own health (internal locus of control), while others do not consider themselves responsible for their oral health (external locus of control) (9). People with external locus of control will be difficult for the health promoter to get through to, because they believe "the dentist will make my teeth healthy". Systematic reviews (11) have shown that for example water fluoridation is the most effective and cost – effective public health measure for caries prevention.

Individual caries prevention

Individual caries prevention is performed at the clinic, by chairside information and in most cases a non - operative treatment. A caries risk assessment should be done at the onset of the treatment and the risk factors should be discussed with the patient. The more factors that can be identified in the individual subject, the greater the validity of the predicted risk evaluation. One – to – one advice has been shown to be effective, but the improvement tends not to be sustained (11). A caries risk assessment is always based on individual prevention.

Why caries risk assessment?

A caries risk assessment should be done to find the causes behind a patient`s caries problem and stop progression of existing caries lesions, to prevent development of new caries lesions and to get a more correct treatment plan for the individual patient. The earlier one can

prevent caries development in the individual patient, the more effective it is. A risk assessment is also done in order to make the patient understand why he/ she gets caries lesions and how to prevent the caries disease before there is an irreversible damage of tooth substance. Reduction of number of caries lesions leads to reduced costs both for the patient and the society. The caries risk is also essential in determining a new recall time. It is important to identify the individual risk levels of each patient rather than treating everyone the same. A dentist should not give all the patients the same non – operative treatment, but focus on those patients who need it the most. The prognosis of other types of treatments, for example caries and prosthodontics, will then possibly be improved in most patients.

When caries risk assessment?

A dentist will automatically assess the caries risk of a patient during the clinical examination, but in some cases one should do a more advanced risk assessment:

- The anamnestic information shows that the patient has been diagnosed with a disease, uses medications, if the patients complaints about xerostomia, works shift/ night, has personal/ social problems or if the patient is totally uninterested in oral health and has an unhealthy diet.
- Findings at the clinical examination show many new carious lesions, caries on atypical surfaces, many root caries lesions and/ or erosion.
- Before extensive prosthodontic treatment.

How to do a caries risk assessment?

Risk factors to be evaluated

There are both pathologic and protective factors involved in the caries disease. Some of these have a larger impact on the disease development than others. It is not possible to evaluate the risk from looking at just one risk factor, you have to evaluate all the factors together. For example, one can have a large number of MS without having carious lesions. If a patient eats a lot of sugar, but at the same time uses a lot of fluoride, the damage on the teeth may not be as severe as it would be without fluoride. In order to make a thorough assessment of the causes, one has to do some objective tests in the clinic, such as the salivary function and microbial tests. The risk factors that can be evaluated are:

- Saliva (quality and quantity)

- Microorganisms

- Oral hygiene

- Fluoride

- Diet

- Anamnesis and clinical findings

After collecting information about all the risk factors the dentists have more information that can be useful and thereby more treatment options available. Based on these risk factors, the dentist decides what risk level the patient has, from low to high.

Saliva

About 90% of the saliva is produced by the major salivary glands. The saliva is a complex body fluid and is regulated almost exclusively by the autonomic nervous system. It has many functions. The five most important functions related to caries are (12):

- Cleaning the mouth/clearance.

- Contribute to colonization and inhibition of bacteria.

- Antimicrobial systems – mucins, lysozymes and immunoglubulins etc.

- Buffering capacity

- The regulation of the calcium/phosphate balance – remineralization and inhibition of demineralization.

Different conditions can lead to hyposalivation with an impairment of one or more of the salivary functions:

- Iatrogenic – radiation therapy in the head and neck region.

- Iatrogenic – medication, a combination of 3 medicines or more or some specific medicaments (diuretics, antidepressant, antipsycotics)

- Diseases – such as Sjögren syndrome, pathology in salivary glands, diabetes 1 and 2.

- Disturbance in the water balance – examples: diarrhea, reduced water intake, anorexia.

How to measure the saliva.

It is important that salivary tests are taken in a standardized way in order to be able to evaluate tests taken at different occasions. Saliva is always collected at the beginning of the treatment session. The patient should not eat, smoke or brush his/her teeth one to two hours before taking the test.

Three different analysis can be made; evaluating the secretion rate of resting saliva and stimulated saliva, and tests for buffer capacity are available. The methods of how to perform these tests can differ.

Evaluating results:

- Resting saliva: Measured in ml/min. Low amount of resting saliva is <0,1ml/min (13).
- Stimulated saliva: Measured in ml/min. Low amount of stimulated saliva is <0,7ml/min (13).

The easiest method to measure the buffer capacity is by adding some saliva to a buffer strip. The buffer strip will change color and this can be compared to the manual.

The most important salivary indicator for increased caries risk is chronically low salivary flow, while the buffering capacity is only moderately associated. There is by now low/ no evidence that other electrolytes and salivary small molecules have a role in affecting an increased risk of caries. The immunglobulins have an insufficient evidence in development of caries. Salivary innate non – immunoglobulin factors (Amylase, saliva glycoproteins) have no relationship with caries status according to the literature (14).

Bacteria

The oral microflora consists of more than 700 different bacteria species (6). Some of these become pathogenic when the ecological balance is shifted. Presence of microbial communities in a biofilm on a tooth surface is a prerequisite for caries lesions to develop. The most important and easiest measureable ones are the MS and LBC. These bacteria are both acidogenic and aciduric. Aciduric bacteria can live in a low pH environment, while the acidogenic also can produce acid. MS dominates at the onset of a caries attack, while LBC becomes more prominent later on in the caries process. LBC are among those

microorganisms that are significantly associated with root caries and are easily measured (15).

Cariogenic bacteria produce acid from fermentable carbohydrates in the diet. They also produce extracellular and intracellular polysaccarides. The extracellular polysaccarides contribute to the biofilm matrix and enhances bacterial adhesion to the tooth surface and bacteria. The intracellular polysaccarides can be used for energy production and converted to acid when sugar is not available in the mouth. It is important to keep in mind that the presence of cariogenic bacteria does not necessarily mean that you have caries. Caries usually develops in fissures and interproximal areas, thus one should be extra thorough when cleaning these areas. Plaque is one of the main etiological factors for the development of caries. The amount of cariogenic bacteria depends on the diet, the oral hygiene and the saliva.

There are different methods for measuring MS and LBC, some of these do not require the access of a laboratorium. The patient should not have used antibiotics the last 4 weeks before taking a bacteria sample.

Microbiological tests can be useful to motivate patients. Diet changes can be measured by simple microbial tests such as Dentocult LB and Strip mutans. The levels of LBC in saliva can be related to the intake of carbohydrates. Excavation of caries can also reduce the LBC. The levels MS increase with the saccarose intake. The LBC test is less sensitive in predicting caries than the test for MS.

We should have in mind that results from a bacteria test can be biased dependent on number of teeth and mistakes during the test taking. The test result should always be related to the number of remaining teeth. A bacteria test is an excellent way to show the patient objectively that he/she has an increased risk for the development of carious lesions. When a patient follows a preventive program new bacteria tests will most likely show lower amounts of MS and LBC. Elderly people often have a higher number of bacteria (16).

Antimicrobial (chemotherapeutical) substances:

Patients with a temporarely or continuously increased caries risk with an increased number of cariogenic microorganisms, can be given antimicrobial treatment. If the patient for some

reason cannot brush normally for a period (f. ex after surgical extraction, periodontal surgery), antimicrobial treatment could also be given. Antimicrobial substances are present in different types of products, such as rinses (with fluoride and chlorhexidine), tooth pastes, gels, gums and varnishes. These products can break down the biofilm or inhibit acidproduction from certain microorganisms. It is important that these substances have as few negative effects as possible.

There are several different antibacterial products, but chlorhexidin is the most commonly used in dentistry. Antibacterial substances can be used both for treatment and as prophylaxis, at home and professionally in the clinic. Chlorhexidine can reduce the level of mutans streptococci, but is less effective decreasing LBC levels.

Oral hygiene

There is no standard level of oral hygiene to be recommended, the main hygiene recommendation is brushing teeth morning and evening with fluoride toothpaste and an appropriate brushing technique. Tooth cleaning influences the metabolism of the biofilm. Individual needs determines what extra oral hygiene measures the patient has to use in order to obtain optimal hygiene. Different prosthodontic fixed and removable dentures, implants, orthodontic treatment, tooth anatomy and alignment can make it necessary to use extra aids like interdental brushes and a solo brush.

The oral hygiene of a patient can be measured by colouring the plaque. One simple and effective way to control the progression of caries at the individual level is to improve the oral hygiene thus suppressing the presence of the dental biofilm. This should be done in combination with regular use of fluoride, preferable in the form of a fluoride toothpaste. In the clinic the dentist can instruct the patient how to keep a good oral hygiene, techniques, aids and use of time. Professional cleaning and motivation of the patient can also be done at the clinic. It is recommended to use dental floss daily to clean approximally where the tooth brush cannot reach. The correct use of dental floss is difficult, so the dental personell should instruct the patient thoroughly. Some other aids that can be used to remove the oral biofilm are tooth picks, interdental brushes, antibacterial mouthrinses and solo brushes. We should consider factors that may challenge the patient`s ability to maintain good oral hygiene, for example a crowded dentition, deep fissures, open restorative margins, or placement of oral

appliances. Other conditions that makes it difficult to maintain an optimal oral hygiene are when patient`s have physical disabilities like tremor, muscle weakness and pain in the oral area (because of wounds, radiation etc.)

Fluoride

The role of fluoride vehicles in caries prevention represents one of the most successful stories in general public health. It is well documented in the literature that fluoride has a anticariogenic effect that prevents caries and decreases or even reverses the progression of early caries lesions (17). Its mechanisms of action are inhibition of demineralization and enhancing the remineralization processes, as well as inhibition of bacterial metabolism (18). When the demineralizing process desolves the hydroxyapatite crystals, fluoride together with calcium and phosphate ions can remineralize the enamel. Fluoride, calcium and phosphate create fluoride apatite, which is less soluble than calcium hydroxy apatite in a low pH environment. The fluoride has also an antibacterial effect. Brushing with fluoride toothpaste gives an elevated fluoride level in saliva and plaque for several hours. It is recommended that everyone uses 1450 ppm fluoride toothpaste in the morning and evening. Patients with increased caries risk should use extra fluoride supplement, such as fluoride rinses (0,05%, 0,2%), tablets (0,25mg, 0,5mg), gum, gel, 5000ppm fluoride toothpaste, fluoride dental floss and tooth picks. Some fluoride products are for use at home, while others are used professionally in the clinic.

There is fluoride in all drinking water, but the amount varies in different areas of the country. The ideal fluoride content in the drinking water is 1mg/ml in our climate (19). On an average we get 0,56mg fluoride each day through the diet (without water). The local oral effect of fluoride is dependent on: what type of fluoride compound (NaF, MFP, SnF2, aminofluoride) that is used, the concentration, the pH of the product, duration of application, frequency of use, and the plaque bacterias sensitivity to the product. When the oral hygiene (deep pH drops) is poor, the fluoride is, however not able to stop demineralization. Fluoride can be seen as an active chemical treatment for caries lesions and a caries preventive vehicle. The use of fluoride is very cost – effective in caries prevention and treatment. Fluoride is the most important protective factor.

Diet

Diet is one of the most important factors in the development of dental caries. There is a clear correlation between frequent consumption of fermentable carbohydrates and the prevalence of dental caries. (20) There are several different types of these carbohydrates, such as monosaccharides, disaccharides and starch. The stickiness of starch enhances the retention time of carbohydrates, resulting in a prolonged pH fall. The cariogenic effect will be amplified in a diet consisting of high amounts of both mono – and disaccharides together with starch. However, starches alone are less cariogenic than sucrose, glucose and fructose. Sucrose is the most cariogenic carbohydrate because it gives the microorganisms, such as MS, the possibility to produce extracellular polysaccarids (1).

When we evaluate the diet we have to look at the frequency, quantity and consistence of the food intake. The frequency of meals is the most important dietary factor (20). When the frequency is high the enamel does not have the time to remineralize between the intakes. Liquids are cleared rapidly, while adhesive (sticky) foods vary in retentiveness. Sweet bisquits and potato chips for example, have high retention rates.

There are some protective factors in the diet, such as cheese and peanuts, that can stimulate an increase in the salivary flow rate after a previous intake of sucrose – containing foods. In addition, cheese raises the plaque calcium concentration, and this protects against demineralization. Other protective factors are non - cariogenic sweeteners (sorbitol, xylitol) that do not cause pH falls in the dental plaque, such as sugarfree gum and pastilles containing sorbitol and xylitol (20).

It is difficult for the dentist to measure the patients diet, but we can get a picture of how the diet is composed by taking a 24 hour dietary record or having the patient fill in a 3 day dietary record. In a 24 hour recall the dentist interviews the patient about what he/ she ate the day before. It is often difficult for patients to remember what they ate yesterday, so a 3 day dietary record is a more accurate way to get an idea of how the diet is composed. The patient should write down what he/she eats and drinks for 3 days in a row, where one day should be on a weekend. It is important to write down everything that comes in to the mouth (incl. gum, pastilles, cigarettes, medicines), the appropriate amount and at what time. The record does however not give a complete information on the total time of exposure.

You should have in mind that some food contains hidden sugars, such as caviar, ketchup and chips. Medicines can also contain sugars.

