CAMBRA Comes of Age
Results From a Practice-Based Research Network Study

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One spring day years ago, sometime in the middle of my professional career, I attended two meetings of my component dental society on the same Saturday. The collection of members attending each event did not have a lot of overlap.

The morning meeting was a sealant clinic and was attended predominantly by new dentists. This meeting was high energy and fun. During the breaks, I chatted with my new colleagues and found out what was happening in their families and careers. Many talked about their career transitions. They were becoming the new owners of existing practices. The greatest problem they were experiencing was achieving the respect/authority of the office staff. In many cases, the retiring dentist was still at the practice for some portion of the week. They found that when the retiring dentist was present, the staff tended to defer and cater to the former owner. This is easy to understand. After all, who had signed their paychecks for years? Who had welcomed them into the team they had enjoyed working with for so long? Who had given direction, answered questions and set the standards? Who had become the central figure in their professional family? It is perfectly natural to find it difficult to shift responsibilities, authority, respect and loyalty to a “newcomer.”

They found that when the retiring dentist was present, the staff tended to defer and cater to the former owner. This is easy to understand. After all, who had signed their paychecks for years? Who had welcomed them into the team they had enjoyed working with for so long? Who had given direction, answered questions and set the standards? Who had become the central figure in their professional family? It is perfectly natural to find it difficult to shift responsibilities, authority, respect and loyalty to a “newcomer.”

Practice transitions can be bumpy. The attitudes and behaviors of both the new dentist and the retiring dentist may not facilitate a smooth transition. There are a myriad of psychosocial variables that may turn into potholes along the practice transition road.

But back to that spring day years ago. The evening came and I attended a strategic planning session with the component leadership. There were no new dentists at this meeting (that lack of diversity was an agenda item for discussion). During a break, I spoke with a friend who had just brought on an associate with the idea of eventually transitioning his practice to the new dentist. My friend was very happy. He said he looked forward to reducing his workdays and handing over the administration headaches to the new dentist. He said he would still be there to give advice to his new associate and see patients a few days a week. (This sounded a lot like the problematic situation that the new dentists in the morning had been describing.) When I saw this same colleague a few months later, he was back to full-time practice and said the transition had not worked out.

These different perspectives on practice transition struck me. Two sets of people were looking at the same professional career event. Yet they both saw it from different standpoints. It seemed like both groups were experiencing a parallax effect. (The apparent displacement of an object as seen from two different points not on a straight line with the object.) The practice is the same but the background shifts from viewer to viewer.

I can see from my own history that it is as important to make a mistake and learn from it as it is to avoid a mistake and miss the opportunity to improve by learning from that mistake.

The new dentist is looking at a successful practice against a backdrop of the future. He sees it in a context where he is in the leadership position with an opportunity to institute modern advances in technology and practice. The retiring dentist sees the same practice against the backdrop of the past. He is sure that the new dentist will benefit from his past success and his seasoned advice. He is sure the new dentist can pick up right where he leaves off. Both positions are understandable and partially true. However, the parallax effect can contribute to a bumpy transition or it can render a successful transition impossible.

Dentistry is a caring profession. Our goal is to provide the best care possible to our patients. We take seriously our duty of care and tend to think no one can care for our patients like we do. We may interpret as faulty or substandard any variation from how we connect with our patients professionally or emotionally.

The transition transaction includes two parties. Both parties want to be the practitioner the patient can confidently trust and rely on for excellent patient-centered care. However, these two parties may have differing views of their roles in relation to one another. The mentor/protégé relationship may not mean the same thing to each party.
When I was looking for a position right out of dental school, I had an interview with a colleague who wanted to shift all his lowest reimbursement-plan patients to a new dentist. He offered me the position and said the new-dentist position would receive 25 percent of collections for a plan that did not reimburse for many procedures. He also advised that the new dentist’s low compensation would be due to the fact that he would be teaching the new dentist so much about practicing dentistry successfully. (I did not take the position but I had to look in the mirror after that interview to make sure I did not have the letters F-O-O-L written across my forehead.) This was not my idea of a mentor and I did not want to “learn” how to take advantage of others. The uncollegial manner of this colleague stayed with me and, to this day, tempers my advice to new dentists.

I think twice before I offer advice from my experience. I understand now that I can learn a lot from new dentists. Not only have they been trained in the most up-to-date technology, they are part of the world from which most new patients come. It is true, I have benefited from the role models offered by some of my established colleagues. However, some things one just has to experience to appreciate. I can see from my own history that it is as important to make a mistake and learn from it as it is to avoid a mistake and miss the opportunity to improve by learning from that mistake.

Some think that connecting participants for practice transition should be like a dating service, matching up new dentists with retiring dentists based on similar treatment or practice philosophies. This could help reduce the parallax effect. But this model relies on a matchmaker or a matchmaking algorithm to try to reach a successful transition, sort of like a go-between arranging a successful marriage. However, similar philosophies may not address the real issue. The real “marriage” here is not between the retiring dentist and the new dentist. The real marriage is between the practice’s patient population and the new dentist.

The problem is the retiring dentist has to be able to gracefully let go and the new dentist has to gracefully take over. It is very difficult to harmonize a patient’s impression of his “old” dentist — “No one will ever take care of me as well as you did,” — with the patient’s exuberant satisfaction with his “new” dentist — “Wow, you take better care of me than anyone ever before.” Reconciling those conflicting patient-satisfaction goals is hard. Transitioning your patients to the care of another can summon feelings not unlike the aching, conflicted feeling of giving away your child in marriage. You want your patients to be happy and well cared for, but you want them to like you best.

According to CDA figures, on average 233 dentists retire every year. Some of those retiring dentists may just close the doors to their practices; some may hand them over to their children or sell to some corporation. But some of those retirees are going to sell the practice to a new dentist, hand over the reins and ride off into the sunset. Practice transition can be very difficult and requires grace on both sides. But when all is said and done, the element that is really paramount in a practice transition is the continuing compassionate care of the patients.

The Journal welcomes letters

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Training Wheels for Cheaters

David W. Chambers, EdM, MBA, PhD

Art Dugoni is the master at making it easy for people to contribute to the profession. But it isn’t always through the big gift. Sometimes it is $100 from an alum whom we hadn’t heard from in years. Art would smile and say, “Consider it a training gift.”

Art is right. Kindness and charity are not events, they are processes. And exactly the same logic applies to moral decay. The surgeon in the Midwest who lost his license for grossly unsanitary office conditions did not commit one big ethical misstep — it was a habit built over a lifetime. Insurance companies catch and successfully prosecute fraud based on patterns of abuse. One bad claim, even if outrageous, often goes through or is challenged in a way that permits graceful retreat. The average age of both physicians and dentists in California who have their licenses disciplined is in the late 50s.

An endo file breaks. After some soul-searching and because the patient says nothing, the dentist overlooks the matter. Another instrument misbehaves; now it is understood that “this sort of thing happens.” A dentist treats a patient until the family breadwinner is out of work and has no insurance. Soon a pattern emerges of aggressive treatment up to the insurance allowance and then protecting the economic interests of the office through formal discharge letters. A routine extraction turns out to be more difficult than anticipated. If one is motivated and makes the right sorts of inquires of friends or online, they can learn how to find the radiographs necessary for upcoding.

Some dentists or dental students hear about techniques for “educating” patients to accept levels of treatment they do not need and cannot afford, but most professionals say “not for me” to this sort of thing. Some have an opportunity to receive coaching in these doubtful practices in an associateship or other employment arrangement. But it requires a combination of bad examples, pressure situations, “successful” small experiments and repetition over time to form bad habits.

There is no reason to expect that it is any different going in the positive direction. A few admonitions from a respected leader in the profession or a couple of dilemma cases is not going to get the job done. Up or down depends mostly on what happens after the experimental behavior is tried.

There is a story that Bernie Madoff’s outrageous misconduct was an accident that might have corrected itself. This nefarious career began with a single bad investment that he intended to cover with an accounting adjustment until the next ship came in. Unfortunately, the next ship was also a mishap. Worse yet, none of Madoff’s friends offered help or asked for an explanation. Silence of his colleagues was part of the pattern.

**The nub:**
1. “The first time you cheat is difficult; after that it gets easier.” — J. R. Ewing, Dallas
2. Big cheats all started as small ones.
3. Conscience is best built or dismantled in small steps.

David W. Chambers, EdM, MBA, PhD, is a professor of dental education at the University of the Pacific, Arthur A. Dugoni School of Dentistry in San Francisco and the editor of the American College of Dentists.
Earliest Recorded Lead Exposure Discovered in Neanderthal Teeth

Using evidence found in teeth from two Neanderthals from southeastern France, researchers from the department of environmental medicine and public health at the Icahn School of Medicine at Mount Sinai report the earliest evidence of lead exposure in an extinct human-like species from 250,000 years ago.

This study is the first to report lead exposure in Neanderthals and is the first to use teeth to reconstruct climate during and timing of key developmental events including weaning and nursing duration — key determinants of population growth. Results of the study were published online in the journal Science Advances in October 2018.

The international research team of biological anthropologists, archaeologists, earth scientists and environmental-exposure experts measured barium, lead and oxygen in the teeth for evidence of nursing, weaning, chemical exposure and climate variations across the growth rings in the teeth. Elemental analysis of the teeth revealed short-term exposure to lead during cooler seasons, possibly from ingestion of contaminated food or water or inhalation of smoke from fires containing lead.

During fetal and childhood development, a new tooth layer is formed every day. As each of these “growth rings” forms, some of the many chemicals circulating in the body are captured in each layer, providing a chronological record of exposure. The research team used lasers to sample these layers and reconstruct the past exposures along incremental markings, similar to using growth rings on a tree to determine its growth history.

This evidence allowed the team to relate an individual’s development to ancient seasons, revealing that one Neanderthal was born in the spring and that two Neanderthal children were more likely to be sick during colder periods. The findings are consistent with mammals’ pattern of bearing offspring during periods of increased food availability. The nursing duration of 2.5 years in one individual is similar to the average weaning age in preindustrial human populations.

“This study reports a major breakthrough in the reconstruction of ancient climates, a significant factor in human evolution, as temperature and precipitation cycles influenced the landscapes and food resources our ancestors relied on,” said lead author Tanya Smith, PhD, of Griffith University.

Read more of this study in Science Advances (2018); doi:10.1126/sciadv.aau9483.
People Overestimate Benefits of Medical Interventions

New research published in the October 2018 issue of Risk Analysis found that people overestimate the benefits and underestimate the risks of a variety of medical procedures, from major heart surgery to a course of minor drugs. The study of 376 adults was conducted by researchers from the University of Plymouth School of Psychology, the University of Essex and the University of Zurich.

In several hypothetical scenarios, participants were asked to imagine that their doctor had recommended a treatment in order to treat an eye infection, a gum infection, a hole in their eardrum, a benign growth and a life-threatening blood disorder, respectively. In each scenario, they were provided with precise information about the probability of success (e.g., saving a tooth) or the probability of the risks (e.g., liver damage). The treatments and side effects were taken from medical studies, but the probabilities of their happening were devised by the study authors for the research only.