The dentist should evaluate this record together with the patient and give individual, specific advice about how to change the diet. It is important not to make too many changes at once, as that can diminish the patient`s cooperation. When the dentist evaluates the diet he/ she should look at the frequency of meals, distribution over the day, nutrition content of meals, the sugar content and frequency. If the patient eats during the night, it is a bigger risk for caries development. To demonstrate a high caries risk associated with frequent eating to the patient, the sugar clocks may be a useful tool. It is very important to follow up the dietary advises because the patient will consider it insignificant if the dentist doesn`t.

To change the diet is complicated because humans dislike changes. With the sugar clocks we can demonstrate how important the nutrient intake is. Frequent eating results in many periods of acid formation in dental plaque (red areas). Where eating occurs five times a day this results in long periods with no acid formation and there is time for remineralization (green areas) (22).


Figure 2 (21).

Anamnesis

The anamnesis is based on general and local factors.

To be able to evaluate a patient`s situation one has to go carefully through the patients health status, including diseases, allergies and use of drugs. Behavioural factors, such as smoking, the socioeconomic status and work, also needs to be checked.

DMFT (Decaved, Missed and Filled Teeth) curves according to age in Denmark. Yellow curve corresponds to the average for the age. Green and red curves correspond to +- 2 DMFT around the average. If the patients DMFT is between the red and green curve it is considered normal. A DMFT above the curves is considered too high and below the curve low according to the average. (23)
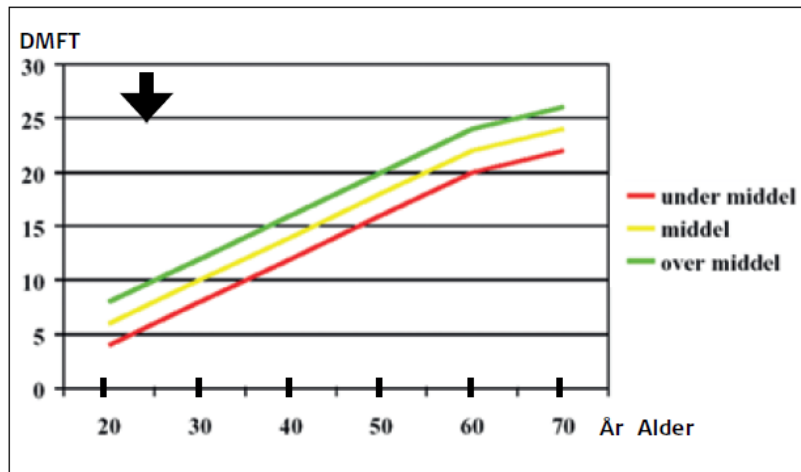
During the examination the dentist should check the past caries experience. This includes all previous treatment and when this treatment was done, and also look for decalsifications and erosions. Check out the DMFT for the age group. DMFT is decayed, missing and filled teeth, and is an index documenting the caries experience. However, this does not tell the reason for a treatment. For example, when teeth are extracted because of orthodontic treatment or restoration of teeth because of trauma. Previous caries experience is one of the strongest predictors of future caries. Check the patients` oral hygiene and get him/her to show and tell how they perform it. Get information about the use of fluoride. Also ask more about the patients` dietary habits, eventually give the patient a dietary record to fill in.

Information of socioeconomic and behavioural factors include:

- environment
- stress/coping
- values
- use of oral health services
- odontofobia
- smoking and number of cigarettes a day, use of snuff, drugs
- social class, education, work hours, income
- knowledge and attitude.

These factors can be understood as determinants of the biological causes of caries. Several general diseases or conditions can directly or indirectly influence the caries process, either through affecting saliva formation and composition, through a caries – inducing dietary pattern or through medicines. Disease or conditions in early childhood may also have influenced the formation of the enamel. Example of such diseases are:

- autoimmune disease (Sjögrens synrome)
- hormonal diseases (diabetes mellitus)
- hereditary disorders (cystic fibrosis)
- infections (HIV)
- metabolic disturbances (anorexia nervosa, bulimia)
- intake of medicines (diuretica, antidepressants, antihistamins)
- radiation towards the head – neck region.

Some genetic factors can also affect the caries development:

- the quality and quantity of the saliva
- tooth morphology
- position and occlusion
- eruption time and sequence
- defects during the tooth development such as hypoplasia, amelogenesis imperfecta and dentinogenesis imperfecta.

The caries risk most often changes during life. For example, young adults moving away from home for the first time may experience a diet change in both frequency and content. People who work shift may also eat or drink high – sugar foods and coffee frequently (1). Several studies show that many elderly have a higher prevalence and incidence of caries, especially root caries. This is due to among other things, gingival retraction, increased frequency of sugar containing foods, medication – induced hyposalivation (which gives a more cariogenic oral flora) and poor oral hygiene (16).

 In the paper "A case – control study of differences between regular and causal adult attenders in general dental practice" by Bullock et al (24) they found that regular dental

visits have a beneficial effect on oral health, or it could be that regular visits are a marker for a generally healthy behavior.

Methods of risk assessment

There are several methods of assessing caries risk, but we have chosen three that we will focus on. These are The Cariogram, Caries Management By Risk Assessment (CAMBRA) and the UIT – method. They all evaluate the same factors, but have some differences in the approach and treatment plans. It is always important that a risk assessment is done at the very beginning of the treatment. The dentist should also evaluate the patient`s cooperation both before operative treatment and after.

The Cariogram

Prof. D. Bratthall developed this concept and the formula for the Cariogram in Malmö. The PC version was created in collaboration with Dr. L. Allander and K – O. Lybegård B.Sc., and the manual was written by D. Bratthall, G. Hänsel Petersson and J.R: Stjernswärd (2003) (25,26).

The Cariogram is a swedish model (launched in 1997), that illustrates the multifactorial background of dental caries in a simple way. The foundation was laid at the Institution of Dentistry in Göteborg. Building on this work the computer-based caries risk assessment model was developed at the Dental University in Malmö. The model has been translated into several languages and is used in many countries. It is a graphic model that shows the individual patients` chances to avoid new carious lesions in the near future. The main purpose of the cariogram is to improve the understanding of the multifactorial aspects of dental caries and to estimate the caries risk. The program does not replace the dentist`s own judgement of the caries risk, but gives valuable hints and may serve as a basis for discussion with the patient about various risk factors and preventive strategies. It shows the etiological factors responsible for the caries risk, and which targeted actions to improve the situation that will have the best effect. In the Cariogram the focus is on the patient as a whole.

To be able to evaluate the caries risk according to the Cariogram the dentist have to collect relevant information regarding the patient, scored according to a standardized protocol and then enter the scores into the computer program.

In order to estimate the caries risk, the Cariogram evaluates different pathological and protective factors, which are given different weights. Some factors are more important for caries development or protection than others, and these have a stronger impact on the outcome of the results when the caries risk is calculated. The factors are also weighted in relation to each other. The Cariogram is based on a large number of scientific publications that have been evaluated to find the right weight for the different factors. It is important to understand that it is not possible to measure the caries risk with mathematical exactness. The Cariogram can show that it is a high probability for the development of new cavities, but can of course not give an exact number of cavities.

In the Cariogram you have to remember to adjust the settings for country/area and group. You can choose between standard set, low risk and high risk. The standard set is suitable in industrialized countries without water-fluoridation. Depending on what group the patient belongs to compared to the general population in the area, you may choose the standard set, low risk or high risk. An example of a patient where the high risk is suitable is an elderly man with exposed root surfaces.

The Cariogram is a pie-circle diagram divided into coloured sectors. There are five different sectors in the pie – circle diagram. These are the green sector (actual chance to avoid new cavity), the dark blue sector (diet), the red sector (bacteria), the light blue sector (susceptibility) and the yellow sector (circumstances). See enclosure number 1.

 For all patients, the factor "0" is the best value and "3" (or "2" where that is maximum) the most unfavourable score. It is possible to enter ten scores in this program, but the Cariogram appears already when only seven of the scores have been entered. Any unfilled box will make the program less specific. In the "clinical feeling"-box there is a standard score of 1. Only if the dentist disagrees with the caries risk estimated by the Cariogram, the score should be changed into higher or lower. When all the scores are set the Cariogram gives you a list of suggestions for actions to take. This is only an advice, there are of course also other different treatment possibilities.

The Cariogram can be an usefull inspiration for the patient to make his/her own efforts. You can easily demonstrate to the patient how the caries risk can be reduced by changing the scores for the different factors. The Cariogram is basically built on selected factors that are

directly involved in the biochemical events on the tooth surface. This does not mean that factors or circumstances indirectly related are ignored, as these factors can contribute to changes of the factors in the Cariogram. For example, poor socio-economic factors can affect both oral hygiene and the diet of an individual negatively.

CAMBRA – Caries Management By Risk Assessment

The CAMBRA model was published in 2003 by a group of experts from the United States (3, 27, 28). It is based upon literature available at that time.

By using CAMBRA the dentist can identify the cause of the disease by evaluating each patient`s risk factors. The dentist uses evidence based treatments (29) such as behavioral, chemical and minimally invasive procedures, in order to manage the risk factors. According to evidence, by using CAMBRA, initial caries may be reversed and disease manifestations may be prevented. CAMBRA also focuses on minimal operative intervention of cavitated lesions and defective restorations.

In CAMBRA the focus is on diagnosis, prognosis and risk analysis. Diagnosis is important because firstly the dentist has to find whether the patient has caries. Secondly, in combination with prognosis and risk, diagnosis forms the basis for treatment decisions and enables the dentist to advice and inform the patient. Diagnosis is required to identify whether a preventive or therapeutic modality is necessary. When the patient has a diagnosis, the dentist can mostly give the patient a suitable prognosis. This prognosis gives a likely course and outcome of the disease in the future. It is possible to give the healthy patient a risk of getting caries by evaluating the risk factors for this disease. In CAMBRA they combine diagnosis and risk/prognosis assessment to get an improved treatment plan. There are four treatment groups and each of them has their own protocol for managing the disease process and recall times.

Treatment plan according to CAMBRA (30): See enclosure number 2.

How to measure the risk of developing caries according to CAMBRA
1.Detection:

The dentist needs to have knowledge about the caries process and how to classify caries lesions. To assess the caries activity, information has to be collected, including all risk factors.

2.Caries diagnosis: CAMBRA has three diagnostic groups. Patients with active non-cavitated and cavitated caries has a <u>caries active diagnosis.</u> When demineralization and remineralization is in balance the patient has no caries attacks, and the diagnosis is <u>caries balanced</u>. <u>Caries undetermined diagnosis</u> is used when characteristics from both groups are present.

3. <u>Prediction of disease:</u> See enclosure. Fill in the caries risk assessment form. You should take bacteria tests evaluating MS and LBC if you have answered yes to one or more of the disease indicators in the first panel.

4.<u>Treatment groups by combined diagnosis and risk – prognosis status:</u> Assessing the future risk for caries by evaluating the risk factors. There are 4 risk categories (3,29).

- <u>Low risk patient:</u> Today no signs or symptoms and no risk factors. Normally this patient has little previous caries experience. But a patient with a higher risk level can also become a low risk patient in the future.
- <u>Moderate risk patient:</u> Patients with caries active lesions that are non-cavitated. Patients that have a caries balanced diagnosis, but have several risk factors. For example patients with hyposalivation or orthodontic brackets.
- <u>High risk patient:</u> Most high risk patients has at least one existing cavity that needs restorative treatment. There may also be active white spot lesions. It is possible to be a high risk patient if you do not have cavitated lesions, as long as you have two or more high risk factors.
- <u>Extreme risk patient:</u> Patients with special needs or hyposalivation.

It may be difficult to place the patient in a specific risk group, but when in doubt it is better to place the patient in the next higher category.

There is no guarantee that a patient will stay in the same risk group in the future. A change in the balance between protective and pathogenic factors may shift the patient to a different risk level. The goal is to get the patient in a lower risk group if possible.

Risk group	Caries – balanced	Caries – active
Low	Caries-balanced low–risk	
Moderate	Caries-balanced moderate-risk	Caries-active moderate-risk
High		Caries-active high risk
Extremely high		Caries-active extreme-risk

5. Treatment plan

CAMBRA has four treatment groups with different treatment needs. Some groups only need non-operative and prophylactic treatment, while others have to get restorative therapy also. See enclosure number 2.

6. Follow up

After following the dentists` recommendations for 3 – 6 months, the patient should come back for a reassessment, including new bacteria samples. Take a new bacterial sample if the levels where moderate or high initially. If the patient is not compliant or the results still are not good, change your recommendations.

UIT (University of Tromsø) method for caries risk assessment

The UIT – method (31) uses the same objective tests and gathers the same clinical information and general and local anamnesis as the Cariogram and CAMBRA. Then you have to evaluate these data and find the appropriate risk level yourself. From this, the dentist has to make a preliminary therapy plan, a definitive therapy plan and give the patient a suitable prognosis and a recall. Inform the patient of the goal of the treatment you have planned. Give individual dietary advice based on the dietary record and oral hygiene instructions. Advice the patient about what kind of fluoride supply he/she needs. After this is done, the dentist can supplement with different fluoride vehicles at the clinic or to be used at home. Eventually antimicrobial treatment might be needed later on.

A follow up of the patient cooperation should always be done before extensive therapy is started.

After collecting the factors

When a caries risk assessment has been done, regardless which method that has been used, the dentist should make a preliminary therapy plan, a definitive therapy plan and inform the patient about the prognosis. The preventive treatment plan for the individual should be given in both verbal and written form. It is important to explain to the patient that it is possible for him/ her to move to a lower risk group/ to increase the percent of avoiding caries by self - administered home care and professional help.

After finding the risk level, the dentist should describe the basic characteristics for caries development and how to prevent it, like avoiding eating things containing ordinary sugar between meals, brush the teeth twice a day with fluoride toothpaste and using dental floss. And then, we should explain individually what the patient should do to reduce his/ her own risk, such as extra fluoride supplements, special dietary advice and stimulate the saliva when needed.

The dentist should always check that the patient is following the imposed preventive program. Positive results like reduced number of cariogenic microorganisms and the arrest of active lesions will motivate the patient to continue the new health program. It is important to get support from family, friends and the community to make it easier to change a behavior. At the next recall appointment, it is essential to reevaluate the prophylactic program. Ask what the patient thinks of the program, does he/ she feel that it`s working, and has it become a routine in their daily life? The dentist should also check the oral hygiene and the caries status. A follow up of objective tests like saliva and bacteria tests should also be done on an individual basis. Keep in mind to check the health status of the patient. Discuss with the patient about their status and make a new risk assessment.

The appropriate recall will differ between the risk groups. For someone with a low risk one can gradually extend the interval towards the 24 – month maximum period. Individualization of recall intervals and prevention leads to lower dental costs for some individuals and a more appropriate use of dental resources (32). Patients with a high risk may need a shorter interval, from 3 months and up, a more intensive preventive care and a closer supervision. If

there are any significant changes of the risk factors, the patient should let the dentist know. Even if a patient is "deemed" to be at low risk of future caries at a particular examination, there is a need for maintenance care (33). Little information is available about the efficacy of caries management and preventive interventions among high risk individuals (34).

For assessment of the results, it is possible to evaluate the different treatments according to their evidence from the SBU - report 2009 (Statens beredning för medicinsk utvärdering) (4).

Different studies have been done to find the evidence of the treatment alternatives. If there is no evidence or the evidence is low, it does not necessarily mean that the treatment doesn`t have an effect, it could be that the effect is difficult to measure.

The strength of evidence shows the total scientific basis for a conclusion. The evidence is continuingly updated based on the best available knowledge (4).

Evidence 1 – strong scientific basis

Evidence 2 – moderately strong scientific basis

Evidence 3 – limited scientific basis

Evidence 4 – Inadequate scientific basis – when the scientific basis is inadequate to draw a conclusion on evidence.

Contradicting scientific basis – when different studies have drawn opposite conclusions and they have the same level of evidence, no conclusion can be drawn

Evidences of preventive measures:

- Fluoride tooth paste has evidence 1 (daily use)
- Prevention programs with fluoride has evidence level 2 (no difference between different combinations of products)
- Professional tooth cleaning with fluoride has evidence level 3
- Tooth paste with xylitol has evidence level 3 (also containing fluoride)
- Fluoride gel/varnish has evidence level 3 (twice per year)
- Fluoride in drinking water has evidence 3

- Fluoride rinse has evidence 3 (no additional effect when using fluoride tooth paste at the same time and when the caries activity is low)
- Fluoride rinse against root caries has evidence 3 (people above 60 years)
- Fissure sealant (resinbased material) has evidence 3
- Preventive program for caries active patients has evidence level 4 (due to inadequate basis)
- Professional tooth cleaning without fluoride has evidence level 4
- Tooth paste with triclosan has evidence level 4 (lacking studies)
- Fluoride lozenges has evidence 4
- Diet information has evidence level 4 (lacking studies)
- Sorbitol/ xylitol in sweets and gum has evidence level 4
- Fissure sealant (GIC) has evidence 4

Caries risk performed on our own patients

Three different methods of caries risk assessment have been performed on five of our own patients at the student clinic.

We wanted to compare them and find out if there is any difference between the recommended prophylactic/operative treatment plan for the different methods. The three methods are: the Uit-method, the Cariogram and the CAMBRA method. We also wanted to try the methods on our own patients to better understand how they work in the dental practice and how much time they require. See enclosure number 3.

Discussion

In the daily life of being a dentist, the trend is towards an increased focus on caries risk assessment. People live longer – at least in the western part of the world – and retain their teeth longer. Caries is a world – wide problem. As caries is both possible to cure and prevent, it should be given top priority. To get the best treatment, a risk assessment should always be done either automatically or when needed, in a more extensive way. It is important to follow up the patient after the risk assessment. The aim of the risk assessment is to help the patient to get in a lower risk group if possible. But the dentist should always have in mind that there can be other factors in the patients life that affects the oral health. It is important to see the

whole person and have understanding for his / her situation. For some patients` the teeth are not so important due to other problems and this is something we should always be thinking of.

There are many factors to take into consideration, both pathological and protective, some are more important than others. Anyway, you have to weigh them against each other. As we know, it is important to look at all the factors as a whole to get the most correct evaluation of the caries risk. Then you hopefully know the cause of the individual patients` caries disease and therefore we can treat it more effectively and correctly. The dentist should have in mind, that the caries risk is not necessarily constant, the factors can change over time. Some factors play a direct role in the disease process, while others have an indirect role. Bacteria and fermentable carbohydrates are directly involved, whereas stress and the use of different medications are examples of factors playing an indirect role. The environment, society and economy of the patient also can affect the factors indirectly.

Some people are more prone to developing caries. This is due to factors that the patient cannot change, for example a patient who has Sjögren`s syndrome and therefore has hyposalivation. Anyway, we can help this patient to handle the hyposalivation in the best way. To reduce the caries risk the patient himself/herself has to do the work to change the factors that are possible to change, while the dentist can help and advice. The dentist should give the patient knowledge about the cause and the process of the caries disease.

Caries risk assessments are not done as often as they should in the private and public sector, and this is due to several reasons:

- The clinic needs special equipment for the bacteria tests.
- Doing a risk assessment takes time at the clinic.
- The patient has to come to the clinic several times.
- Cost of the material for the test and the clinical time.
- It may be difficult to charge the patient.
- Older dentists probably lack knowledge about the risk assessment methods available.
- To get the most accurate risk is dependent on the patient cooperation. For example the patient has to write a correct and honest dietary record.

In the student clinic the material is available and there is enough time to do a risk assessment. The student as well as the patient can also learn a lot from it.

In this literature study we have investigated different methods of caries risk assessment; the Cariogram, CAMBRA and the UIT – method.

Our own patients

Our patients had different risk levels, from 9 – 94 percent chance to avoid caries according to the Cariogram, from moderate to high according to CAMBRA, and from low to high risk according to the UIT – method. These risk assessments are presented in the enclosure. After reading about the methods and trying them on our patients, we have got a better understanding about how the models work and which is, as we see it, the best model to use.

The Cariogram

We think the Cariogram is a good model to find and visualize the caries risk for several reasons. It is easily available in different languages online and at no cost. It is very easy to use, as it is a computer program and the risk appears directly after plotting in the weight of the different factors. The pie – diagram in different colors is highly understandable for the patient and it is easy for the dentist to demonstrate what the patient can do to change her/his risk. By changing the factors the dentist can show the altered chance of avoiding caries in a very comprehensible way. This probably makes the patient more motivated to change the risk.

What is special about the Cariogram is that it shows the risk in a positive way, as "the chance to avoid caries". Another thing we think is good with this model is that it shows the chance of avoiding caries in percent. You can also find an appropriate treatment plan for the actual risk of the patient. In our opinion, this treatment plan is especially good because it is very individual and is focused on the actual problem behind the disease. The treatment is based on factors with high scores, and therefore will change the factors that probably is the cause of the disease. This is just a help for the dentist, there are also other possible treatments.

The Cariogram is much used in student clinics in Sweden as it is an understandable way to show the cause of the disease and how important the factors are.

CAMBRA

CAMBRA has a well arranged caries risk assessment form for filling in the factors and caries activity. In CAMBRA the different factors have the same weight, for example will use of fluoride toothpaste have the same impact as use of xylitol gum. In addition they use some products that are probably more common in the USA than in Scandinavia, for example calcium phosphate paste. Regarding the diet they do not evaluate the amount of sugar, only the LBC amount. When you eat three or more snacks between meals it is regarded as a risk factor, independent of the content of the snack and frequency above three. It is unclear to us what they mean with three snacks, whether it`s three chocolate pieces or three cocholate bars.

What we think is positive with this model, is that there are finished treatment plans with the appropriate recall for each of the four risk groups. However, we think the treatment plans might be too extensive and can overwhelm the patient. Instead of giving the patient the whole treatment at once, it might be better to gradually change the factors. The treatment plans are very general and not individual, because they don`t consider which factors that are the cause of the disease for the specific patient. For example, a patient can be informed to use more fluoride even though the use of fluoride is not the problem for this patient. Therefore we think the dentist should not just hand out these treatment plans, but instead individualize them. The dentist must on his/her own find which risk group the patient belongs to, and this can sometimes be difficult. Since there are just four risk groups, many different risk patients can be in the same risk group and receive the same treatment plan. It is a weakness with this method that all patients within the same risk group receives the same treatment plan even though some of the patients are in the lower limit of the risk group and some are nearly tipping towards a higher risk group. We think CAMBRA has a low threshold for placing patients in the high risk group, and a high threshold for the low risk patient. At the bottom of the caries risk assessment form there is a picture of a weight. And this weight will tip to one or the other side depending on the protective and pathologic factors. We think this weight is a bit difficult to understand.

UIT - method

In the UIT – method we evaluate the same factors and take the same tests as in the other methods. The dentist has to estimate the appropriate caries risk, treatment plan and recall

on their own. This risk assessment method is more challenging for the dentist as he/ she has to estimate the risk level and make the treatment plan by himself/ herself. No preexisting manuals are available. We think this makes it a bit more time consuming.

The UIT – method is completely individual as the dentist will have to consider the proper risk after evaluation of all the risk factors. In this way the method is very good. However, there is a risk that not all the factors will be evaluated because there is no manual to follow, and it may be easy to forget to evaluate one of the factors. In our opinion this is a method that all dentists should be able to do because it is based on the fundamental principles of the protective and pathological factors in the caries development. This knowledge is important to have, no matter what type of caries risk assessment method is used.

Comparison of the different methods

All three methods evaluate the same factors and use the same tests to find the caries risk. While the Cariogram and CAMBRA give the dentist a risk and treatment plan, in the UIT – method the dentist has to use his/her knowledge to give a risk and treatment plan. Another difference is that CAMBRA also give a suitable recall. CAMBRA is based on the best evidence available at this time, but several studies also show that the Cariogram is effective in determining caries risk.

We think the Cariogram is the best of these methods because it is the easiest one to use both for the patient and the dentist. The Cariogram shows in percent the chance to avoid caries, while CAMBRA just have four risk groups. The patient may not understand what it means to have moderate risk, but if you tell him/her the percent chance to avoid caries he might understand it better.

While CAMBRA just has four treatment plans, one for each risk group, the Cariogram has a lot of different treatment plans, depending on each risk factor. The UIT – method is the most individual method. The treatment plans we get from the Cariogram is better than CAMBRA, in our opinion, because they are more individual and the treatment suggestions are more in line with what we are learning. In the treatment plans for CAMBRA, fissure sealants are included. Since fissure sealants are mostly used on children, it is a less relevant treatment for adults. An example of this is when a minimal invasive treatment has been done. It could then be favorable to seal the rest of the fissures to avoid bacterial leakage. All three risk

assessment methods include antibacterial substances in the treatment when necessary. The CAMBRA treatment plans says exactly how to use the antibacterial vehicle and which concentration, while in the Cariogram treatment plans, it is up to the dentist to decide how to use it and at what concentration. CAMBRA treatment plans contains an exact description of vehicles and how they should be used. The Cariogram treatment plans are suggestions to the dentist about what can be done, while the CAMBRA treatment plans are for the patient too. The dietary advices in the CAMBRA and Cariogram treatment plans are not specific, the dentist has to evaluate the dietary record more accurately just like in the UIT – method.

The Cariogram model is more individual than CAMBRA in the factors, the risk level and treatment plan. Both the CAMBRA and the Cariogram method takes about the same amount of time to complete. The UIT – method is a fine way to collect the factors and find the cause of the disease. It focuses more on individual problem based treatment plans and treatment. This method is important to understand because in fact, it`s the basic knowledge to be able to perform a caries risk assessment independent of method.

<u>Why the caries risk assessment is effective for the patient and the dentist</u>

When a caries risk assessment has been done the dentist can give the patient the most correct treatment. It is hopefully easier for the patient to understand why he/ she develops caries and what he/she can do about it. The dentist can check if the patient is cooperating by taking a new bacteria test and check the remineralization of earlier initial carious lesions. To succeed with getting the patient in a lower risk group is highly dependent on the patient cooperation. The dentist should point out to the patient the importance of cooperation to be able to achieve a lower caries risk. If the patient doesn`t change behavior he/ she can`t expect a change in the caries problems. The dentist can only give advice, fluoride varnish and remove the symptoms of the disease. The prognosis of later treatment is better after a risk assessment. However, it is important to remember that the caries risk you get after a risk assessment applies only at the moment the risk assessment is done, if any risk factors change in the future, the risk will also change.

Conclusion

Today, there is an increased focus on assessment of the caries risk. Several models and tests are available. Caries is a multifactorial disease and it is important to consider all the factors involved. In the future, there will be more interest in this topic. More patients keep their own teeth longer and care about their oral health. The treatment and prevention of caries, as well as recall intervals should depend on the patients` caries risk. To prevent caries and get initial lesions to remineralize are cost – effective treatments. The Cariogram is an excellent way to find the caries risk and the causes of the disease. Both the patient and the dentist will have an advantage from doing a caries risk assessment. Keep the healthy tooth healthy.