Participants were then asked to indicate by moving a pointer on a scale of 0–100 percent how likely they believed that they were to experience one of the benefits or risks. Results showed that on average people perceived the benefit as higher than the benefit midpoint. For example, in the case of the tooth, the perceived likelihood of benefit was 48 percent compared with the midpoint of 45. The perceived risk of the side effects—in the case of the dental procedure, a possible gum infection—was perceived to be 46 percent compared to the risk midpoint (or average) of 50 percent. The biggest difference was regarding a kidney operation for a benign growth, where the perceived risk of the possible side effect, paralysis (43 percent), was significantly lower than the actual risk (53 percent).

Learn more about this study in Risk Analysis (2018); doi.org/10.1111/risa.13204.

Malnutrition Tied to Tooth Loss

A new study led by researchers at Rutgers University is linking bad oral health to malnutrition. The findings were recently published in the Journal of Aging Research and Clinical Practice. The study analyzed the health records of 107 community-dwelling senior citizens treated at the Rutgers School of Dental Medicine clinic between 2015 and 2016.

Researchers saw a trend in which patients with 10 to 19 teeth were more likely to be at risk for malnutrition. Those patients were reported to have higher rates of weight loss, ate less and more frequently reported that they suffered with dementia, depression and severe illnesses compared to those who did not suffer from malnourishment.

“The mouth is the entryway for food and fluid intake,” said lead author Rena Zelig, DCN, RDN, CDE, CSG, director of the master of science in clinical nutrition program at the Rutgers School of Health Professions. “If its integrity is impaired, the functional ability of an individual to consume an adequate diet may be adversely impacted.”

These findings show that dental clinics are an ideal location to check a patient’s nutritional status and identify who may be at risk for malnutrition, according to the study. “Clinicians also can provide patients with referrals to registered dietitians and community assistance programs such as Meals on Wheels to prevent further decline in nutritional status,” Dr. Zelig said.

This study was the first part of a mixed-methods grant to research the associations between tooth loss and nutritional status in older adults. The second part of the grant built on these results and qualitatively studied the eating experience and eating-related quality of life of community-dwelling older adults using qualitative interviews.

Read more of this study in the Journal of Aging Research and Clinical Practice (2018); dx.doi.org/10.14283/jarcp.2018.19.
Air Pollution Associated With Mouth Cancer Risk

High levels of air pollutants, especially fine particulate matter (PM2.5) and, to a lesser extent, ozone, may be linked to a heightened risk of developing mouth cancer, according to a study published online in the *Journal of Investigative Medicine*. The study is the first of its kind to associate oral cancer with PM2.5.

The number of new cases and deaths from mouth cancer is increasing in many parts of the world. Known risk factors include smoking, drinking, human papilloma virus and, in parts of South East Asia, the chewing of betel quid (paan), a mix of ingredients wrapped in betel leaves.

Exposure to heavy metals and emissions from petrochemical plants are also thought to be implicated in the development of the disease, while air pollution, especially PM2.5, is known to be harmful to respiratory and cardiovascular health.

To find out if air pollutants might have a role in the development of mouth cancer, the researchers mined national cancer, health, insurance and air-quality databases. They drew on average levels of air pollutants — sulphur dioxide, carbon monoxide, ozone, nitrogen monoxide, nitrogen dioxide and varying sizes of fine particulate matter — measured in 2009 at 66 air-quality monitoring stations across Taiwan.

In 2012–13, researchers checked the health records of 482,659 men aged 40 and older who had attended preventive health services and had provided information on smoking and betel-quid chewing. In that year, 1,617 cases of mouth cancer were diagnosed among the men. The diagnoses were then linked to local area readings for air pollutants taken in 2009.

Smoking and frequent betel-quid chewing were significantly associated with heightened risk of a diagnosis, but so too were high levels of PM2.5, according to the study. After taking account of potentially influential factors, increasing levels of PM2.5 were associated with an increasing risk of mouth cancer.

When compared with levels below 26.74 μg/m3, those above 40.37 μg/m3 were associated with a 43 percent heightened risk of a mouth cancer diagnosis. A significant association was also observed for ozone levels below 28.69 and 30.97 parts per billion.

Learn more in the *Journal of Investigative Medicine* (2018); dx.doi.org/10.1136/jim-2016-000263.

Poor Oral Health Linked to Higher Blood Pressure

People with high blood pressure taking medication for their condition are more likely to benefit from the therapy if they have good oral health, according to new research in the American Heart Association’s journal *Hypertension*.

Findings of the analysis, based on a review of medical and dental exam records of more than 3,600 people with high blood pressure, reveal that those with healthier gums have lower blood pressure and responded better to blood pressure-lowering medications compared with individuals who have periodontitis. Specifically, people with periodontal disease were 20 percent less likely to reach healthy blood pressure ranges compared with patients in good oral health.

The target blood pressure range for people with hypertension is less than 130/80 mmHg according to the latest recommendations from the American Heart Association/American College of Cardiology. In the study, patients with severe periodontitis had systolic pressure that was, on average, 3 mmHg higher than those with good oral health. While seemingly small, the 3mmHg difference is similar to the reduction in blood pressure that can be achieved by reducing salt intake by 6 grams per day (equal to a teaspoon of salt or 2.4 grams of sodium), the researchers said.

The presence of periodontal disease widened the gap even further, up to 7 mmHg, among people with untreated hypertension, the study found. Blood pressure medication narrowed the gap, down to 3 mmHg, but did not completely eliminate it, suggesting that periodontal disease may interfere with the effectiveness of blood pressure therapy.

Learn more about this study in *Hypertension* (2018); doi/10.1161/HYPERTENSIONAHA.118.11528.
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CAMBRA* Comes of Age

Peter Rechmann, DMD, PhD

CAMBRA has reached legal age. Twenty-one years ago in 1997, John D.B. Featherstone, MSc, PhD, at the University of California, San Francisco (UCSF), applied for a National Institute of Health Grant to conduct the first clinical trial with a preventive approach to caries management — known later as the caries management by risk assessment (CAMBRA) study.

In April 2002, the California Dental Association Foundation hosted a conference where experts reviewed and updated the science and practice of caries prevention. This led to a two-part publication series that featured 16 expert papers in the *Journal of the California Dental Association* in 2003 entitled “Cariology in the New World Order: Moving from Restoration Toward Prevention.”

The goal was to provide practitioners with tools to elevate this preventive standard in their own practices.

The ideological movement of preventing caries rather than the traditional treatment path supplanted the traditional treatment path. CAMBRA began the medical-model approach to disease management. The Western, Central and Eastern CAMBRA coalitions were created, each with their own unique focus. Emphases were directed toward practicing dentists and their staff, development of a standardized cariology curriculum for all U.S. dental schools and inclusion of CAMBRA principles in the licensure process.

In 2007, the October and November issues of the *Journal* presented CAMBRA clinical protocols, products and the roles of RDHs, RDAs and office staff, which influenced change and a consensus statement with implementation guidelines to support oral health. The consensus document was adopted by hundreds of dental experts, academic researchers, practitioners and dental organizations summarizing the main principles and clinical application of CAMBRA.

The CDA Foundation hosted a symposium in January 2011 to advance the practice of dental disease management. The symposium engaged
researchers, clinicians, insurers and policymakers in a discussion on caries management, the impact of caries on access to care and financial implications and policies at the time that inhibited widespread adoption of the protocols. In its October 2011 issue, the Journal, for the first time, included a validation paper confirming the validity of the CAMBRA caries risk assessment (CRA) as a result of a six-year retrospective study by Doméjean and co-workers.

Recently, a national CAMBRA coalition was created. Annual meetings have been held since 2015 bringing together all areas of dental professionals and public and private-payers groups. In 2018, the National CAMBRA Coalition hosted its annual event for the first time in conjunction with the American Academy of Cariology (AAC). The topic of AAC’s second annual conference was “Dental Caries Progress — Sugar or Bacterial Dysbiosis” featuring a series of national and international speakers who presented impressive highlights of modern cariology.

This issue of the Journal features a series of five papers reporting the latest CAMBRA-related research results, updates on clinical-practice CAMBRA implementation and a report from a unique model program. The series begins with the results from a practice-based research network (PBRN) created in the San Francisco Bay Area by Peter Rechmann, DMD, PhD, and co-workers to study the efficiency of CAMBRA in “the real world outside the university ivory tower.” This randomized, controlled, double-blind two-year clinical CAMBRA-PBRN trial with individual-level caries risk assignment of 460 patients to standard of care versus active CAMBRA treatment demonstrated that caries risk level as well as caries disease indicators were significantly reduced in the CAMBRA intervention group.

The introduction of the CAMBRA-PBRN trial paper summarizes the CAMBRA history, the results of the first UCSF-CAMBRA clinical trial and available evidence related to the validity of the CAMBRA CRA system. The second paper, authored by John D.B. Featherstone, MSc, PhD, and co-workers, provides a practical evidence-based update of the CAMBRA system for use in clinical practice for patients aged 6 years through adult. This paper updates the CAMBRA CRA tool, allowing the preparation of a risk-based treatment plan that combines chemical therapy with necessary restorative treatment for a minimally invasive, successful outcome. The paper’s “caries self-management menu of options” assists patients in setting their self-management goals for caries management.

The third paper provides an updated practical CRA tool for use by the clinician in CAMBRA for young children aged 0 to 5. The paper provides updates on the original CRA tool for children aged 0 to 5 that was published in 2007 and reviewed in 2010 and includes risk-factor updates such as the caries status of the caregiver or sibling and the family health literacy status. Comprehensive guidelines for CRA and detailed management plans for each risk level with additional guiding principles were provided to create a personalized management plan.

The fourth paper’s goal with Douglas A. Young, DDS, EdD, MBA, MS, as lead author is to disseminate guidelines and rationale used in previous studies to improve the performance and accuracy of assessing the caries risk of an individual. These simplified guidelines aim to aid health care professionals to better understand how to determine the correct caries risk level of their patients. Consequently, these guidelines will foster the ability of properly recommending and prescribing appropriate interventions.

The final paper in this CAMBRA-themed issue is a report by John L. Blake, DDS, from the Children’s Dental Health Clinic in Long Beach, Calif., that provides a large nonprofit comprehensive dental care program. An instituted early-caries-management program includes a family meeting with a registered dental hygienist for a 30-minute session, a dental screening and an education session including a nutrition discussion, a toothbrush prophylaxis and a fluoride varnish application. This field report provides some first and promising results in terms of caries experience. The younger the children were at the time they participated in this program, the greater were their benefits in terms of reduced caries experience.