Enclosure number 1.

The Cariogram
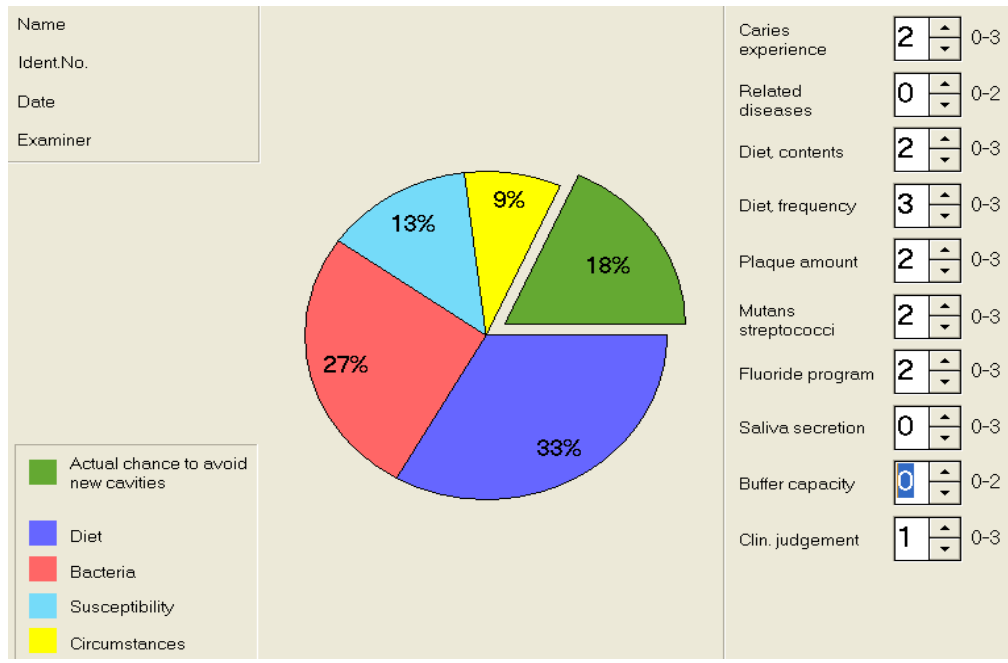
Green sector: actual chance to avoid new cavity.

Shows the chance to avoid caries. The bigger the green sector the better for the dental health. The green sector never shows 0% or 100% chance to avoid caries. If the green sector is 75% or more, it indicates a very good chance to avoid new cavities in the following year if the conditions are unchanged. While, 25% or less indicates a very high caries risk.

Dark blue sector: diet

Diet contents:

Score	Explanation
0=Very low fermentable carbohydrate	Very low fermentable carbohydrate, extremely "good" diet. Lowest

1=Low fermentable carbohydrate, "non-cariogenic diet"	Low fermentable carbohydrate, sugars or other caries inducing carbohydrates on a low level.
2= Moderate fermentable carbohydrate content	Moderate fermentable carbohydrate content. Diet with relatively high content of sugars or other caries inducing carbohydrats.
3= High fermentable carbohydrate, inappropriate diet	Inappropriate diet from a caries perspective. High intake of sugars or other caries inducing carbohydrates.

Diet frequency:

Score	Explanation
0=Maximum 3 meals per day (including snacks)	Very low diet intake frequency, a maximum of 3 times per 24hour.
1=Maximum 5 meals per day	Low diet intake frequency, maximum of 5 times per 24 hour.
2=Maximum 7 meals per day	High diet intake frequency, a maximum of 7 times per 24 hour.
3=More than 7 meals per day	Very high diet intake frequency, more than 7 times per 24 hour.

This is one of the key factors in the estimation of caries risk. Even a small sugary snack contribute to acid production.

Red sector: bacteria

Plaque, amount

Score	Explanation
0=Extremely good oral hygiene, plaque index, PI<0,4	No plaque, all teeth surfaces are very clean. Very good oral hygiene, uses both tooth brush and interdental cleaning.
1=Good oral hygiene, PI=0,4-1	A film of plaque adhering to the gingival margin and adjacent area of the tooth. The plaque may be seen only after application of disclosing solution or by using the probe on the

	tooth surface.
2=Less than good oral hygiene, PI=1,1-2.	Moderate accumulation of soft deposits, which can be seen with the naked eye.
3=Poor oral hygiene, PI>2,0	Abundance of soft matter within the gingival pocket and/or on the tooth and gingival margin. The patient is not interested in cleaning the teeth or has difficulties in cleaning. You feel like cleaning his/her teeth thoroughly, professionally and immediately!

Plaque is important in the caries process while it is a direct etiological factor for caries.

Mutans streptococci

Score	Explanation
0=Strip mutans class 0	Very low or zero amount of mutans streptococci in saliva. Only about 5% of the tooth surface colonized by the bacteria.
1=Strip mutans class 1	Low levels of mutans streptococci in saliva. About 20% of the tooth surface colonized by the bacteria.
2=Strip mutans class 2	High amount of mutans streptococci in saliva. About 60% of the tooth surface colonized by the bacteria.
3=Strip mutans class 3	Very high amount of mutans streptococci in saliva. More than 80% of the tooth surface colonized by the bacteria.

Mutans has an especially active role in the early stage of the lesion formation.

Light blue sector: susceptibility

Fluoride programme

Score	Explanation
0=receives "maximum" fluoride programme	Fluoride plus constant use of additional measures – tablets or rinsings and varnishes. A "maximum" fluoride programme.

1=Additional F measures, infrequently	Fluoride toothpaste plus some additional measures – tablets or rinsings and varnishes infrequently.
2=Fluoride toothpaste only	Fluoride toothpaste only, no supplements.
3=Avoiding fluorides, no fluoride	Avoiding fluorides, not using fluoride toothpaste or other fluoride measures.

Fluoride is a very important factor for remineralisation of early caries lesions and in inducing resistance to caries.

Saliva secretion - amount

Score	Explanation
0=Normal saliva secretion	Normal saliva secretion, more than 1,1ml stimulated saliva per minute.
1=Low, 0,9-11ml stimulated saliva/min	Low, form 0,9 to less than 1,1ml stimulated saliva per min.
2=Low, 05-0,9ml saliva/min	Low, from 0,5 to less than 0,9ml stimulated saliva per minute.
3=Very low, Xerostomia, <0,5ml saliva/min	Very low saliva secretion, dry mouth, less than 0,5ml saliva per minute; problem judged to be long-standing.

Saliva buffer capacity

Score	Explanation
0=Adequate, dentobuff blue	Normal or good buffer capacity, saliva pH_>6,0
1=Reduced, dentobuff green	Less than good buffer capacity, saliva pH 4,5 – 5,5
2=Low, dentobuff yellow	Low buffer capacity, saliva pH<_4,0

Yellow sector: circumstances

Past caries experience (caries prevalence)

Score	Explanation
0=Caries free and no fillings	Completely caries free, no previous fillings, no cavities or missing teeth due to caries.
1=Better than normal	Better than normal – better status than normal, for that age group in that area.
2=Normal for age group	Normal status for age group.
3=Worse than normal	Worse status than normal for age group, or several new caries lesions the last year.

To choose the right score, the dentist should have some knowledge about the caries prevalence in the country/area where the patient lives.

Related disease

Score	Explanation
0=No disease	There are no signs of general disease of importance related to dental caries. The patient is "healthy".
1=Disease/conditions, mild degree	A general disease, which can indirectly influence the caries process, or other conditions which can contribute to higher caries risk, e.g. poor eye-sight, inability to move.
2=Severe degree, long-lasting	Patient could be bed-ridden or may need continous medication for example affecting the saliva secretion.

Clinical judgement: opinion of the dental examiner, "clinical feeling"

Score	Explanation
0=More positive than what the cariogram shows based on the scores entered	The dentist opinion is that the patient has a higher chance to avoid caries than what the cariogram says.
1=Normal setting. Risk according to the other values entered.	When the dentist has the same opinion of the caries risk as the cariogram.
2=Worse than what the cariogram shows based on the scores entered	The dentist has a feeling that the caries risk is higher than the

	cariogram shows.
3=Very high caries risk, examiner is convinced that caries will develop, irrespective of what the cariogram shows based on the score entered	The dentist is very sure that caries will occur the coming year and want the green sector to be minimal.

"Clinical judgement" is automatical pre-set to score 1. If the dentist has a reason to believe

that the chances are better or worse, change to lower or higher values respectively.

All figures from the Cariogram are found in source 23.

CAMBRA

TABLE 1

Caries Risk Assessment Form — Children Age 6 and Over/Adults

Patient Name: __ _____ _____ _____ _____ Chart #: _____ _____ Date:_____ _____ _____ _____

Assessment Date: Is this (please circle) base line or recall

Disease Indicators (Any one "YES" signifies likely "High Risk" and to do a bacteria test**)	YES = CIRCLE	YES = CIRCLE	YES = CIRCLE
Visible cavities or radiographic penetration of the dentin	YES		
Radiographic approximal enamel lesions (not in dentin)	YES		
White spots on smooth surfaces	YES		
Restorations last 3 years	YES		
Risk Factors (Biological predisposing factors)		YES	
MS and LB both medium or high (by culture**)		YES	
Visible heavy plaque on teeth		YES	
Frequent snack (> 3x daily between meals)		YES	
Deep pits and fissures		YES	
Recreational drug use		YES	
Inadequate saliva flow by observation or measurement (**If measured, note the flow rate below)		YES	
Saliva reducing factors (medications/radiation/systemic)		YES	
Exposed roots		YES	
Orthodontic appliances		YES	
Protective Factors			
Lives/work/school fluoridated community			YES
Fluoride toothpaste at least once daily			YES
Fluoride toothpaste at least 2x daily			YES
Fluoride mouthrinse (0.05% NaF) daily			YES
5,000 ppm F fluoride toothpaste daily			YES
Fluoride varnish in last 6 months			YES
Office F topical in last 6 months			YES
Chlorhexidine prescribed/used one week each of last 6 months			YES
Xylitol gum/lozenges 4x daily last 6 months			YES
Calcium and phosphate paste during last 6 months			YES
Adequate saliva flow (> 1 ml/min stimulated)			YES
**Bacteria/Saliva Test Results: MS: LB: Flow Rate: ml/min. Date:			

VISUALIZE CARIES BALANCE
(Use circled indicators/factors above)
(EXTREME RISK – HIGH RISK + SEVERE SALIVARY GLAND HYPOFUNCTION)
CARIES RISK ASSESSMENT (CIRCLE): EXTREME   HIGH   MODERATE   LOW

Doctor signature/#: __ _____ _____ _____ _____ _____ _____ Date:_____ _____ _____ _____

Treatment plans

Dear (Patient X),

Congratulations, you have been assessed at low risk for future dental decay. We want to help you stay that way. You will find that you will be able to maintain your current level of oral health if you do the following:

- Brush twice daily with an over-the-counter fluoride-containing toothpaste.

- Review with us your dietary and oral hygiene habits and receive oral hygiene instructions. If good, continue with your existing dietary and oral hygiene habits unless there is a change in status, such as new medications.

- Get a thorough professional cleaning as needed for your periodontal health. We will be happy to provide these cleanings for you.

- Return for a caries recall exam (when requested) in six to 12 months to re-evaluate your current caries risk.

- Have new bitewing radiographs (X-rays) taken about every 24 to 36 months to check for cavities.

- Consider using xylitol gum/candies and over-the-counter fluoride rinse (0.05 percent sodium fluoride) instead of regular gum/candy or mouth-wash.

- Get fluoride varnish after teeth cleanings, base line bacterial test, sealants if your dentist recommends it. You may or may not need this. It depends on your oral conditions.

- Other recommendations:

Dear (Patient Y),

You have been assessed to be at moderate risk for new dental decay in the near future because you have (fill in the blank). We want you to move into a safer situation to avoid new decay in the future. Here are some ways to accomplish this goal:

- Review your dietary and oral hygiene habits with us and receive oral hygiene instructions.

- Brush twice daily with an over-the-counter fluoride-containing toothpaste, following the oral hygiene instruction procedures you have been given.

- Purchase an over-the-counter fluoride rinse (0.05 percent sodium fluoride, e.g. Fluorigard or ACT) and rinse with 10 ml (one cap full) once or twice daily after you have used your fluoride toothpaste. Continue daily until your next dental exam.

- Get a thorough professional cleaning from us as needed for your periodontal health.

- Chew or suck xylitol-containing gum or candies four times daily.

- Return when requested for a caries recall exam in four to six months to re-evaluate your progress and current caries risk.

- Get new bitewing radiographs (X-rays) about every 18-24 months to check for cavities.

- Get a fluoride varnish treatment every four to six months at your caries recall exams.

- You may also need a base line bacterial test and sealants (depending on your situation and condition).

- Other recommendations:

Dear (Patient Z),

Our assessment reveals you are at a high risk of having new dental decay in the near future because you have (fill in the blank). We want to help you to move to a safer situation to avoid new decay if at all possible. We strongly recommend the following:

- Complete a caries bacterial test with us today (as a base line before antibacterial therapy). We will have the results of this test in three days.

- Complete a saliva flow measurement to check for dry mouth. This is a very simple test that we will do today as part of the bacterial assessment.