It has been a great honor for me to introduce this special CAMBRA-themed issue of the Journal, not only because of the 21 years of CAMBRA existence, but more important because of the overwhelming evidence we have that the developed CRA tool results in an accurate assessment of caries risk and consequently supports the creation of effective and individualized caries management plans.
Caries Management by Risk Assessment: Results From a Practice-Based Research Network Study

Peter Rechmann, DMD, PhD; Benjamin W. Chaffee, DDS, MPH, PhD; Beate M.T. Rechmann; and John D.B. Featherstone, MSc, PhD

ABSTRACT Thirty dentists with clinical practices outside of a university setting were trained and calibrated successfully in DMFS and ICDAS-scoring. This randomized, controlled, parallel-arm, double-blind two-year clinical trial with individual-level caries risk assignment of 460 patients to standard of care as control versus active CAMBRA* treatment as intervention demonstrated that caries risk level, as well as caries disease indicators, were significantly reduced in the CAMBRA intervention group compared to the controls at all recall time points.
CAMBRA, scientific, evidence-based solutions for prevention and treatment of caries as a manageable medical condition, not a mechanical problem, were translated into clinically relevant guidelines for dentists.10

The ideology of managing caries lesions very early, before they have reached the cavitated stage, without drilling but by preventive measures has been embraced within many modern dental practices.11,12 Noninvasive and minimally invasive treatment concepts13–15 are now widely accepted by dental practitioners. Following these concepts and taking into consideration each patient’s caries risk, invasive restorative treatments can be delayed and performed at more advanced caries lesion stages, if not avoided entirely.11,12,16

In many dental practices throughout the world, the CAMBRA philosophy has been completely incorporated into the practice routine and embodied by the entire patient care team, including dental assistants and hygienists, front desk staff and dentists.

In short, CAMBRA requires the dentist to identify the caries risk level of the individual patient by evaluating their disease indicators, risk factors and preventive factors using a caries risk assessment (CRA) form (see other articles in this issue). Taking those factors into account, a caries risk level of low, moderate, high or extreme is assigned. According to the assigned risk level, changes in the patient’s lifestyle are discussed and, if necessary, additional preventive chemical measures are recommended.10,17–22 CAMBRA also includes carrying out noninvasive therapies and minimally invasive restorative procedures for tooth structure conservation and, finally, recall and review.23

**First CAMBRA Clinical Trial**

The first CAMBRA study was performed at the University of California, San Francisco (UCSF) between 1999 and 2004.4 The study was a randomized, prospective, controlled clinical trial over two years. Impressively, the results indicated that an over-the-counter (OTC) fluoride toothpaste and rinse combined with an antibacterial agent (chlorhexidine) were able to significantly reduce the cariogenic bacterial load over the study period. Bacteria testing also strikingly revealed that, in the control group, placing restorations alone did not reduce the mutans streptococci (MS) bacterial challenge. MS represent a group of major cariogenic bacteria. The MS bacterial challenge in the CAMBRA intervention group was significantly lower at each recall visit.

In addition, it was shown that just placing restorations did not lower the caries risk level of individuals in the control group.4 In contrast, the intervention group receiving the antibacterial and preventive fluoride measures showed a significantly decreased number of subjects at high caries risk. The antibacterial and fluoride therapy had successfully altered the balance between pathological and protective caries risk factors, lowering the caries risk level among intervention group patients.

One other major finding of the first CAMBRA clinical trial was a reduced number of new caries lesions over the two years for the high-caries-risk subjects in the intervention group. The participants in the intervention group developed fewer new cavities, with a statistically significant 24 percent lower increase in new decayed/filled tooth surfaces (DMFS) than the control subjects. In summary, the CAMBRA trial demonstrated that for high-caries-risk patients, employing fluoride and bactericidal agents lowers caries risk and fewer cavitated lesions will occur.4
Predictive Validity of the CAMBRA Risk Assessment System

The CAMBRA CRA system was evaluated in several outcomes studies.20,24 First, at the UCSF School of Dentistry clinics Doméjean and co-workers tracked charts of 2,571 patients who had been assessed for their caries risk. At baseline, they identified 39 percent as moderate, 69 percent as high and 88 percent as extreme patients. At the UCSF student dental clinics, 18,004 patient charts with 4,468 recall visits at the UCSF student dental clinics, 2,274 patients with follow-up at the UCSF School of Dentistry, Chaffee and co-workers reported the effectiveness of anticaries agents, including 5,000 ppm fluoride toothpastes, chlorhexidine rinse and xylitol. They showed that patients who had received any of these agents twice or more over 18 months had developed 20 percent lower increase of decayed or filled teeth over those who never or only once had received those anticaries products.26

CAMBRA Practice-Based Research Network Study

The original UCSF-CAMBRA trial took place in a university dental school setting.4 In order to demonstrate that CAMBRA not only works in a university “ivory tower” but can also successfully be implemented in the “real world,” a practice-based research network (PBRN) was created in the San Francisco Bay Area. The idea behind performing studies in PBRNs is to engage dentists in studies that are directly related to daily clinical practice.27 PBRNs should advance both research and dental practice through quality improvement.27,28 PBRN studies are meant to move scientific advances rapidly into daily practice and simultaneously provide structure for sharing of information between practitioners.29

The California Dental Association (CDA) was instrumental in establishing the San Francisco Bay Area network, which was created to conduct a CAMBRA study in dental offices and health care centers. The basic goal of the CAMBRA-PBRN trial was to recruit 30 dentists to perform a two-year randomized, controlled, double-blind study involving approximately 30 patients per dental practice. The hypothesis to be tested was that caries management based on caries risk level assignment significantly reduces patient caries risk level and reduces the need for caries restorative treatment over two years compared to a generally accepted standard of care.

Materials and Methods

Dentist Recruitment, Training and Calibration

San Francisco Bay Area dentists were invited by CDA newsletter advertisements and phone calls to attend informational meetings about the CAMBRA-PBRN study. CDA organized one-day information sessions. During these sessions, study design, expected involvement of the dentists in conducting the study and requirements to join the PBRN were explained. Based on a priori power calculation, it was determined that a sample size of 30 dentists to be recruited into the study would be sufficient. Before the main CAMBRA-PBRN study started, a total of 30 dentists...
TABLE 1
Dispersed Treatment Products Based Upon the Assessed Caries Risk Level for the Intervention Group and the Control Group

<table>
<thead>
<tr>
<th>Group assignment/ products at risk level</th>
<th>Low risk</th>
<th>Moderate risk</th>
<th>High risk</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intervention group</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crest cavity protection (P&amp;G) (1,100 ppm F) 2x daily</td>
<td>Crest cavity protection (P&amp;G) (1,100 ppm F) 2x daily</td>
<td>Ortho wash rinse (3M ESPE) (0.05% F), daily</td>
<td>Xylitol candies (Epic) 4x daily (8 grams total)</td>
</tr>
<tr>
<td>Crest cavity protection (P&amp;G) (1,100 ppm F) 2x daily</td>
<td>Crest cavity protection (P&amp;G) (1,100 ppm F) 2x daily</td>
<td>Crest cavity protection (P&amp;G) (1,100 ppm F) 2x daily</td>
<td>Clinpro 5000 (3M ESPE) (5,000 ppm F toothpaste)</td>
</tr>
<tr>
<td>Xylitol candies (Epic) 4x daily (8 grams total)</td>
<td>Crest Scope rinse (P&amp;G) (mint taste), daily</td>
<td>Crest cavity protection (P&amp;G) (1,100 ppm F) 2x daily</td>
<td>Peridex (3M ESPE) Chlorhexidine gluconate (0.12%) rinse 1/day for 1 week, every month*</td>
</tr>
<tr>
<td>Sorbitol candies (Epic) 4x daily (8 grams total)</td>
<td>Crest Scope rinse (P&amp;G) (mint taste), daily</td>
<td>Crest cavity protection (P&amp;G) (1,100 ppm F) 2x daily</td>
<td>Xylitol candies (Epic) 4x daily (8 grams total)</td>
</tr>
<tr>
<td>Sorbitol candies (Epic) 4x daily (8 grams total)</td>
<td>Placebo varnish (3M ESPE)</td>
<td>Placebo varnish (3M ESPE)</td>
<td>Vanish (3M ESPE) F varnish</td>
</tr>
</tbody>
</table>

* Until the next periodic oral exam, then reassess.

(13 female, 17 male) had joined. Three dentists were employed at three different federally qualified health centers (FQHC) and 27 were dental-office owners.

A calibration study was performed in order to assure that all participating dentists would record oral conditions in the same detailed way24 in the main CAMBRA-PBRN study and to assure that results could be compared among participating practices. In order to minimize interexaminer variability in data gathering, including the assessment of caries risk, carious lesion classification and recording of existing restorations, the study dentists were required to attend one training meeting and one calibration workshop. Training meetings and calibration workshops were offered on multiple dates and attended by three to eight dentists per session. The study examiners participated in the training and calibration sessions with other staff members of their dental practices to enhance understanding and support of the study with the entire patient-care team. The UCSF Institutional Review Board (IRB) had approved the prestudy dentist calibration (IRB #10-04504).

The attendees were trained and calibrated in two caries classification systems that were later used in the main CAMBRA-PBRN study. First, they were trained in examining and correctly charting decayed, missing, filled tooth surfaces — the DMFS index,31,32 following strict scoring rules. Because noncavitated caries lesions in enamel can be managed by remineralization without restorative intervention,13,14 the dentists were also calibrated in classifying caries lesions at a noncavitated stage.13 The International Caries Detection and Assessment System (ICDAS)35,36 offers criteria for scoring of noncavitated lesions.37 The dentists were specifically trained to differentiate between sound (ICDAS 0), noncavitated caries lesions (ICDAS 1 or 2) (FIGURE 3) and cavitated caries lesions (ICDAS 3 and above). This allowed the participating dentists to record consistent and detailed clinical findings in the main study.

Examinations occurred after the teeth were carefully cleaned (dental prophylaxis). Dentists performed a visual exam without tactile probing of enamel, using loupes with 2x magnification.

The 30 participating dentists were calibrated to a single gold-standard examiner during the six calibration sessions.38 To determine the interexaminer reliability with the gold standard, an average of 13 or more patients per examiner were checked for DMFS and ICDAS. Each examiner scored between 1,036 and 2,220 tooth surfaces. To calculate the interexaminer reliability, kappa statistics were used. All dentists achieved interexaminer kappa values of > 0.75 in comparison to the gold-standard examiner, with a mean interexaminer kappa of 0.84 considered as a “very good” agreement with the gold standard. A “moderate” kappa of 0.55 for agreement in noncavitated lesions showed that this differentiation was more difficult and might require additional time and clinical education for future PBRN studies.39 For both indices, interexaminer reliability values achieved between the gold-standard examiner and future study examiners were at least as high as typically found in the literature and considered acceptable for high-quality dental assessments.40

**Main Study: Eligibility Criteria, Enrollment and Treatment Assignment**

The UCSF IRB approved the main study (IRB #10-02153) and the study was registered on clinicaltrials.gov (ID: NCT01176396). In the PBRN practices, potential patients were informed about the study goals, possible risks and
In the PBRN trial, a digital system was modeled after the way a gold-standard assessor had assigned caries risk in the UCSF quality assurance study. For each caries risk level (i.e., low, moderate and high), randomization lists had been provided to help PBRN dentists to randomize their patient to the “active intervention” group or the “standard of care” control group. Providers were blinded to actual group assignment, which appeared on the randomization lists as two different colors: black or white. Extreme-risk patients were excluded from the study due to ethical reasons (to avoid withholding anticaries therapies). Intervention group products and recommendations were based on CAMBRA guidelines. For each caries risk level (i.e., low, moderate and high), randomization lists had been provided to help PBRN dentists to randomize their patient to the “active intervention” group or the “standard of care” control group. Providers were blinded to actual group assignment, which appeared on the randomization lists as two different colors: black or white. Extreme-risk patients were excluded from the study due to ethical reasons (to avoid withholding anticaries therapies). Intervention group products and recommendations were based on CAMBRA guidelines.