- Review with us your dietary and oral hygiene habits and receive instructions on both. The most important thing is to reduce the number of between-meal sweet snacks that contain carbohydrates, especially sugar. Substitution by snacks rich in protein, such as cheese, will also help as well as the xylitol gum or candies described below.

- Brush twice daily with a high fluoride toothpaste, either Control RX or Prevident Plus toothpaste (5,000 parts per million fluoride). We will provide some for you today. This is to be used twice daily in place of your regular toothpaste.

- Rinse for one minute, once a day with a special antibacterial mouthrinse we will provide for you today. It is called Peridex or Periogard and has an active ingredient called chlorhexidine gluconate at 0.12 percent. You should use this once daily just before bed at night (10 ml for one minute), but only for one week each month. You must use this at least one hour after brushing with the 5,000 ppm fluoride toothpaste.

- Have the necessary restorative work done, such as fillings or crowns, as needed, in a minimally invasive fashion.

- Suck or chew xylitol candies or gum four times daily. You can obtain supplies from us today or we can help you buy these elsewhere.

- Get sealants applied to all of the biting surfaces of your back teeth to keep them from being reinfected with the bacteria that cause dental decay. We will be happy to do this for you.

- Return when requested for a caries recall exam in three to four months to re-evaluate your progress and current caries risk.

- Participate in another caries bacterial test at your caries recall exam or earlier to compare results with your first visit. This will allow us to check whether the chlorhexidine is working satisfactorily.

- Allow us to review your use of chlorhexidine and Control RX/Prevident and oral hygiene at that visit.

- Get a thorough professional cleaning as needed for your periodontal health.

- Get new bitewing radiographs (X-rays) about every six to 18 months to check for cavities.

- Get a fluoride varnish treatment for all of your teeth every three to four months at your caries recall exams.

- Other recommendations:

Dear (Patient Z),

Our assessment indicates that you are at extreme risk of new dental decay in the near future because you have (fill in the blank) and you have severe "dry mouth" due to (fill in the blank). We want you to move to a safer situation to avoid new decay if at all possible. Please do the following right away:

- Complete a caries bacterial test with us today (as a base line before antibacterial therapy). We will know the results of this test in three days.

- Complete a saliva flow measurement to confirm your extreme dry mouth. This is a very simple test that we will complete today as part of the bacterial assessment.

- Review your dietary and oral hygiene habits with us and receive instructions about how to improve them both. The most important thing is to reduce the number of between-meal sweet snacks that contain carbohydrates, especially sugar. Substitution by snacks rich in protein, such as cheese, will also help as well as the xylitol gum or candies recommended below.

- Brush twice daily with a new strong toothpaste, either Control RX or Prevident Plus toothpaste (5,000 parts per million fluoride). We will provide you with some today. This is to be used twice daily in place of your regular toothpaste.

- Rinse for one minute, once a day with a special antibacterial mouthrinse that we will provide you with today. It is called Peridex or Periogard and has an active ingredient called chlorhexidine gluconate at 0.12 percent. You will use this once daily just before going to bed at night (10 ml for one minute), but only for one week each month. You must use this at least one hour after brushing with the 5,000 ppm fluoride toothpaste.

- Get a fluoride varnish treatment for all of your teeth every three months at your caries recall exams.

- Receive the necessary restorative work such as fillings and crowns, as needed, in a minimally invasive fashion.

- Suck or chew xylitol candies or gum four times daily. You can obtain supplies from us today or we can help you buy these elsewhere.

- Use a special paste that contains calcium and phosphate (e.g., MI paste). Apply it several times daily to your teeth. We will teach you how to do this properly.

- Obtain a thorough professional cleaning during your current visit.

- Get a sealant treatment on all of the biting surfaces of your back teeth to keep them from being reinfected with the bacteria that cause dental decay.

- Use a baking soda rinse (or similar neutralizing product) four to six times daily during the day. You can make this yourself by shaking up two teaspoons of baking soda in an eight-ounce bottle of water.

- Please return when called for a re-evaluation in about one month.

- Please return when requested for a caries recall exam in three months.

- Get new bitewing radiographs (X-rays) about every six months until no cavitated lesions are evident.

- Come in for another caries bacterial test at the three-month visit or sooner to compare results with your first visit to check whether the chlorhexidine is working satisfactorily.

- Receive a review of your use of chlorhexidine and Control RX/Prevident and oral hygiene at that visit.

- Come in for a thorough professional cleaning as needed for your periodontal health.

- Get another fluoride varnish treatment of all teeth again at three-month caries recall visit and another set of bitewing X-rays at six months.

We will provide you with a timetable to help you to remember all of these procedures.

Although this sounds like a lot of things to do and to remember, this intensive therapy is necessary to stop the rapid destruction of your teeth. It can really work, and if you are willing to put in the time and effort, you can clear up your mouth, gums, and teeth and avoid costly restorative dental work in the future. Please help us to help you.

All figures from CAMBRA are found in source 28.

Patient 1: Male, age 43.

The patient is a 43 years old man. He comes to the dentist because of discolored teeth and discomfort from some of his molars. Last visit at dental office was five years ago, he then only got a check – up. No medicines or allergies. He drinks a lot of coca cola throughout the day and smokes about ten cigarettes a day. 3 main meals per day. Clinically, many active caries lesions and erosions. Some of the caries lesions were at atypical sites. He has 28 teeth. Gingivitis and visible plaque. High number of cariogenic bacterias. Stimulated saliva a little lower than normal. Buffer capacity was medium. Brushes his teeth twice a day with fluoride tooth paste.

UIT - method

We think this patient has a high caries risk because of his many active caries attacks, some of which are located atypically. And because his oral hygiene is poor and he drinks a lot of sugared drinks with a low pH. He is a heavy smoker and his saliva is not optimal.

Recommended treatment for the patient is operative treatment for caries lesions degrees 3 – 4. Profylactic treatment should be instruction in brushing technique and use of dental floss, and motivating the patient to make dental flossing a daily habit. Recommend fluoride rinse 0.2mg/ml and application of fluoride varnish. Review the diet diary with the patient, discuss and advise how to reduce the coca cola intake and the smoking. Explain relationship between diet, bacteria and caries, and that the patient is more exposed to caries because of his not optimal saliva. Recall 6 months.

Cariogram

- **Caries experience:** Many caries lesions. 5 years since last visit to dentist. Score 3.
- **Related disease:** Healthy patient, no medicines. Score 0.
- **Diet, content:** High sugar intake. High lactobacillus counts. Score 3.
- **Diet, frequency:** High frequency of sugar intakes. Score 3.
- **Plaque, amount:** Less than good oral hygiene. Score 2.
- **Mutans streptococci**: High amount (10`5). Score 2.
- **Fluride programme:** Fluoride toothpaste only. Score 2.
- **Saliva secretion, amount:** Low (0,8ml/min). Score 2.
- **Saliva buffer capacity:** Reduced buffer capacity(green). Score 2.

- **Clinical judgement:** Score 1.
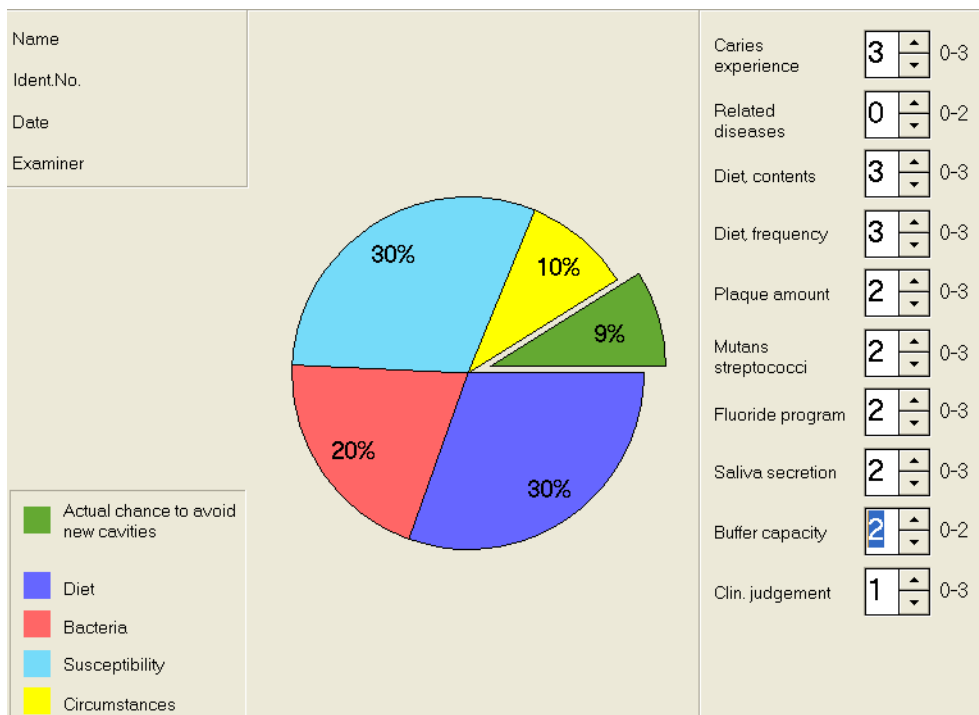
The therapy suggestion from the Cariogram:
The Cariogram indicates a Very high risk for caries. Urgent actions are needed.

Consider all parameters where score 2 or 3 have been added in the
boxes - which of them can most easily be changed to the better?
Examples of actions in this case are:

* The Diet situation with respect to both content of fermentable
  carbohydrates and frequency of eating is a clear problem - a much
  better "dietary discipline" is needed.

* The Bacterial situation with respect to both plaque amount and
  Mutans streptococci level has a heavy impact - both factors should
  be urgently controlled. Improved oral hygiene and repeated
  professional tooth cleaning is advised. For an effective reduction
  of the mutans streptococci, a Chlorhexidine gel treatment session
  is recommended.

* Due to the high caries risk, a reinforced Fluoride program in addition
  to the fluoride toothpaste is encouraged.

* The low saliva secretion rate is a major problem. Try to figure out
  the reasons behind the reduced rate and investigate if there are
  possibilities to improve the situation. If use of medicines for general
  disease is an etiological factor, discuss with patients' physician if
  alternatives are available, which do not affect saliva secretion. If

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saliva secretion cannot be improved, even more intensive efforts for other parameters must be installed.

* The buffer capacity is reduced. Try to figure out the reasons behind. Buffer capacity is partly related to saliva secretion rate. Consider possibilities to improve the situation. Smoking is one factor negatively affecting buffer capacity.

In deciding which etiological factors to try to reduce, it is important to understand WHY the particular unfavourable factors are present. Such an approach may make it easier to assess if it is possible to improve the factor or not.

For this High Risk case, it is important to follow up on actions taken to make sure they have been effectively installed. It is recommended to repeat the caries risk evaluation after about half a year.

The Cariogram expresses the over-all caries risk only. It does not take into account problems such as fractures of teeth or fillings, discolorations etc which may make new fillings necessary.

CAMBRA

Caries Risk Assessment Form — Children Age 6 and Over/Adults

Patient Name:_____ Chart #:_____ Date:_____

Assessment Date: Is this (please circle) base line   or   recall

Disease Indicators (Any one "YES" signifies likely "High Risk" and to do a bacteria test**)	YES = CIRCLE	YES = CIRCLE	YES = CIRCLE
Visible cavities or radiographic penetration of the dentin	● YES		
Radiographic approximal enamel lesions (not in dentin)	● YES		
White spots on smooth surfaces	● YES		
Restorations last 3 years	☐ YES		
Risk Factors (Biological predisposing factors)		YES	
MS and LB both medium or high (by culture**)		● YES	
Visible heavy plaque on teeth		● YES	
Frequent snack (> 3x daily between meals)		● YES	
Deep pits and fissures		YES	
Recreational drug use		YES	
Inadequate saliva flow by observation or measurement (**If measured, note the flow rate below)		● YES	
Saliva reducing factors (medications/radiation/systemic)		YES	
Exposed roots		YES	
Orthodontic appliances		YES	
Protective Factors			
Lives/work/school fluoridated community			● YES
Fluoride toothpaste at least once daily			● YES
Fluoride toothpaste at least 2x daily			YES
Fluoride mouthrinse (0.05% NaF) daily			YES
5,000 ppm F fluoride toothpaste daily			YES
Fluoride varnish in last 6 months			YES
Office F topical in last 6 months			YES
Chlorhexidine prescribed/used one week each of last 6 months			YES
Xylitol gum/lozenges 4x daily last 6 months			YES
Calcium and phosphate paste during last 6 months			YES
Adequate saliva flow (> 1 ml/min stimulated)			YES
**Bacteria/Saliva Test Results: MS: LB: Flow Rate: ml/min. Date:			

VISUALIZE CARIES BALANCE
(Use circled indicators/factors above)
(EXTREME RISK = HIGH RISK + SEVERE SALIVARY GLAND HYPOFUNCTION)
CARIES RISK ASSESSMENT (CIRCLE): EXTREME   HIGH   MODERATE   LOW

Doctor signature/#:_____ Date:_____

This patient has a high caries risk because of many active carious lesions into the dentin, initial carious lesions and his other risk factors. He only has 2 protective factors.

Treatment plan:

Dear (Patient Z),

Our assessment reveals you are at a high risk of having new dental decay in the near future because you have (fill in the blank). We want to help you to move to a safer situation to avoid new decay if at all possible. We strongly recommend the following:

■ Complete a caries bacterial test with us today (as a base line before antibacterial therapy). We will have the results of this test in three days.

■ Complete a saliva flow measurement to check for dry mouth. This is a very simple test that we will do today as part of the bacterial assessment.

■ Review with us your dietary and oral hygiene habits and receive instructions on both. The most important thing is to reduce the number of between-meal sweet snacks that contain carbohydrates, especially sugar. Substitution by snacks rich in protein, such as cheese, will also help as well as the xylitol gum or candies described below.

■ Brush twice daily with a high fluoride toothpaste, either Control RX or Prevident Plus toothpaste (5,000 parts per million fluoride). We will provide some for you today. This is to be used twice daily in place of your regular toothpaste.

■ Rinse for one minute, once a day with a special antibacterial mouthrinse we will provide for you today. It is called Peridex or Periogard and has an active ingredient called chlorhexidine gluconate at 0.12 percent. You should use this once daily just before bed at night (10 ml for one minute), but only for one week each month. You must use this at least one hour after brushing with the 5,000 ppm fluoride toothpaste.

■ Have the necessary restorative work done, such as fillings or crowns, as needed, in a minimally invasive fashion.

■ Suck or chew xylitol candies or gum four times daily. You can obtain supplies from us today or we can help you buy these elsewhere.

■ Get sealants applied to all of the biting surfaces of your back teeth to keep them from being reinfected with the bacteria that cause dental decay. We will be happy to do this for you.

■ Return when requested for a caries recall exam in three to four months to re-evaluate your progress and current caries risk.

■ Participate in another caries bacterial test at your caries recall exam or earlier to compare results with your first visit. This will allow us to check whether the chlorhexidine is working satisfactorily.

■ Allow us to review your use of chlorhexidine and Control RX/Prevident and oral hygiene at that visit.

■ Get a thorough professional cleaning as needed for your periodontal health.

■ Get new bitewing radiographs (X-rays) about every six to 18 months to check for cavities.

■ Get a fluoride varnish treatment for all of your teeth every three to four months at your caries recall exams.

■ Other recommendations:

Patient 2: Female, age 20, student.

The patient comes to the clinic for a examination. She is healthy and does not use any medications. Last examination was 1 year earlier and then she got her first little filling. The patient has 3 initial caries lesions which have been there for several years. 28 teeth. DMFT: 2. The deep fissures are sealed. Fluoride toothpaste twice a day and additional fluoride rinse every day. Tooth floss every day. Good oral hygiene. The diet consists of 4 main meals, but in the weekend there can be some snacks in between meals. She does not drink juice and only rarely soda. Salivary secretion rate was within normal range and the bacteria levels are moderate.

UIT – method

We think this patients` caries risk is low because of the low previous caries activity, the good oral hygiene and use of fluoride. The diet is not particularly cariogenic and she is going regularly to the dentist. Salivary secretion rate and buffer capacity is good.

Recommended treatment: fluoride varnish on initial carious lesions and motivating the patient to continue with good oral hygiene. Recall 18 months.

Cariogram

- **Caries experience:** Better than normal for age group. Score 1.
- **Related disease:** Healthy patient, no medicines. Score 0.
- **Diet, content:** Low fermentable carbohydrate. Sugars or other caries inducing carbohydrates on a low level. Medium level of lactobacillus (10^4). Score 1.
- **Diet, frequency:** Low diet intake frequency. Score 1 .
- **Plaque, amount:** Good oral hygiene. Score 1.
- **Mutans streptococci:** Low level (10`4). Score 1.
- **Fluride programme:** Fluoride toothpaste and rinse daily. Score 0.
- **Saliva secretion, amount:** Normal (1,3ml/min). Score 0.
- **Saliva buffer capacity:** Good buffer capacity (blue). Score 0.
- **Clinical judgement:** Score 1.

Name	Caries experience	1 ▲▼ 0-3
Ident.No.	Related diseases	0 ▲▼ 0-2
Date	Diet, contents	1 ▲▼ 0-3
Examiner	Diet, frequency	1 ▲▼ 0-3
	Plaque amount	1 ▲▼ 0-3
94%	Mutans streptococci	1 ▲▼ 0-3
2%	Fluoride program	0 ▲▼ 0-3
2%	Saliva secretion	0 ▲▼ 0-3
	Buffer capacity	0 ▲▼ 0-2
	Clin. judgement	1 ▲▼ 0-3

■ Actual chance to avoid new cavities
■ Diet
■ Bacteria
■ Susceptibility
■ Circumstances
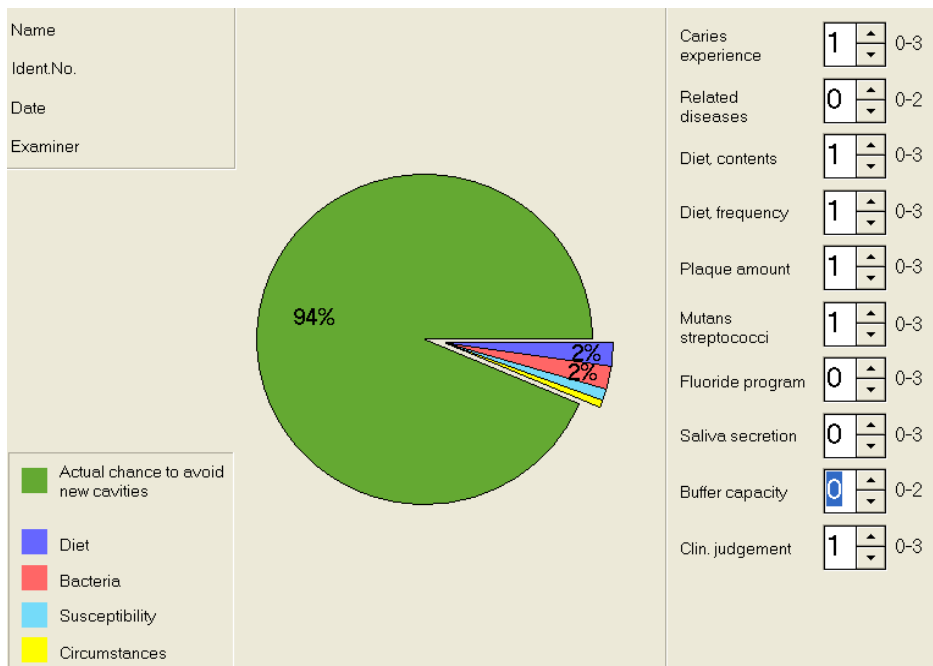
The Cariogram indicates a Low risk for caries.
If there is an interest to even further try to minimize the risk, consider all parameters where scores higher than 0 or 1 have been added in the boxes
 - can any of them be changed to the better?
The factors contributing to the positive situation should be explained to the patient. It should be observed that the risk profile for a specific surface may be different from the over-all picture revealed by the Cariogram. Preventive actions for any surface possibly showing progressing caries is encouraged. The Cariogram expresses the over-all caries risk only. It does not take into account problems such as fractures of teeth or fillings, discolorations etc which may make new fillings necessary.
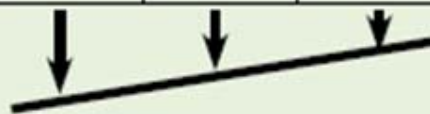
CAMBRA

TABLE 1

Caries Risk Assessment Form — Children Age 6 and Over/Adults

Patient Name: _____ Chart #: _____ Date: _____

Assessment Date: Is this (please circle) base line   or   recall

Disease Indicators (Any one "YES" signifies likely "High Risk" and to do a bacteria test**)	YES = CIRCLE	YES = CIRCLE	YES = CIRCLE
Visible cavities or radiographic penetration of the dentin	YES		
Radiographic approximal enamel lesions (not in dentin)	● YES		
White spots on smooth surfaces	● YES		
Restorations last 3 years	● YES		
Risk Factors (Biological predisposing factors)		YES	
MS and LB both medium or high (by culture**)		● YES	
Visible heavy plaque on teeth		YES	
Frequent snack (> 3x daily between meals)		YES	
Deep pits and fissures		● YES	
Recreational drug use		YES	
Inadequate saliva flow by observation or measurement (**If measured, note the flow rate below)		YES	
Saliva reducing factors (medications/radiation/systemic)		YES	
Exposed roots		YES	
Orthodontic appliances		YES	
Protective Factors			
Lives/work/school fluoridated community			● YES
Fluoride toothpaste at least once daily			● YES
Fluoride toothpaste at least 2x daily			● YES
Fluoride mouthrinse (0.05% NaF) daily			● YES
5,000 ppm F fluoride toothpaste daily			YES
Fluoride varnish in last 6 months			● YES
Office F topical in last 6 months			YES
Chlorhexidine prescribed/used one week each of last 6 months			YES
Xylitol gum/lozenges 4x daily last 6 months			YES
Calcium and phosphate paste during last 6 months			YES
Adequate saliva flow (> 1 ml/min stimulated)			● YES

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

↓ ↓ ↗

VISUALIZE CARIES BALANCE
(Use circled indicators/factors above)
(EXTREME RISK – HIGH RISK + SEVERE SALIVARY GLAND HYPOFUNCTION)
CARIES RISK ASSESSMENT (CIRCLE): EXTREME   HIGH   MODERATE   LOW

Doctor signature/#: _____   Date: _____

According to CAMBRA, this patient has a moderate risk because of the 2 initial carious lesions (caries active) and a few other risk factors. She is not in a high risk group because of many protective factors and that she doesn`t have caries that needs restorative treatment.

Treatment plan:

Dear (Patient Y),

You have been assessed to be at moderate risk for new dental decay in the near future because you have (fill in the blank). We want you to move into a safer situation to avoid new decay in the future. Here are some ways to accomplish this goal:

- Review your dietary and oral hygiene habits with us and receive oral hygiene instructions.

- Brush twice daily with an over-the-counter fluoride-containing toothpaste, following the oral hygiene instruction procedures you have been given.

- Purchase an over-the-counter fluoride rinse (0.05 percent sodium fluoride, e.g. Fluorigard or ACT) and rinse with 10 ml (one cap full) once or twice daily after you have used your fluoride toothpaste. Continue daily until your next dental exam.

- Get a thorough professional cleaning from us as needed for your periodontal health.

- Chew or suck xylitol-containing gum or candies four times daily.

- Return when requested for a caries recall exam in four to six months to re-evaluate your progress and current caries risk.

- Get new bitewing radiographs (X-rays) about every 18-24 months to check for cavities.

- Get a fluoride varnish treatment every four to six months at your caries recall exams.

- You may also need a base line bacterial test and sealants (depending on your situation and condition).

- Other recommendations:

Patient 3: Female, age 21, student.

The patient comes to the clinic for an examination. 2 initial carious lesions in her wisdom teeth. 32 teeth. DMFT: 4. Healthy and no medications. Uses fluoride tooth paste twice a day and daily fluoride rinse. Tooth floss every day. Good oral hygiene. 4 main meals a day and some in between healthy snacks (fruit). Sugar free gum between meals. Salivary secretion rate and buffer capacity is moderate. High levels of MS and low levels of LBC.
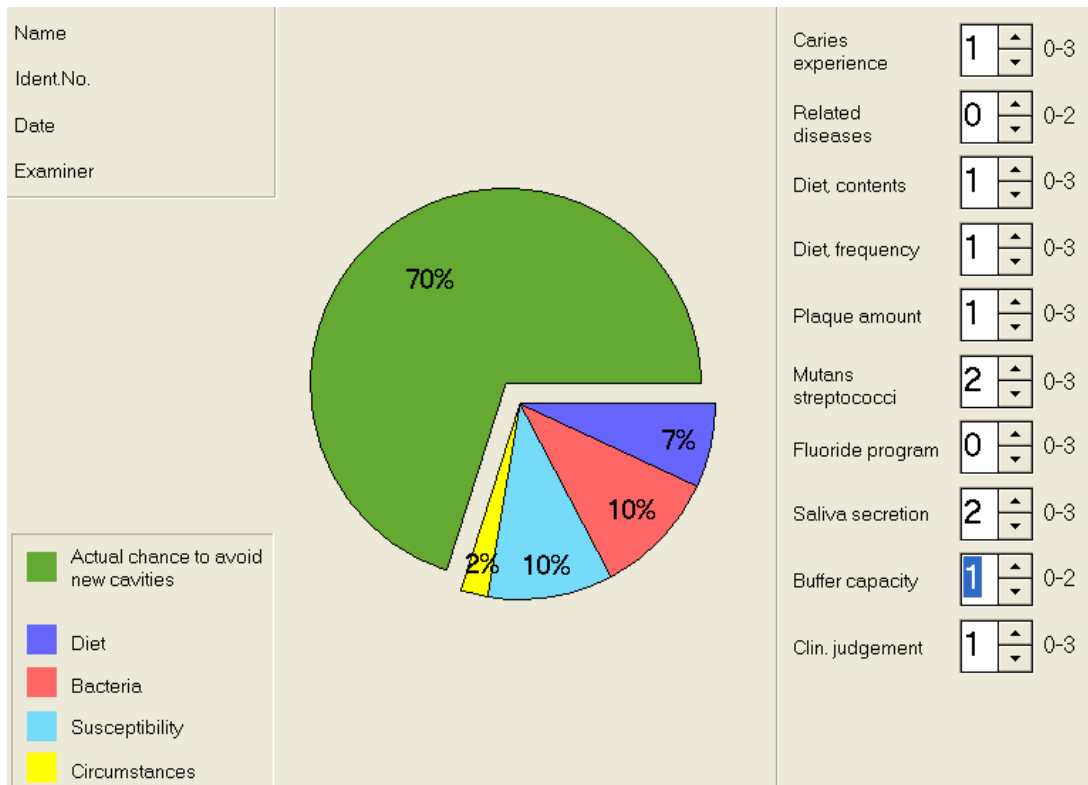
UIT – method

We think this patient has a low – moderate caries risk . The factors that increase the risk are the reduced salivary flow rate and buffer capacity, the high MS levels and the 4 previous fillings. The risk is less then moderate because of her good oral hygiene, use of fluoride, no initial lesions eccept in the wisdom teeth, and the diet.
Recommended treatment: fluoride varnish on initial lesions and motivating the patient to continue with good oral hygiene. Recommend solo brush on wisdom teeth. Recall 12 months.