TABLE 1 itemizes the provided products for each caries risk level, separated into “intervention” and “control” treatment. Patient participants as well as all members of the dental practice, including the dentist, were blinded to actual group assignment. All products were covered with black or white wraps with printed user instructions on each product; thus, brand name and product content could not be identified. Products were given to the participant in black and white product bags, comprising all products suggested for the specific risk level. Patients received sufficient product supplies to last six months and were instructed to request more if needed. Each product bag included laminated instruction sheets on how to use the products at home.

Finally, participants were scheduled for a recall every six months for the two-year study duration. The high-caries-risk patients received a phone call from the PBRN practice a week before a new calendar month started. During this phone call, patients were reminded to use their dispensed rinse for the first week of the month (one-minute rinse, 60 minutes after brushing teeth each evening). In addition, each PBRN practice was reminded by the UCSF study coordinator to place those reminder phone calls.

Of the 21 PBRN practices actively recruiting patients into the study, all data from one office were excluded from the final analysis (19 participants). The office did not follow recruitment, recall and data-collection instructions. The remaining 20 dentists enrolled 460 eligible patients. The eligibility criteria to be included in data analysis were: A baseline CRA was performed and assignment to the “black” or “white” group was recorded in the computer chart. Each practice enrolled a mean of $23.0 \pm 16.8$ patients with a range from two to 55 patients.

CAMBRA-PBRN Study Results

At enrollment, of the 460 eligible patients, 192 patients were at low caries risk, 26 at moderate and 242 were assessed as having high caries risk. Of the high-caries-risk patients, 137 were randomly assigned to the intervention group and 105 to the control group. For the low-caries-risk patients, 93 were assigned randomly to the intervention and 99 to the control (FIGURE 4). At baseline, the intervention
and control groups were not statistically significantly different in mean age (37 years intervention; 35 years control) and gender (69 percent female intervention; 68 percent female control). By chance, of the 242 baseline high-caries-risk patients, more (n = 137) were assigned to the intervention group (57 percent) than to the control group (P = 0.05).

**High Caries Risk**

**TABLE 2** illustrates the number and percentage of participants who at baseline were classified as having high caries risk. The table also shows for each follow-up visit, in total and by treatment group assignment, how many patients were still classified as high risk. The follow-up rate for the intervention group was 58.4 percent at six months, 50.4 percent at 12 months, 39.4 percent at 18 months and 32.1 percent at 24 months. For the control group, the follow-up rates were similar (54.3 percent, 44.8 percent, 39.0 percent and 37.1 percent, respectively). In total, 151 initially high-caries-risk participants came to at least one follow-up visit with 85 (62.0 percent follow-up) in the intervention group and 66 (62.9 percent follow-up) in the control group.

For participants assessed as having high caries risk at baseline, **FIGURE 5** shows the percentage staying at high risk, separately at each recall. Over the two years, the percentage of patients who stayed at high caries risk was lower in the intervention group than the control group, with just 25 percent of participants staying at high caries risk in the intervention group at the 24-month recall. Interestingly, the percentage of high-caries-risk participants was also reduced over time for the control group down to 54 percent staying at high risk. Nevertheless, for all recall time points differences between the two groups were statistically significant (overall significance P < 0.001).

**Low Caries Risk**

**TABLE 2** shows at each follow-up visit, in total and by treatment group, the number and percentage of patients who at the beginning of the study were classified as having low caries risk and then later were assessed as increasing their risk level to moderate or high risk. For the intervention group, the follow-up rate was 68.8 percent at six months, 60.2 percent at 12 months, 57.0 percent at 18 months and 38.7 percent at 24 months. The follow-up rates for the controls were 72.7 percent, 70.7 percent, 59.6 percent and 49.5 percent, respectively. In total, 154 initially low-risk participants provided data from at least one follow-up visit, with 73 (78.5 percent follow-up) patients in the intervention group and 81 (81.8 percent follow-up) in the control group.

**FIGURE 6** shows the percentage of patients who changed their caries risk level from low at baseline to a higher caries risk at recalls. Only a small percentage converted to high caries risk over time. At the 18-month recall, 3.9 percent of the intervention group and 18.0 percent of the control group were assessed as having moderate or high caries risk, the difference being statistically significant (P = 0.05) (**FIGURE 6**). The difference between the intervention group and control group was not significantly different at any other individual time point. Over the entire study period, the percentage of participants changing their caries risk from low to moderate or high was significantly lower in the intervention group (P = 0.03).

**Clinical Outcomes — Disease Indicators**

In this CAMBRA-PBRN trial, the number of new fillings due to caries was very low in both groups. For this reason, we looked further into the registered disease indicators, namely visually or radiographically observed cavities into dentin, proximal enamel lesions, restorations due to caries in the last year and active white spot lesions at each recall time point with a white spot lesion defined as active if the surface appeared chalky and nonactive if the surface was shiny. These disease indicators include cavities and account for other signs of the existence of the caries disease. Consequently, they give a broader view of the caries situation of a patient. **FIGURE 7** represents the percentage of initially high-risk patients demonstrating newly registered disease indicators. The percentage of newly developed disease indicators decreased over time in both study groups. At all recall
time points, the percentage of patients with newly registered disease indicators was lower for patients in the intervention than for those in the control group. These differences were statistically significant at the 12- and 18-month recall visits. The intervention group showed new disease indicators in only 46 percent and 31 percent at the 12- and at the 18-month recall, respectively, while in the control group 64 percent and 53 percent, respectively, had developed new disease indicators. The overall statistical significance for differences between the intervention group and control group was \( P = 0.04 \) (FIGURE 7).

**Discussion**

To study whether CAMBRA can be successfully implemented outside a structured university setting, a practice-based research network was created in the San Francisco Bay Area. Thirty dentists were enrolled to perform a two-year, randomized, controlled, double-blind clinical CAMBRA trial in their practices. The dentists were trained and calibrated to assess caries risk, score the conventional DMFS index and use the ICDAS clinical scoring system.

The first UCSF-CAMBRA trial included only patients who were high caries risk at the study start. In that study, the chemical therapy (OTC fluoride toothpaste daily, OTC F mouth rinse daily and 0.12% chlorhexidine gluconate mouth rinse once a day for one week every month) in the intervention group resulted in significantly lower numbers of patients at high caries risk over time. In the intervention group, 50–70 percent of participants stayed at high caries risk and 70–90 percent of participants stayed at high caries risk in the control group. In contrast, in the present CAMBRA-PBRN study, only 25 percent of the participants in the intervention group and 54 percent of the control group remained at high caries risk after two years (FIGURE 5). Nevertheless, at all recall intervals, differences between the control group and intervention group in percentage of patients remaining at high risk were statistically significant.

Impressively, the percentage of high-risk participants remaining at this risk level during subsequent visits was much lower in the present CAMBRA-PBRN study than in the first UCSF-CAMBRA trial. There might be several reasons. For instance, in the UCSF-CAMBRA study 5,000 ppm prescription toothpaste was not available at that time, thus only 0.12% chlorhexidine plus OTC fluoride rinse (0.05% NaF) and OTC fluoride toothpaste (1,100 ppm F paste) were provided as intervention products. High-caries-risk participants assigned to the intervention group in the CAMBRA-PBRN study received a combination of prescription 5,000 ppm F paste, chlorhexidine rinse, xylitol mints and fluoride varnish. In the UCSF-CAMBRA study, the control group “continued their usual products” — they did not receive any products. In the present PBRN study, the control-group participants all received standard-of-care products. It is likely
that these products contributed to the observed risk-level reduction in this control group. The control products heightened saliva flow (sorbitol candies) and in addition might have had bactericidal effects (cetylpyridinium chloride rinse). Thus, the participants’ risk level in the control group was also dramatically reduced, unlike in the UCSF-CAMBRA study. Another important factor in the present study was that participants in both groups were called monthly to remind them to use their products. Most participants were also patients of record in private practices and, presumably, had ongoing personal relationships with the providers.

Therefore, it is likely that compliance was much better in this study than in the university-based original UCSF-CAMBRA study, in which the primary providers were students in the predoctoral clinic and the patients’ compliance may have been poor.

As a plausible consequence of using saliva-enhancing mints and other potentially beneficial products in the control group in the present study, newly developed disease indicators (ongoing caries measures, as described above) decreased for both the intervention and control treatment groups. Nonetheless, the percentage of newly developed disease indicators for participants in the intervention group was lower than for those in the control group. Fewer newly developed disease indicators unmistakably establish a reduced manifestation of the caries disease, which is expressed by radiographically observed cavities into dentin, proximal enamel lesions, restorations due to caries in the last year and active white spot lesions (FIGURE 7). Only 30–35 percent of intervention group patients and 50–55 percent in the control group had new caries indicators at 18 to 24 months, whereas in the original CAMBRA study this number was about 55–60 percent in the intervention group and about 70–75 percent in the control group. Recorded disease indicators strongly determine the caries risk level of the patient. Consequently, the monitored reduction in numbers of participants with high caries risk parallels the declined percentage of newly developed disease indicators.

In contrast to the original UCSF-CAMBRA study, the CAMBRA-PBRN not only enrolled high-caries-risk patients but also studied patients at moderate or low caries risk. The hypothesis was that provision of
chemical therapy, including OTC fluoride rinse and xylitol products to moderate-risk patients would prevent increases to high-risk status over time. However, at baseline, few patients (5.7 percent of the total sample) were classified at moderate risk, and thus, there were insufficient numbers to allow assessment as a separate category. Among initially low-risk patients, as expected, only a small percentage showed an increased caries risk over time. This finding provides evidence that the initial low-risk assignment was correct. The small number with an increase in caries risk level at 24 months might have resulted from changes in participant behaviors or other risk or protective factors. At the 18-month visit, a statistically significant difference between groups was observed despite the fact that both intervention and control low-risk patients received the same prevention study products (1,100 ppm F toothpaste).

All of the above discussion points are based upon the observed data for study participants who returned for further visits and examinations. As in all studies, as the study progressed some participants did not return for further examination or only returned for some but not all visits. It is interesting to speculate that all of the no-show patients did not return because they were no longer at high risk and no longer felt they needed to seek dental care.

Conclusion

Thirty dentists as potential participants in a CAMBRA-PBRN trial were trained and calibrated successfully in DMFS and ICDAS scoring. The interexaminer reliability to a gold standard was high. The high interexaminer reliability showed that dentists who work in their own primarily nonresearch practices can be successfully trained and calibrated in data collection, based on specific guidelines created to anticipate potential research-study scenarios. However, separate reliability for assessment of noncavitated lesions, as in other studies, was lower.