Cariogram

- **Caries experience:** better than normal for age group. Score 1.
- **Related disease:** Healthy patient, no medicines. Score 0.
- **Diet, content:** Low fermentable carbohydrate. Sugars or other caries inducing carbohydrates on a low level. Low level of lactobacillus (10^3). Score 1.
- **Diet, frequency:** Low diet intake frequency. Score 1 .
- **Plaque, amount:** Good oral hygiene. Score 1.
- **Mutans streptococci:** High level (10`6). Score 2.
- **Fluride programme:** Fluoride toothpaste and rinse daily. Score 0.
- **Saliva secretion, amount:** Low (0,8ml/min). Score 2.
- **Saliva buffer capacity:** Medium buffer capacity (green). Score 1.
- **Clinical judgement:** Score 1.

Name		Caries experience	1 ⬍ 0-3
Ident.No.		Related diseases	0 ⬍ 0-2
Date		Diet, contents	1 ⬍ 0-3
Examiner		Diet, frequency	1 ⬍ 0-3

70%

7%

10%

2% 10%

Actual chance to avoid new cavities

Diet

Bacteria

Susceptibility

Circumstances

Plaque amount   1 ⬍ 0-3
Mutans streptococci   2 ⬍ 0-3
Fluoride program   0 ⬍ 0-3
Saliva secretion   2 ⬍ 0-3
Buffer capacity   1 ⬍ 0-2
Clin. judgement   1 ⬍ 0-3

The Cariogram indicates a rather Low risk for caries. Some actions could further lower the risk.

If there is an interest to further minimize the risk, consider all parameters where scores higher than 0 or 1 have been added in the boxes - can any of them be changed to the better?

* Although caries risk is low, the Mutans streptococci level is high. It is a potential risk factor. If any caries lesions are progressing, local fluoride and chlorhexidine treatments could be considered.

* The saliva secretion rate is low. Try to figure out the reasons behind the reduced rate and investigate if there are possibilities to improve the situation.

* The buffer capacity is reduced. Try to figure out the reasons behind. Buffer capacity is partly related to saliva secretion rate. Smoking is one factor negatively affecting buffer capacity.

The factors contributing to the positive situation should be explained to the patient. It should be observed that the risk profile for a specific surface may be different from the over-all picture revealed by the Cariogram. Preventive actions for any surface showing progressing caries is encouraged.

The Cariogram expresses the over-all caries risk only. It does not take into account problems such as fractures of teeth or fillings, discolorations

etc which may make new fillings necessary.

CAMBRA

TABLE 1

Caries Risk Assessment Form — Children Age 6 and Over/Adults

Patient Name: _____ Chart #: _____ Date: _____

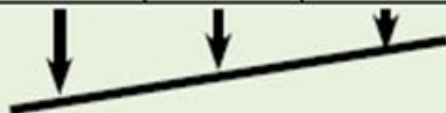Assessment Date: Is this (please circle) base line   or   recall

Disease Indicators (Any one "YES" signifies likely "High Risk" and to do a bacteria test**)	YES = CIRCLE	YES = CIRCLE	YES = CIRCLE
Visible cavities or radiographic penetration of the dentin	YES		
Radiographic approximal enamel lesions (not in dentin)	● YES		
White spots on smooth surfaces	● YES		
Restorations last 3 years	YES		
Risk Factors (Biological predisposing factors)		YES	
MS and LB both medium or high (by culture**)		● YES	
Visible heavy plaque on teeth		YES	
Frequent snack (> 3x daily between meals)		YES	
Deep pits and fissures		YES	
Recreational drug use		YES	
Inadequate saliva flow by observation or measurement (**If measured, note the flow rate below)		● YES	
Saliva reducing factors (medications/radiation/systemic)		YES	
Exposed roots		YES	
Orthodontic appliances		YES	
Protective Factors			
Lives/work/school fluoridated community			● YES
Fluoride toothpaste at least once daily			● YES
Fluoride toothpaste at least 2x daily			● YES
Fluoride mouthrinse (0.05% NaF) daily			● YES
5,000 ppm F fluoride toothpaste daily			YES
Fluoride varnish in last 6 months			YES
Office F topical in last 6 months			YES
Chlorhexidine prescribed/used one week each of last 6 months			YES
Xylitol gum/lozenges 4x daily last 6 months			YES
Calcium and phosphate paste during last 6 months			YES
Adequate saliva flow (> 1 ml/min stimulated)			YES
**Bacteria/Saliva Test Results: MS: LB: Flow Rate: ml/min. Date:			

VISUALIZE CARIES BALANCE
(Use circled indicators/factors above)
(EXTREME RISK – HIGH RISK + SEVERE SALIVARY GLAND HYPOFUNCTION)
CARIES RISK ASSESSMENT (CIRCLE): EXTREME   HIGH   MODERATE   LOW

Doctor signature/#: _____   Date: _____

This patient has a moderat risk level because of the 2 initial lesions and some risk factors. She also has several protective factors and is therefore not a high risk patient.

Treatment plan:

Dear (Patient Y),

You have been assessed to be at moderate risk for new dental decay in the near future because you have (fill in the blank). We want you to move into a safer situation to avoid new decay in the future. Here are some ways to accomplish this goal:

- Review your dietary and oral hygiene habits with us and receive oral hygiene instructions.
- Brush twice daily with an over-the-counter fluoride-containing toothpaste, following the oral hygiene instruction procedures you have been given.
- Purchase an over-the-counter fluoride rinse (0.05 percent sodium fluoride, e.g. Fluorigard or ACT) and rinse with 10 ml (one cap full) once or twice daily after you have used your fluoride toothpaste. Continue daily until your next dental exam.
- Get a thorough professional cleaning from us as needed for your periodontal health.
- Chew or suck xylitol-containing gum or candies four times daily.
- Return when requested for a caries recall exam in four to six months to re-evaluate your progress and current caries risk.
- Get new bitewing radiographs (X-rays) about every 18-24 months to check for cavities.
- Get a fluoride varnish treatment every four to six months at your caries recall exams.
- You may also need a base line bacterial test and sealants (depending on your situation and condition).
- Other recommendations:

Patient 4: Male, age 31

Comes to the clinic for examination, the last was in 2002. Healthy and no medications. Fluoride tooth paste twice a day and daily tooth flossing. Poor oral hygiene according plaque index. He has 12 initial carious lesions and 3 manifest carious lesions. 29 teeth. DMFT: 7. Few main meals and many in between snacks (coffee, coca cola, chocolate). Salivary secretion rate and buffer capacity within normal range. High levels of bacteria.
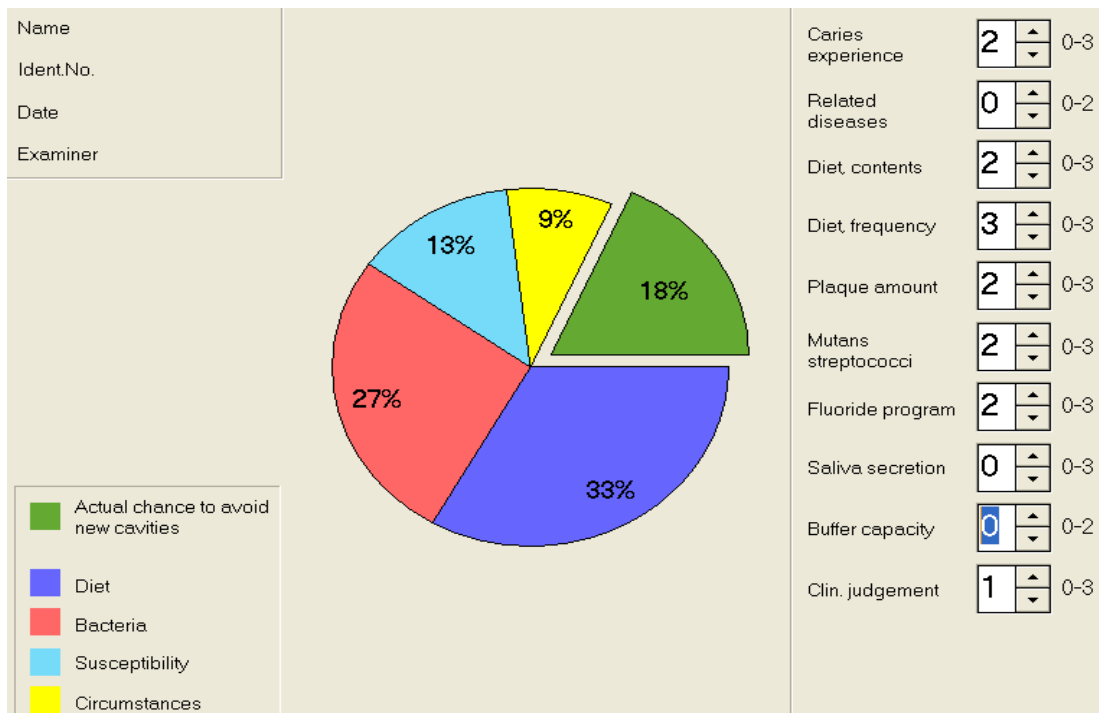
UIT – method

We think the patient has a high caries risk because of poor oral hygiene, many initial lesions, cariogenic diet and high levels of cariogenic bacteria.

Recommended treatment: instruction and motivation in proper oral hygiene (brushing and flossing technique). Daily fluoride rinse (0,2 %). Fluoride varnish on initial lesions. Operative treatment of manifest carious lesions. Motivate the patient to reduse coca cola intake, could be replaced with water and fruit/ vegetables. Explain relationship between diet, bacteria and caries. Recall 6 months.

Cariogram

- **Caries experience:** normal for age group. Score 2.
- **Related disease:** Healthy patient, no medicines. Score 0.
- **Diet, content:** Moderate fermentable carbohydrate content. Moderate level of lactobacillus (10^3). Score 2.
- **Diet, frequency:** Very high diet intake frequency. Score 3.
- **Plaque, amount:** Less than good. Moderate accumulation of soft deposits, can be seen by naked eye. Score 2.
- **Mutans streptococci:** High level (10^6). Score 2.
- **Fluride programme:** Fluoride toothpaste only. Score 2.
- **Saliva secretion, amount:** Normal (1,2 ml/min). Score 0.
- **Saliva buffer capacity:** Good buffer capacity (blue). Score 0.
- **Clinical judgement:** Score 1.

The Cariogram indicates a Very high risk for caries. Urgent actions are needed. Consider all parameters where score 2 or 3 have been added in the boxes - which of them can most easily be changed to the better?
Examples of actions in this case are:

* The Diet situation with respect to both content of fermentable carbohydrates and frequency of eating is a clear problem - a much better "dietary discipline" is needed.

* The Bacterial situation with respect to both plaque amount and Mutans streptococci level has a heavy impact - both factors should be urgently controlled. Improved oral hygiene and repeated professional tooth cleaning is advised. For an effective reduction of the mutans streptococci, a Chlorhexidine gel treatment session is recommended.

* Due to the high caries risk, a reinforced Fluoride program in addition to the fluoride toothpaste is encouraged.

In deciding which etiological factors to try to reduce, it is important to understand WHY the particular unfavourable factors are present. Such an approach may make it easier to assess if it is possible to improve the factor or not.

For this High Risk case, it is important to follow up on actions taken, to make sure they have been effectively installed. It is recommended to repeat the caries risk evaluation after about half a year.

The Cariogram expresses the over-all caries risk only. It does not take into account problems such as fractures of teeth or fillings, discolorations etc which may make new fillings necessary.

CAMBRA

TABLE 1

Caries Risk Assessment Form — Children Age 6 and Over/Adults

Patient Name: _____ Chart #: _____ _____ Date: _____ _____ _____ _____
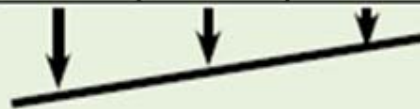
Assessment Date: Is this (please circle) base line   or   recall

Disease Indicators (Any one "YES" signifies likely "High Risk" and to do a bacteria test**)	YES = CIRCLE	YES = CIRCLE	YES = CIRCLE
Visible cavities or radiographic penetration of the dentin	● YES		
Radiographic approximal enamel lesions (not in dentin)	● YES		
White spots on smooth surfaces	● YES		
Restorations last 3 years	YES		
Risk Factors (Biological predisposing factors)		YES	
MS and LB both medium or high (by culture**)		● YES	
Visible heavy plaque on teeth		● YES	
Frequent snack (> 3x daily between meals)		● YES	
Deep pits and fissures		YES	
Recreational drug use		YES	
Inadequate saliva flow by observation or measurement (**If measured, note the flow rate below)		YES	
Saliva reducing factors (medications/radiation/systemic)		YES	
Exposed roots		YES	
Orthodontic appliances		YES	
Protective Factors			
Lives/work/school fluoridated community			● YES
Fluoride toothpaste at least once daily			● YES
Fluoride toothpaste at least 2x daily			● YES
Fluoride mouthrinse (0.05% NaF) daily			YES
5,000 ppm F fluoride toothpaste daily			YES
Fluoride varnish in last 6 months			YES
Office F topical in last 6 months			YES
Chlorhexidine prescribed/used one week each of last 6 months			YES
Xylitol gum/lozenges 4x daily last 6 months			YES
Calcium and phosphate paste during last 6 months			YES
Adequate saliva flow (> 1 ml/min stimulated)			● YES
Bacteria/Saliva Test Results: MS: LB: Flow Rate: ml/min. Date:			

VISUALIZE CARIES BALANCE
(Use circled indicators/factors above)
(EXTREME RISK = HIGH RISK + SEVERE SALIVARY GLAND HYPOFUNCTION)
CARIES RISK ASSESSMENT (CIRCLE): EXTREME   HIGH   MODERATE   LOW

Doctor signature/#: _____ _____ _____ _____ _____ Date: _____ _____ _____ _____

This patient has a high caries risk because of several caries lesions into the dentin and many initial lesions. He has some protective factors.