In this CAMBRA-PBRN study with clinical practices outside of a university setting, it was demonstrated that the principles and philosophy of CAMBRA could be successfully implemented into dental practice with dramatic reductions in caries risk and in the development of new caries clinical indicators. Twenty dentists of the network successfully completed the two-year CAMBRA trial. The randomized, controlled, parallel-arm, double-blind clinical trial with individual-level CRA of 460 patients to standard of care as control versus active CAMBRA treatment as intervention demonstrated that caries risk levels, as well as caries disease indicators, were significantly reduced in the CAMBRA intervention group compared to the controls at all recall time points.**

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Caries Management by Risk Assessment (CAMBRA)*: An Update for Use in Clinical Practice for Patients Aged 6 Through Adult

John D.B. Featherstone, MSc, PhD; Pamela Alston, DDS, MPP; Benjamin W. Chaffee, DDS, MPH, PhD; and Peter Rechmann, DMD, PhD

ABSTRACT A system for caries management by risk assessment (CAMBRA) was published in 2007. This paper provides a practical evidence-based update for the clinician to use in practice for patients aged 6 through adult. Use of this updated CAMBRA tool allows preparation of a risk-based treatment plan that combines chemical therapy (fluoride, with or without antibacterial) with necessary restorative treatment for a minimally invasive successful outcome. Fluoride therapy must be supplemented by antibacterial therapy in high- and extreme-caries-risk patients.

DEPARTMENT OF DENTAL CARIES

Dental caries continues to be a major problem for patients of all ages. Billions of dollars are spent annually in the U.S. on restorative treatment of dental caries. Placing restorations can restore tooth form and function but does not affect the risk factors that caused the disease, such as a cariogenic diet, insufficient saliva or high levels of cariogenic bacteria in the rest of the mouth. Nor does it change the protective factors. Therefore, successful management of dental caries requires management of the disease with chemical therapy and behavior change, in addition to minimally invasive restorative work. Assessment of the level of risk for future occurrence of dental caries

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CAMBRA is a registered trademark of the University of California, San Francisco.

*CAMBRA update

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lesions is very important as the first step in managing dental caries. The risk level determines the personalized caries management approach for each patient. The procedure for determining caries risk status is described in practical terms below, together with appropriate caries management approaches including chemical therapy. While the caries risk assessment (CRA) form used in this paper has been further simplified based on available evidence, further discussion on this topic can be found in an additional paper in this issue.2

For decades there have been numerous attempts to provide methodology to predict future dental caries or to assess caries risk and to manage the disease.1–6 There are many publications related to these topics. It is not the aim of this paper to review these published works. The purpose of this paper is to provide an update and practical guidelines for dental practitioners for a CRA and caries management system that has been developed in California for patients aged 6 through adult, originally published in 20077,8 but utilized for more than 15 years in the teaching clinics of the University of California, San Francisco (UCSF), School of Dentistry.7 The procedures and philosophy are known as “caries management by risk assessment” and abbreviated to CAMBRA. This paper also briefly summarizes the science behind the methodology of CAMBRA and the outcomes of 15 years of clinical application in thousands of patients.

The Science Behind Caries Risk Assessment and Caries Management

There are hundreds of papers that have contributed to our understanding of the overall mechanism of dental caries and the roles of fluoride and other agents in the management of the disease. Based upon decades of research on dental caries by many investigators, we proposed the “caries balance” as a clinically oriented way of understanding the difference between progression or reversal of caries in the mouth.10–13 In summary, dental caries is demineralization of tooth mineral caused by acid generated when cariogenic bacteria in the plaque (biofilm) on the teeth metabolize fermentable carbohydrates. The demineralization can be inhibited by salivary components, antibacterial agents and fluoride or reversed by remineralization that requires calcium, phosphate and fluoride. The progression or reversal of dental caries is driven by the “caries balance” (FIGURE 1), namely the balance between the biological caries risk factors (pathological factors) (primarily: 1) cariogenic (acid-producing) bacteria, 2) fermentable carbohydrates and 3) salivary dysfunction) and protective factors (primarily: 1) sufficient saliva, 2) remineralization that requires calcium, phosphate and fluoride and 3) antibacterial agents). Possible antibacterial agents include chlorhexidine, silver diamine fluoride (SDF), hypochlorite (bleach) and others currently in development. See following sections for further detail.

Caries Risk Assessment – Practical Stepwise Guidelines

The assessment of caries risk for each individual patient is essential as the basis for the management of dental caries. Caries risk is the likelihood of the patient having new caries lesions (white spots, cavities, etc.) in the near future. There are many CRA forms and procedures in the recent literature and some are commercially available. Two such systems have been extensively studied in long-term patient-outcomes research. One is the Carigram system from Sweden14 and the other is the CAMBRA system that was developed at the University of California, San Francisco, in conjunction with several other universities and the California Dental Association.7–9,15 The CAMBRA system has been shown to be highly predictive of future caries in three different studies, featuring thousands of patients, for the group aged 6 years through adult and most recently for the group aged 0 to 5 years.9,16–18 An electronic version of the CAMBRA CRA procedure is expected to be available in the near future.

The following step-by-step outline guide is for use of the CAMBRA system with the group aged 6 years through adult. Details are given later in this paper. The CAMBRA system identifies four risk levels, namely low, moderate, high and extreme. CRA takes place as part of the regular comprehensive oral exam in the following sequence, leading to formulating...

FIGURE 1. The caries balance showing the balance between biological caries risk factors (pathological factors) and protective factors. The balance can either be toward progression or reversal of the disease. Updated from Featherstone, 1999.13 Each component is described in the text. Antibacterial agents may include chlorhexidine, silver diamine fluoride, hypochlorite (bleach) or new agents currently in development.
an individualized caries management treatment plan that includes chemical therapy. Here are the steps in the process:

1. Take dental and medical history.
2. Conduct clinical examination.
3. Detect caries lesions early enough to reverse or prevent progression.
4. Assess and document the caries risk as low, moderate, high or extreme utilizing data from steps 1, 2 and 3 and a short list of questions listed in the CRA form (TABLE 1).
5. Produce and document a treatment plan that includes chemical therapy appropriate to the caries risk level.
6. Prescribe and/or provide chemical therapy for the patient that includes fluoride with or without antibacterial therapy based upon the caries risk level.
7. Use minimally invasive restorative procedures to conserve tooth structure and function.
8. Recall and review at intervals appropriate to the caries risk status.
9. Reassess and document caries risk level at recall and modify the treatment plan as necessary.

The first four steps of the process comprise the CRA, which identifies clinical status, pathological factors and protective factors to provide an individualized, overall portrait of caries risk (TABLE 1). In the following steps, that risk assessment, in turn, informs the development and implementation of a personalized caries management plan. Hence, CAMBRA is a two-phase process involving both CRA and management of caries as a biologically determined, clinical disease. Steps 1, 2 and 3 are familiar elements of any conventional oral examination and form the basis of the CRA. Steps 2 and 3 provide a list of what are called “disease indicators,” which are simply clinical signs of the presence of caries, most likely ongoing over time.

Step 4 uses a few simple questions (as listed in the CRA form in TABLE 1) to attempt to determine the cause of the ongoing disease or to determine whether it is under control. Only those factors that have been shown to be statistically significantly related to ongoing caries risk or reversal are included here. TABLE 1 is a ready-to-use CRA form that provides a visual summary of all three categories. Instructions for its use and definitions of terms follow here and are briefly summarized in the second page of the form (FIGURE 2).

The CAMBRA system has been shown to be highly predictive of future caries in three different studies, featuring thousands of patients.

Disease Indicators
Disease indicators are these clinically observed results of previous and/or ongoing dental caries destruction of the tooth mineral:

a. Observed cavitation or radiographic evidence of progression into the dentin.
b. White spot lesions (that are new or active) on smooth surfaces.
c. Radiographic evidence of noncavitated demineralization into the enamel (usually by bitewing radiographs).

The CAMBRA system has been shown to be highly predictive of future caries in three different studies, featuring thousands of patients.

For a new-patient visit, one or more of these disease indicators signals at least “high caries risk.” For a patient of record at a follow-up visit, any new appearance of a disease indicator signals at least “high caries risk.” If hyposalivation is present, in addition, this signals “extreme risk.”

Biological and Environmental Risk Factors (Pathological Factors)

The following are biological and environmental risk factors that have been shown to be statistically related to caries risk:

a. Heavy plaque on the teeth. This simple measure, as observed by the clinician, has been shown in our clinical outcomes studies in thousands of patients to be a strong indicator of cariogenic bacterial activity and is strongly related to ongoing caries.9,17–19 Note: At the time of writing, there is no validated chairside test commercially available for measuring cariogenic bacterial levels. Therefore, cariogenic bacteria counts have been eliminated from the CRA form in this revised version, although a placeholder has been retained in TABLE 1 to allow for a quantitative bacteria test to be added back at a later date when an evidence-based test becomes available.

b. Frequent snacking on fermentable carbohydrates, at least three times daily outside of meal times.

c. Use of medications that induce hyposalivation. Xerostomia is a side effect of some of the most commonly prescribed medications and risk of dry mouth increases with the number of medications prescribed.20
d. Reduced salivary function (low flow rate) by observation (dry mouth appearance and symptoms) or by measurement (stimulated flow rate less than 0.5 ml/minute) — hyposalivation.

e. Deep pits and fissures.

f. Daily or regular use of recreational drugs.

g. Exposed tooth roots.
h. Orthodontic appliances.

In the risk-assessment procedure, any items on this list with a positive response are marked with a yes (TABLE 1) in the appropriate column. Each yes adds to the risk level. Items a and b can be modified by behavioral management. A yes to items c and d will normally indicate extreme risk if other risk factors and disease indicators suggest at least high risk. Deep pits and fissures suggest the use of preventive sealants (depending on the age and risk status of the patient). Item f, most likely, indicates hyposalivation, depending on the drugs used. “Meth mouth” is an extreme-caries-risk situation. Older people almost all have exposed tooth roots, indicating more attention is needed to fluoride and other preventive measures. Orthodontic appliances, such as brackets, automatically place the patient at least into moderate risk. Orthodontic appliances lead to preferential growth of cariogenic bacteria during the time of the orthodontic treatment.21

### TABLE 1

*CAMBRA is a registered trademark of the University of California, San Francisco*
Determining the caries risk as low, moderate, high or extreme

Add up the number of “yes” checks for each of the disease indicators (column 1) and risk factors (column 2). Offset this total by the total number of “yes” checks for protective factors (column 3). Use these numbers to determine whether the patient has a higher risk-factor score than a protective-factor score or vice versa. Use the caries balance to visualize the overall result and determine the risk level:

![Caries Balance Diagram](image)

This enables a determination of low, moderate or high risk determined by the balance between disease indicators/risk factors and protective factors. The “yes” indications are also used to modify behavior or determine additional therapy.

In addition to counting the “yes” checks as described above, the following three modifiers apply:

1. **High and extreme risk.** One or more disease indicators signals at least high risk. If there is also hyposalivation, the patient is at extreme risk. Even if there are no positive disease indicators the patient can still be at high risk if the risk factors definitively outweigh the protective factors. Think of the caries balance: Visualize the balance diagram as illustrated above.

2. **Low risk.** If there are no disease indicators, very few or no risk factors and the protective factors prevail, the patient is at low risk. Usually this is obvious.

3. **Moderate risk.** If the patient is not obviously at high or extreme risk and there is doubt about low risk, then the patient should be allocated to moderate risk and followed carefully, with additional chemical therapy added. An example would be a patient who had a root canal as a result of caries four years ago and has no new clinical caries lesions, but has exposed tooth roots and only uses a fluoride toothpaste once a day.

**Protective Factors**

Protective factors are environmental factors or chemical therapy that help to swing the caries balance to caries prevention or reversal. The most important factors that are proven effective are:

- **a.** Lives, goes to school or works in a fluoridated drinking water area.
- **b.** Uses a fluoride toothpaste once daily.
- **c.** Uses a fluoride toothpaste at least twice daily. (It is well established that twice daily provides considerable added benefit. If the patient provides a yes to question c, a yes should be marked to question b.)
- **d.** Uses a high-concentration prescription (5,000 ppm F) fluoride toothpaste twice daily.
- **e.** Has had fluoride varnish applied in the last six months.
- **f.** Uses 0.05% sodium fluoride mouthrinse daily.
- **g.** Uses 0.12% chlorhexidine gluconate mouthrinse daily for one week each month as prescribed for caries control or other proven antibacterial treatment.¹
- **h.** Has normal adequate salivary flow and function by inspection or measurement. Each of these items with a positive response receives a “yes” score.

Note: Xylitol use is no longer listed as a protective factor in this revised CRA version as the evidence is limited.²³

For patients with high-frequency carbohydrate consumption, xylitol gum or lozenges can be considered as substitutes for fermentable carbohydrates.

Determining the Caries Risk as Low, Moderate, High or Extreme

Add the number of “yes” checks for each of the risk-factor and protective-factor columns. Use these numbers to determine whether the patient has a higher risk-factor score than a protective-factor score or vice versa. This enables a determination of low, moderate or high risk determined by the balance between disease indicators/risk factors and protective factors. The “yes” indications are also used to modify behavior or determine additional therapy (see below). The use of a modified caries balance (FIGURE 2) to visualize the caries risk and the contributions of disease indicators, risk factors and protective factors will be helpful.

- **High and extreme risk.** One or more disease indicators signals at least high risk. If there is also hyposalivation, the patient is at extreme risk. Even if there are no positive disease indicators, the patient can still be at high risk if the risk factors definitively outweigh the protective factors. Think of the caries balance: Visualize a scale (FIGURES 1 and 2).
Low risk. If there are no disease indicators, very few or no risk factors and the protective factors prevail, the patient is at low risk. Usually this is obvious.

Moderate risk. If the patient is not obviously at high or extreme risk and there is doubt about low risk, then the patient should be allocated to moderate risk and followed carefully with additional chemical therapy added. An example would be a patient who had a root canal as a result of new clinical caries lesions but has no new clinical caries lesions but has exposed tooth roots and only uses a fluoride toothpaste once a day.

Chemical Therapy Needed According to the Caries Risk Assessment

The following guidelines have been used and proven by a practice-based clinical trial and by outcomes assessment in thousands of patients.9,23 Chemical therapy, such as fluoride toothpaste, must be included in the treatment plan for all patients (even low risk).24 Fluoride-containing agents are likely to be sufficient to maintain a healthy caries balance in low-risk or moderate-risk patients. Restorative work as needed will be included in conjunction with the chemical therapy. The restorative work, which is typically needed in high-risk patients, must be done according to the principles of minimally invasive dentistry.25 The biggest issue related to success of the CAMBRA treatment is compliance with the chemical therapy, especially when it is home-use. It is essential to work with the patient through motivational interviewing and counseling so that they use the home-use regimens as prescribed or the therapy will not be effective.

Low-Caries-Risk Chemical Therapy

The guideline is to “keep it simple.” Whatever the patient is doing appears to be working. If the plaque levels are low, oral hygiene looks good and the patient uses a fluoride toothpaste daily, then the recommendation is simple: “Keep doing what you are doing and use an over-the-counter fluoride toothpaste (1,000–1,450 ppm F) at least twice daily.” Recall for a follow-up visit at 12-month intervals.

Moderate-Caries-Risk Chemical Therapy

The moderate-caries-risk patient needs additional therapy to keep them where they are, or better, to move them to low caries risk. Two alternatives are given, depending on the level of compliance.

■ Alternative 1: Over-the-counter fluoride toothpaste twice daily plus 0.05% sodium fluoride mouthrinse daily at night. The patient should also be counseled to reduce between-meal snacking and to conscientiously follow this regimen.

■ Alternative 2: Prescription high-fluoride (5,000 ppm F) toothpaste at least twice daily plus counseling on reducing between-meal snacking of fermentable carbohydrates (substituting with xylitol-containing lozenges or candies). This regimen is very simple and is recommended for those who may not comply with the toothpaste plus fluoride mouthrinse as in Alternative 1. The disadvantage is the need to prescribe the fluoride toothpaste and the additional cost. The advantage of this second alternative is the simplicity of the protocol and better likelihood of compliance. Recall at six-month intervals for follow-up visits.
High-Caries-Risk Chemical Therapy

The high-caries-risk patient must have antibacterial therapy to lower the bacterial challenge. Fluoride alone, at whatever concentration and frequency, will not be enough and the caries will continue to develop. The best proven antibacterial therapy currently available is chlorhexidine mouthrinse (or gel). It is not ideal, as it is only partially effective. It was proven effective in two clinical trials provided a specific regimen is used.\textsuperscript{1,23} New and better therapy will be available in the future. SDF has recently gained popularity and guidelines for use in young children have been published.\textsuperscript{26} There are several systematic reviews on SDF,\textsuperscript{27–29} but it has severe staining as a side effect and can only be used in limited settings. Hypochlorite (bleach)-based antibacterial carries rinse is also marketed, but at the time of writing there is no published clinical trial demonstrating its efficacy and there may be safety concerns for use in children. New antibacterial agents are in development, specifically for caries in children. New antibacterial therapy currently available is SDF, but it has severe staining as a side effect and can only be used in limited settings.

As the time of writing, the following is the proven chemical therapy for high-caries-risk patients.\textsuperscript{1,9}

There are three components:

a. Fluoride varnish applied in the clinic at the time of the clinical visit and reapplied every four to six months (for children and adults).

b. Brushing with a prescription, high-fluoride (5,000 ppm F) toothpaste, at least twice daily, plus counseling on reducing between-meal snacking of fermentable carbohydrates.

c. Rinse for one minute once daily for one week each month with 10 ml of a chlorhexidine gluconate mouthrinse (0.12%). This should be done at least one hour apart from the fluoride toothbrushing, preferably last thing at night before bed. The regimen is to be continued for at least a year until the disease is controlled and the risk level is lowered. Recall at four- to six-month intervals for follow-up visits.

Extreme-Caries-Risk Chemical Therapy

The extreme-caries-risk patient must have antibacterial therapy to lower the bacterial challenge. Fluoride alone, at whatever concentration and frequency, will not be enough and the caries will continue to develop. The therapy is the same as for high risk (including antibacterial therapy) plus additional buffering.

a. Fluoride varnish applied in the clinic at the time of the clinical visit and reapplied every four to six months (for children and adults).

b. Brushing with a prescription, high-fluoride (5,000 ppm F) toothpaste, at least twice daily, plus counseling on reducing between-meal snacking of fermentable carbohydrates.

c. Rinse for one minute once daily for one week each month with 10 ml of a chlorhexidine gluconate mouthrinse (0.12%). This should be done at least one hour apart from the fluoride toothbrushing, preferably last thing at night before bed. The regimen is to be continued for at least a year until the disease is controlled and the risk level is lowered to moderate or low.

d. Rinse ad libitum throughout the day every day with a baking soda solution made fresh daily (2 teaspoons in 8 ounces (250 ml) of water).

e. In cases that are not responding, consider adding the home use of fluoride trays with 5,000 ppm F gel for five minutes daily. Recall at three- to four-month intervals for follow-up visits.

High- and Extreme-Caries-Risk Patients — Guiding Principles

In the case of high- and extreme-caries-risk patients, their caries progression cannot be controlled by conventional fluoride therapy and conventional restorative work alone. All clinical studies on such subjects clearly show major caries progression in spite of combined fluoride and restorative therapy. Therefore, antibacterial therapy, dietary modification, fluoride therapy and minimally invasive restorative procedures must all be used in combination to manage dental caries in high- and extreme-risk patients. In extreme-risk patients, pH control must also be added as described above. In cases where patients do not appear to be responding, additional therapy may be needed, such as home-use fluoride gel, additional antibacterial therapy such as SDF and, very importantly, additional help to assist the patient with compliance.

Implementation in a Clinical Practice Setting — Patient and Practice Commitments

Implementing the CAMBRA system delivers to dental practices a new capability to manage caries and influence patient behavior. While the CAMBRA system involves changing patients’ mindsets and attitudes, it may involve changing dental team members’ mindsets and attitudes as well. With training and coaching, support and encouragement, dental staff members can learn how to interview patients effectively using motivational interviewing (MI) skills and gain self-satisfaction using them. They can learn how to assist patients in setting self-management goals and achieving them. They can build on their skills in delivering oral health education tailored to patients’ oral health literacy levels.
Implementing CAMBRA into practice goes smoother when the entire team is engaged, kept informed and able and encouraged to give input and feedback. Making decisions as democratically as possible helps to keep the team invested. Decisions principally involve how to incorporate CAMBRA into the workflow. CAMBRA does add time to the patient visit and this requires scheduling adjustments. Whether the additional time is significant or nominal depends upon the dental team members’ communication proficiency and time-management skills. With training and experience, both improve over time.

The questions on the CRA form are asked in an open-ended fashion using MI tactics. MI is a way of creating effective dialogue with patients so patients will share genuinely their health behaviors.30,31 Open-ended questions require more time, thought and effort for patients to answer, but they elicit helpful insights. Sometimes ambivalence to making health behavior changes surfaces. MI guides patients through their ambivalence. The interviewer’s affirmations are designed to empower patients by helping them to recognize their intrinsic strengths. The interviewer’s reflective listening allows patients to clarify misinterpretations and add more depth to their responses. Summaries by the interviewer are a way of pulling together the information gathered during the CRA in order to guide patients toward action.

The benefits of taking time to perform the CRA using MI skills are that patients are more likely to take self-responsibility and make sustainable health behavior changes when they select goals that they believe are important and achievable. Sometimes patients prefer to break goals into incremental steps; in such cases, progress is monitored at each patient encounter. While not reimbursable by payers, reporting the Current Dental Terminology (CDT) Code for motivational interviewing, D9993, can be used to document how providers are utilizing MI with patients to improve their oral health outcomes.