Treatment plan:

Dear (Patient Z),

Our assessment reveals you are at a high risk of having new dental decay in the near future because you have (fill in the blank). We want to help you to move to a safer situation to avoid new decay if at all possible. We strongly recommend the following:

- Complete a caries bacterial test with us today (as a base line before antibacterial therapy). We will have the results of this test in three days.

- Complete a saliva flow measurement to check for dry mouth. This is a very simple test that we will do today as part of the bacterial assessment.

- Review with us your dietary and oral hygiene habits and receive instructions on both. The most important thing is to reduce the number of between-meal sweet snacks that contain carbohydrates, especially sugar. Substitution by snacks rich in protein, such as cheese, will also help as well as the xylitol gum or candies described below.

- Brush twice daily with a high fluoride toothpaste, either Control RX or Prevident Plus toothpaste (5,000 parts per million fluoride). We will provide some for you today. This is to be used twice daily in place of your regular toothpaste.

- Rinse for one minute, once a day with a special antibacterial mouthrinse we will provide for you today. It is called Peridex or Periogard and has an active ingredient called chlorhexidine gluconate at 0.12 percent. You should use this once daily just before bed at night (10 ml for one minute), but only for one week each month. You must use this at least one hour after brushing with the 5,000 ppm fluoride toothpaste.

- Have the necessary restorative work done, such as fillings or crowns, as needed, in a minimally invasive fashion.

- Suck or chew xylitol candies or gum four times daily. You can obtain supplies from us today or we can help you buy these elsewhere.

- Get sealants applied to all of the biting surfaces of your back teeth to keep them from being reinfected with the bacteria that cause dental decay. We will be happy to do this for you.

- Return when requested for a caries recall exam in three to four months to re-evaluate your progress and current caries risk.

- Participate in another caries bacterial test at your caries recall exam or earlier to compare results with your first visit. This will allow us to check whether the chlorhexidine is working satisfactorily.

- Allow us to review your use of chlorhexidine and Control RX/Prevident and oral hygiene at that visit.

- Get a thorough professional cleaning as needed for your periodontal health.

- Get new bitewing radiographs (X-rays) about every six to 18 months to check for cavities.

- Get a fluoride varnish treatment for all of your teeth every three to four months at your caries recall exams.

- Other recommendations:

Patient 5: Male, age 32.

Comes to the student clinic because he wants an occlusal splint. Healthy and no medications. Fluoride tooth paste twice a day, no additional fluoride or tooth floss. 2 initial carious lesions. 28 teeth. Erosion into the dentin on most teeth. DMFT: 12. 3 main meals per day. He drinks coca cola up to several times every day. Salivary secretion rate normal and buffer capacity medium – high. High MS levels and moderate LBC levels.
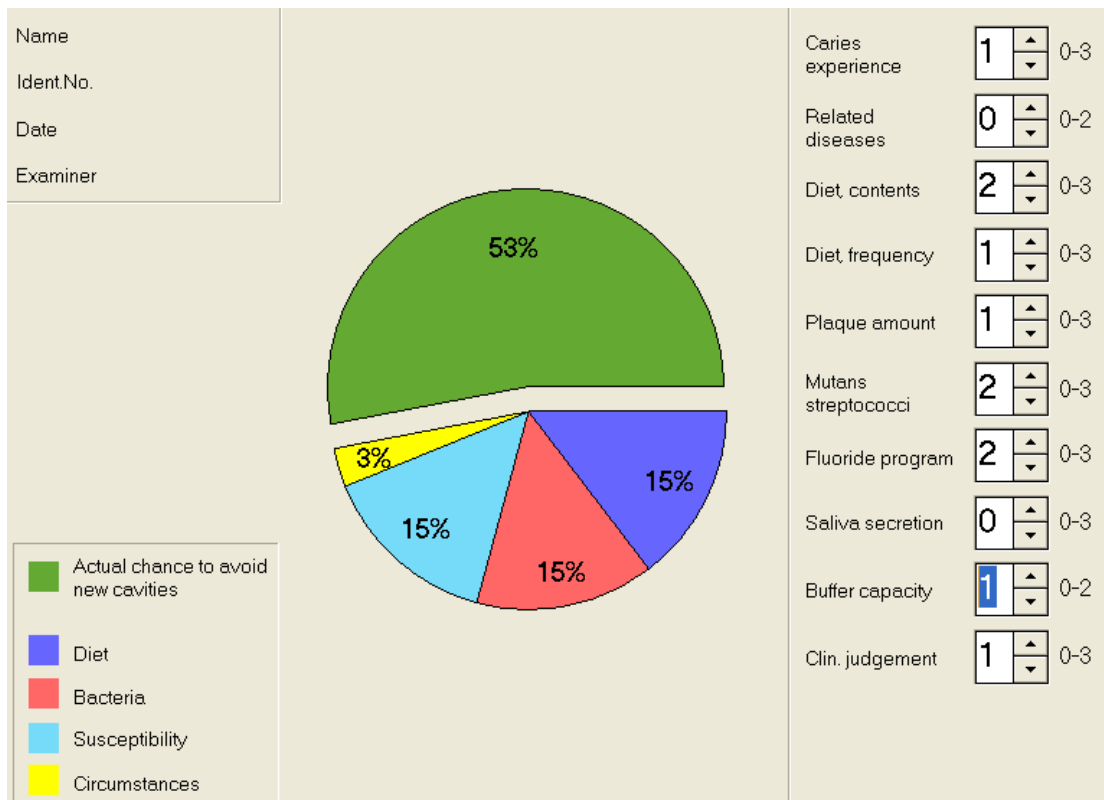
UIT – method

We think this patient has a low – moderate caries risk. The daily coca cola intake, high level of MS, erosion damages increases the risk. While, low plaque levels, good salivary secretion rate and low frequency of meals, reduces the risk.

Recommended treatment: Restorative treatment for erosions. Increase fluoride supply and instruct and motivate to use dental floss. Fluoride varnish on initial lesions. Motivate patient to reduce coca cola intake, suggest alternatives.

Cariogram

- **Caries experience:** better than normal for age group. Score 1.
- **Related disease:** Healthy patient, no medicines. Score 0.
- **Diet, content:** Moderate fermentable carbohydrate content. Moderate level of lactobacillus (10^3). Score 2.
- **Diet, frequency:** Low diet intake frequency. Score 1.
- **Plaque, amount:** Good oral hygiene. A film of plaque adhering to the free gingival margin and adjacent area of the tooth. Score 1.
- **Mutans streptococci:** High level (10`6). Score 2.
- **Fluride programme:** Fluoride toothpaste only. Score 2.
- **Saliva secretion, amount:** Normal (1,7 ml/min). Score 0.
- **Saliva buffer capacity:** Moderate - good buffer capacity (green -blue). Score 1.
- **Clinical judgement:** Score 1.

Name		Caries experience	1 ⊕	0-3
Ident.No.		Related diseases	0 ⊕	0-2
Date		Diet, contents	2 ⊕	0-3
Examiner		Diet, frequency	1 ⊕	0-3
		Plaque amount	1 ⊕	0-3
		Mutans streptococci	2 ⊕	0-3
		Fluoride program	2 ⊕	0-3
		Saliva secretion	0 ⊕	0-3
		Buffer capacity	1 ⊕	0-2
		Clin. judgement	1 ⊕	0-3

Pie chart values: 53%, 15%, 15%, 15%, 3%

Legend:
- Actual chance to avoid new cavities
- Diet
- Bacteria
- Susceptibility
- Circumstances

The Cariogram indicates an Intermediate risk for caries. Actions are recommended to reduce the risk.
Consider all parameters where score 2 or 3 have been added in the boxes
- which of them can most easily be changed to the better? Examples of actions in this case are:

* The Diet with respect to its content of fermentable carbohydrates is a problem - a reduced intake of such products would be an advantage.

* The Bacterial situation with respect to counts of Mutans streptococci is one of the problems. If any caries lesions are progressing, local fluoride and chlorhexidine treatments could be considered.

* A reinforced fluoride program in addition to the fluoride toothpaste is one possible action to reduce the caries risk.

* The buffer capacity is reduced. Try to figure out the reasons behind. Buffer capacity is partly related to saliva secretion rate. Consider possibilities to improve the situation. Smoking is one factor negatively affecting buffer capacity.

In deciding which etiological factors to try to reduce, it is important to understand WHY the particular unfavourable factors are present. Such an approach may make it easier to assess if it is possible to improve the

factor or not.

As a border-line risk case, it is recommended to follow up on the results of the actions installed. It should be observed that the risk profile for a specific surface may be different from the over-all picture revealed by the Cariogram. Preventive actions for any surface showing progressing caries is encouraged.

The Cariogram expresses the over-all caries risk only. It does not take into account problems such as fractures of teeth or fillings, discolorations etc which may make new fillings necessary.
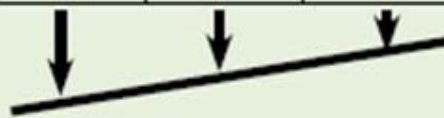
CAMBRA

TABLE 1

Caries Risk Assessment Form — Children Age 6 and Over/Adults

Patient Name: _____ Chart #: _____ Date: _____

Assessment Date: Is this (please circle) base line or recall

Disease Indicators (Any one "YES" signifies likely "High Risk" and to do a bacteria test**)	YES = CIRCLE	YES = CIRCLE	YES = CIRCLE
Visible cavities or radiographic penetration of the dentin	YES		
Radiographic approximal enamel lesions (not in dentin)	● YES		
White spots on smooth surfaces	● YES		
Restorations last 3 years	● YES		
Risk Factors (Biological predisposing factors)		YES	
MS and LB both medium or high (by culture**)		● YES	
Visible heavy plaque on teeth		YES	
Frequent snack (> 3x daily between meals)		YES	
Deep pits and fissures		YES	
Recreational drug use		YES	
Inadequate saliva flow by observation or measurement (**If measured, note the flow rate below)		YES	
Saliva reducing factors (medications/radiation/systemic)		YES	
Exposed roots		YES	
Orthodontic appliances		YES	
Protective Factors			
Lives/work/school fluoridated community			● YES
Fluoride toothpaste at least once daily			● YES
Fluoride toothpaste at least 2x daily			● YES
Fluoride mouthrinse (0.05% NaF) daily			YES
5,000 ppm F fluoride toothpaste daily			YES
Fluoride varnish in last 6 months			YES
Office F topical in last 6 months			YES
Chlorhexidine prescribed/used one week each of last 6 months			YES
Xylitol gum/lozenges 4x daily last 6 months			YES
Calcium and phosphate paste during last 6 months			YES
Adequate saliva flow (> 1 ml/min stimulated)			● YES
**Bacteria/Saliva Test Results: MS: LB: Flow Rate: ml/min. Date:			

VISUALIZE CARIES BALANCE
(Use circled indicators/factors above)
(EXTREME RISK = HIGH RISK + SEVERE SALIVARY GLAND HYPOFUNCTION)
CARIES RISK ASSESSMENT (CIRCLE): EXTREME   HIGH   MODERATE   LOW

Doctor signature/#: _____   Date: _____

This patient has a moderate caries risk because of several initial caries lesions and high bacteria level. He has several protective factors also.

Dear (Patient Y),

You have been assessed to be at moderate risk for new dental decay in the near future because you have (fill in the blank). We want you to move into a safer situation to avoid new decay in the future. Here are some ways to accomplish this goal:

- Review your dietary and oral hygiene habits with us and receive oral hygiene instructions.

- Brush twice daily with an over-the-counter fluoride-containing toothpaste, following the oral hygiene instruction procedures you have been given.

- Purchase an over-the-counter fluoride rinse (0.05 percent sodium fluoride, e.g. Fluorigard or ACT) and rinse with 10 ml (one cap full) once or twice daily after you have used your fluoride toothpaste. Continue daily until your next dental exam.

- Get a thorough professional cleaning from us as needed for your periodontal health.

- Chew or suck xylitol-containing gum or candies four times daily.

- Return when requested for a caries recall exam in four to six months to re-evaluate your progress and current caries risk.

- Get new bitewing radiographs (X-rays) about every 18-24 months to check for cavities.

- Get a fluoride varnish treatment every four to six months at your caries recall exams.

- You may also need a base line bacterial test and sealants (depending on your situation and condition).

- Other recommendations:

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