A prepared outline for each type of CAMBRA visit (initial, recall, treatment) and standard talking points promote visit consistency for all patients. Scripting patient education helps to keep the visit on track, but scripting must also allow for differences in patients’ oral health literacy levels. A CDT code, D9994, has been added in the dental case management series to document patient education to improve oral health literacy. With attention to time management, the added visit length does not detract from overall practice productivity.

When all clinical staff members are trained on the CAMBRA system, any available staff member can be deployed to perform parts of the CAMBRA component of the patient visit.

In the course of CAMBRA visits, staff will invariably encounter patients who will struggle to make changes and adhere to their caries self-management goals. With coaching, dental staff members can learn how to help patients who have low self-efficacy, that is, little confidence in their ability to make changes. YouTube videos and continuing dental education courses/webinars can assist with didactic training in coaching techniques.

Another key decision relates to how the therapeutic products will be made available to the patients. Options include writing prescriptions. If the patients will receive prescriptions, the dental staff will need to make sure the selected pharmacy actually stocks the products. Another option is to dispense the products at the practice, either by selling them on a retail basis or on a fee basis using CDT code D9630. The option to make the products available gratis, although very generous, does not necessarily lead to a commitment by the patients to use them. Even if the practice does not want to charge full price, a nominal fee reinforces the notion to the patient that the products have value. If the CAMBRA therapeutics are dispensed at the practice, dental staff will need to find the time and space to maintain the inventory and follow rules for dispensing the prescription drugs.

Taking care to tailor the delivery of information to patients’ oral health literacy levels improves patient understanding. A concise written summary of patients’ self-management goals is helpful for postvisit recall. TABLE 2 is an example of a check sheet that can be used to assist patients to determine their specific goals.

Although the entire dental team is involved, dental practices may benefit from having a CAMBRA champion helping to drive the implementation process. The CAMBRA champion may be a dentist, dental assistant, dental hygienist or dental care coordinator. The CAMBRA champion will identify resources, such as CAMBRA webinars, YouTube videos and continuing dental education courses, arrange lunch-and-learn meetings, speak to dental supply representatives about new products, function as a troubleshooter and keep the team motivated. It behooves
the CAMBRA champion to take the time to check in with staff during staff meetings and informally. The CAMBRA champion should stay sufficiently attentive to the clinic environment to identify opportunities and barriers proactively to support long-term sustainability of the CAMBRA system in the practice.

When patients understand caries as a chronic disease and adhere to their personalized caries self-management plans, the behavioral changes they make are likely to be more sustainable. They are more motivated to keep their appointments and complete their treatment plans. They don’t want to face recare due to failure to manage the aspects of caries disease that are within their control. The reward for staff is satisfaction in successfully managing patients with the best possible care.

**Future Directions in Caries Management and Risk Assessment**

Risk-based noninvasive caries management, as embraced in CAMBRA, effectively and significantly lowers the occurrence of new caries lesions in continuing dental patients. However, CAMBRA falls short of eliminating caries risk entirely. Additional research and emerging therapies aim for future advances. For the practicing dentist, implementing up-to-date evidence-based approaches is key to providing patients with the best possible care.

CRA is strongly predictive but is not deterministic: Even with widely vetted CRA instruments, some patients who appear to be low risk will develop active disease, while not all patients who seem to be high risk are destined to have cavities. Recent developments in personalized dentistry, notably the incorporation of genetic information, promise new, precise insight into caries risk but may be many years from practical application. For the clinician today, no single existing method perfectly predicts future caries. The CAMBRA risk assessment and management guidelines offer a straightforward protocol, grounded in evidence, but are not intended to be prescriptive. Adding clinical reasoning and judgment allows the clinician to work collaboratively with the patient to develop a caries management plan that accounts for individual patient preferences, life situations and goals.

The effectiveness of anticaries chemical therapies will improve with better treatments to manage plaque biofilms and reduce cariogenic bacterial challenge. Classic 20th century experiments underscored the importance of lactobacilli and mutans streptococci in caries development; yet, species-specific therapies, such as an anticaries vaccine, have not proven successful. Modern concepts view the oral microbiome as an interconnected and dynamic system featuring symbiotic relationships between microbiota, the host and the oral environment. In this model of oral health and disease, newer therapies will seek to modify the microbiome itself (e.g., probiotics or prebiotics), modulate biofilm growth and metabolism or manipulate the oral environment (e.g., enhance saliva and/or host defenses), leading to a health-promoting balance.

Many existing anticaries therapies rely on routine patient engagement in home care. Poor adherence often undermines what would be efficacious treatments, but achieving lasting behavior change at the individual patient level is notoriously difficult. Motivational interviewing in dental settings has demonstrated success as a communication strategy to promote patient behavior change. Further effort is needed to enhance training and educational opportunities for integrating motivational interviewing techniques into dental practice.

In addition to helping each individual patient, dental professionals can support broader health-promoting policies in their communities. For example, dentists can be effective advocates for community water fluoridation and reducing sugar consumption. The World Health Organization guidelines for limiting sugar consumption were based partly on evidence that lower sugar intakes would dramatically reduce tooth decay worldwide.

One of the barriers to adoption of the CAMBRA system, or other similar systems, is that reimbursement by insurance carriers is currently very limited for dental providers for doing CRA and the related chemical therapy and patient guidance. This situation is changing as evidence accumulates.

**Conclusions**

This paper provides a practical, straightforward, evidence-based update for the clinician to use in practice for patients aged 6 through adult. The evidence described here consists of a wide body of background literature, two clinical trials and several clinical outcomes studies in thousands of patients. Use of this updated CAMBRA tool allows
preparation of an individualized, risk-based treatment plan that combines chemical therapy (fluoride with or without an antibacterial agent) with necessary restorative treatment for a minimally invasive successful outcome. Fluoride therapy must be supplemented by antibacterial therapy in high- and extreme-caries-risk patients.

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REFERENCES

7. Foundation. Ms. Baisley is a fourth-year dental student at UCSF.

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STRONG PROTECTION.
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An Updated CAMBRA* Caries Risk Assessment Tool for Ages 0 to 5 Years

John D.B. Featherstone, MSc, PhD; Yasmi O. Crystal, DMD, MSc; Benjamin W. Chaffee, DDS, MPH, PhD; Ling Zhan, DDS, PhD; Francisco J. Ramos-Gomez, DDS, MS, MPH

ABSTRACT This paper provides a practical caries risk assessment (CRA) tool for use by the clinician in caries management by risk assessment (CAMBRA) in 0- to 5-year-olds that updates the original tool published in 2007 and reviewed in 2010. This CRA incorporates evidence-based research from recent implementation studies and is the basis of a risk-based disease-management model that targets individual risk factors, as fluoride therapy alone may be insufficient for high-risk patients.

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Early childhood caries (ECC) in young children aged 0 to 5 years continues to be a major problem, negatively affecting the well-being, development and growth of children and their families.1,2 Severe cases of ECC are very difficult to manage and are often accompanied by future decay.3,4 Assessment of the risk level for future occurrence of dental caries lesions is an important first step in managing dental caries and monitoring oral health improvement over time. Successful management of ECC requires a risk-based approach to formulate an individualized treatment plan using a chronic disease management model, which aims at targeting the risk factors (biological, environmental and social) that contribute to the establishment and progression of this multifactorial disease. This individualized treatment plan should include behavior/lifestyle modification (for diet improvement,
less sugar intake and plaque control) and nonsurgical caries management, in addition to appropriate restorative work. The caries risk level determines the personalized caries-management approach for each patient. Personalization further takes into consideration the behavioral barriers of the individual child (their level of cooperation for restorative treatment and home oral health care) and the social context of the child and family.

For decades, there have been numerous attempts to provide methodology to predict future dental caries, to assess caries risk and to manage the disease process. There are many publications related to these topics, including those for children aged 0 to 5 years. It is not the aim of the present paper to review these published works.

The purpose of this paper is to provide an updated, evidence-based, practical CRA tool for use by dental practitioners for young children aged 0 to 5 years. The procedures and philosophy known as caries management by risk assessment and abbreviated to CAMBRA were published in the Journal of the California Dental Association in 2007 for patients aged 6 years through adult as well as for young children aged 0 to 5 years and have been utilized for more than 15 years in the teaching clinics of the University of California, San Francisco, School of Dentistry (UCSF) and at the University of California, Los Angeles, School of Dentistry pediatric dental clinic as well as several community health centers in California.

Caries Balance as the Basis for Caries Risk Assessment

Many papers have contributed to our understanding of the overall mechanism of dental caries and the roles of fluoride and other agents in the management of the disease process. Based upon decades of research on dental caries by many investigators, we proposed the “caries balance” as a clinically oriented way of evaluating the continuum between progression or reversal of caries in the mouth. Driving this continuum is the balance between the biological caries risk factors (pathological factors), which are, primarily, cariogenic (acid-producing) bacteria, fermentable carbohydrates and salivary dysfunction, and protective factors, which are sufficient saliva, antibacterial agents and remineralization that requires calcium, phosphate and fluoride.

Caries Risk Assessment for Ages 0 to 5: Evidence to Date From UCSF Clinical Outcomes Studies

Assessment of caries risk for each patient is essential as the basis for the management of dental caries for patients of all ages. Caries risk is the likelihood of the patient having new caries lesions (white spots, cavitated lesions) in the near future. The CAMBRA system has been shown to be highly predictive of future caries in three different studies, totaling more than 20,000 patients, for the age group 6 years through adult and for the age group 0 to 5 years. The results of the outcomes studies in the UCSF pediatric dental clinics are summarized here as the basis for the updated CRA that follows.

An evaluation published in 2016 described the importance of individual risk-assessment items in relation to providers’ CRA decisions and clinical outcomes. This study assessed the relative importance of 17 CRA items, for children aged 6 months to 72 months, in dental provider’s decision-making regarding CRA and in association with clinically evident dental caries at follow-up. At baseline, 3,810 children were assessed and follow-up data were available for 1,315 after four to 36 months. The CRA procedures used to assess low, moderate, high or extreme risk were as published previously by Ramos-Gomez and co-workers. Extreme risk was defined as high risk plus hypposalivation. The 17 CRA indicators are listed in Table 1 and can be categorized to align with the American Association of Pediatric Dentistry risk-assessment item types: biological and environmental risk factors, protective factors and clinical indicators. A provider-assigned risk category (low, moderate, high or extreme) was strongly associated with follow-up decay (Figure). There were very few extreme-risk patients (2 percent), so they...
were combined with high-risk patients. 

**FIGURE 1** also shows similar results for ages 6 through adult CAMBRA CRA for comparison. Both studies showed very good assignment of caries risk by multiple providers using the CAMBRA procedures. Of the 17 CRA indicators used in children aged 0 to 5 years, seven were statistically significantly associated with decay at follow-up (TABLE 1, COLUMN 2). In further assessment of the data using random forest analysis, only four of those seven baseline CRA items were independently associated with follow-up decay (TABLE 1, COLUMN 3).

Four items were evident – decay, heavy dental plaque, recent restorations and frequent snacking – with baseline evident decay being the strongest predictor.

A subsequent clinical outcomes study in the UCSF pediatric dentistry clinics examined cumulative dental treatment (restorations) over two years in children initially aged 6 months to 72 months in relation to baseline CRA indicators. Of 2,188 available patients, 919 had no follow-up exam and 1,260 returned for follow-up. From those, 519 were excluded (treated under general anesthesia or sedation) and the cumulative restorative treatment of the remaining 750 treated in the conventional clinic setting was assessed in the analyses. All patients had a CRA at baseline and risk was assigned according to the published procedures, based upon the provider’s judgment after evaluating the 17 CRA indicators as shown in **TABLE 1**, **COLUMN 1**. Of the 750 children included, at baseline, 21 percent were classified as low risk, 25 percent as moderate, 53 percent as high and 1 percent as extreme. Nearly all children received fluoride varnish (FV) at baseline. Thereafter, high-risk children were intended to receive FV every three to four months (for those who attended follow-up visits) and every six months for moderate-risk children. FV was not indicated for low-risk patients.

Risk category was associated with the cumulative mean number of treated teeth over two years, namely 0.53, 1.02 and 4.47 for low, moderate and high/extreme, respectively. Receiving any treatment was greatest for high/extreme-risk children but not statistically significantly different between low-risk and moderate-risk children. More than 50 percent of the cumulative restorative treatment performed in the high-risk group was done in the first 190 days after assessment, presumably reflecting existing treatment needs at the time of CRA, a time period in which the low- and moderate-risk groups required almost no restorative treatment. The respective increments for low-, moderate- and high/extreme-risk groups from 190 days to two years, which presumably is a better measure of new caries lesions after the initial CRA, were 0.51, 0.89 and 2.11, clearly showing a continuing need for restorations in the high/extreme-risk group in spite of fluoride preventive measures (figure 2 in Chaffee et al.29). As in the previous study, heavy plaque, obvious decay and recent restorations were strongly associated with subsequent decay.

<table>
<thead>
<tr>
<th>Baseline CRA item</th>
<th>Column 1 ***</th>
<th>Column 2 ***</th>
<th>Column 3 ***</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Risk indicators</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low socioeconomic status</td>
<td>YES</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>Frequent snacking</td>
<td>YES</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>Caregiver or sibling has tooth decay</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottle used that is not water or milk**</td>
<td>**</td>
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</tr>
<tr>
<td>Bottle used continually</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottle used in bed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special care needs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inadequate saliva flow</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salivary reducing medications</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Protective items</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community water fluoridation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drinks fluoridated water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brushes daily with fluoride toothpaste</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluoride varnish in past six months</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caregiver uses xylitol</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Clinical disease indicators</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evident tooth decay or white spots</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Heavy dental plaque on the teeth</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Recently placed restorations (past two years)</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

**TABLE 1**

Caries Risk Assessment Components as Currently Used in the UCSF Pediatric Dental Clinics for Patients Aged 0 to 5 ***

<table>
<thead>
<tr>
<th>Baseline CRA item</th>
<th>Column 1 ***</th>
<th>Column 2 ***</th>
<th>Column 3 ***</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Risk indicators</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low socioeconomic status</td>
<td>YES</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>Frequent snacking</td>
<td>YES</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>Caregiver or sibling has tooth decay</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottle used that is not water or milk**</td>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottle used continually</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottle used in bed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special care needs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inadequate saliva flow</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salivary reducing medications</td>
<td>YES</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Protective items</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community water fluoridation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drinks fluoridated water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brushes daily with fluoride toothpaste</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluoride varnish in past six months</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caregiver uses xylitol</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Clinical disease indicators</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evident tooth decay or white spots</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Heavy dental plaque on the teeth</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Recently placed restorations (past two years)</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

*** Use of a bottle that contains fluids other than water or milk was significant in a later clinical outcomes study.29

**CRA items are based upon Ramos-Gomez et al.6,7,16 Column 1 lists the 17 CRA items utilized in these clinics. Column 2 highlights the seven CRA items found statistically significantly related to decay at follow-up (n = 3,810 at baseline; n = 1,315 at follow-up) in Chaffee et al, 2016.31 Column 3 highlights the four CRA items found independently associated with decay at follow-up by random forests analysis in the same study.31
with nonmilk or nonwater were also significantly associated with subsequent decay. However, it should be noted that the use of milk in a bottle overnight and nursing on demand in the presence of cariogenic bacteria provides a prolonged acid challenge that increases the risk for caries and should be strongly discouraged.

The significant associations in the previous two studies form the basis for the updated CRA form presented here. As there was very limited data for the extreme-risk category, this updated version of the CRA will use three risk categories for 0- to 5-year-olds, namely low, moderate and high.

Caries Risk Assessment — Practical Stepwise Guidelines

The following step-by-step guide is for use of the CAMBRA system with young children aged 0 to 5 years. Details are given in the following sections. The updated 0- to 5-year-old CRA procedure (TABLE 2) identifies low, moderate and high risk for this age group. CRA takes place as part of the regular comprehensive or periodical oral exam in the following sequence or in a sequence that suits the workflow of each individual practice or practitioner. The CRA is the basis for formulating an individualized caries management treatment plan. Here are the steps in the process:

1. From the medical, dental and social histories reported, compile relevant data to record in the CRA form (TABLE 2, COLUMNS 2 and 3).
2. Talk to the caregiver (mother or other caregiver) to make sure all questions listed in the CRA form are answered (TABLE 2, COLUMNS 2 and 3). The discussion will include the risk factors and protective factors, leading to the subsequent clinical exam and later to a discussion of self-management goals.
3. Conduct a clinical examination in an age-appropriate way: knee to knee or with the child sitting on their own, ideally with the parent being able to be shown the findings. Start with detecting and recording presence of plaque, ideally with a visible plaque index score (VPI), and showing parents the problem areas. This answers the heavy-plaque question in TABLE 2, COLUMN 2. Follow with a toothbrush prophylaxis to remove debris and clean surfaces for better visualization during the exam, showing parents the proper brushing technique. The use of a flosser for interdental plaque removal, when appropriate, should also be demonstrated.
4. From the intraoral examination, detect and record caries lesions from their earliest stages (white spots, which can be arrested or reversed by remineralization) to advanced caries (cavitation). From radiographical examination (if available depending on the child’s age and cooperation), detect and record radiographic decay.
5. Assess and document the caries risk as low, moderate or high utilizing data from the complete CRA form with data included in Columns 1, 2 and 3 of TABLE 2. The procedure is further described later in this segment and in TABLE 2. With children aged 0 to 5 years, the questions will likely be answered prior to the clinical examination.
6. Produce and document a caries management plan that addresses all the risk factors that may contribute to the development or progression of disease for that specific patient, including lifestyle and behavior modification for caregivers and the child to achieve plaque control and diet improvements.
7. Prescribe and/or provide chemical therapy for the patient that includes fluoride, with or without antibacterial therapy, based upon the caries risk level and the age of the patient. Details are described later in this segment. Consider integrating motivational interviewing principles with caregivers and patients (when age appropriate) to set up achievable goals for home management plans.
8. Develop a restorative treatment plan that takes into consideration age, behavior (cooperation for treatment delivery), health status and social determinants, favoring minimally invasive restorative procedures to conserve tooth structure whenever possible, restoring function and aiming at providing that patient with the means to achieve adequate plaque control.
9. Establish periodicity of recalls and review at intervals appropriate to the caries risk status to continue active surveillance of noncavitated lesions, provide in-office preventive measures and reinforce behavioral changes and adherence to prescribed daily home regimes.
### TABLE 2

Updated CAMBRA*** Caries Risk Assessment Form for Patients Aged 0 to 5 (January 2019); available in its original form as a patient download at cda.org/CAMBRA4)

<table>
<thead>
<tr>
<th>Caries risk component</th>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological or environmental risk factors*</td>
<td></td>
<td></td>
<td>Check if Yes**</td>
</tr>
<tr>
<td>Frequent snacking (more than three times daily)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uses bottle/nonspill cup containing liquids other than water or milk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother/primary caregiver or sibling has current decay or a recent history of decay (see high-risk description below)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family has low socioeconomic/health literacy status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medications that induce hyposalivation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protective factors**</td>
<td>Check if Yes**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lives in a fluoridated drinking water area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drinks fluoridated water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uses fluoride-containing toothpaste at least two times daily — a smear for ages 0–2 years and pea sized for ages 3–6 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has had fluoride varnish applied in the last six months</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biological risk factors — clinical exam*</td>
<td></td>
<td></td>
<td>Check if Yes**</td>
</tr>
<tr>
<td>Cariogenic bacteria quantity — Not currently available</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy plaque on the teeth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disease indicators — clinical exam</td>
<td></td>
<td></td>
<td>Check if Yes**</td>
</tr>
<tr>
<td>Evident tooth decay or white spots</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recent restorations in last two years (new patient) or the last year (patient of record)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final Score:</td>
<td>Column 1 total</td>
<td>Column 2 total</td>
<td>Column 3 total</td>
</tr>
<tr>
<td>Yes in column 1: Indicates high risk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes in columns 2 and 3: Consider the caries balance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final Overall Caries Risk Assessment Category</td>
<td>High ☐</td>
<td>Moderate ☐</td>
<td>Low ☐</td>
</tr>
</tbody>
</table>

***CAMBRA is a registered trademark of the University of California, San Francisco.

* Biological and environmental risk factors are split into a) question items, b) clinical exam.

** Check the yes answers in the appropriate column. Shading indicates which column to place the appropriate yes.

---

### FIGURE 3

Instructions for using the caries risk assessment form.

**CMBRA is a registered trademark of the University of California, San Francisco.**

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**Determining the caries risk as high, moderate or low**

1. **High risk.** If there is a “yes” in column 1 (one or both disease indicators), the patient is at high risk. Even if there are no “yes” disease indicators, the patient can still be at high risk if the risk factors definitively outweigh the protective factors. Mother or caregiver with current or recent dental decay most likely indicates high caries risk for the child. Use the “yes” checks for each of the risk factor and protective factor columns to visualize the caries balance as illustrated below. The balance clearly to the left indicates high caries risk, whereas clearly to the right the risk level is low.

2. **Moderate risk.** If there are no disease indicators and the risk factors and protective factors appear to be balanced, then a moderate caries risk determination is appropriate. If in doubt, move the moderate to a high classification.

3. **Low risk.** If there are no disease indicators, very few or no risk factors and the protective factors prevail, the patient is at low risk.

Any items checked “yes” may also be used as topics to modify behavior or determine additional therapy. Use the following modified caries balance to visualize the overall result and determine the risk level:

---

**Additional caries-related components for caregiver/patient counseling**

- Frequency of use of fluoride toothpaste and amount
- Use of silver diamine fluoride in appropriate cases
- Dietary counseling to reduce frequency and amount of fermentable carbohydrates, especially sucrose, fructose (high-fructose corn syrup) and continual fruit juice (e.g., apple juice)
- Bottle used continually, bottle used in bed or nursing on demand
- Child has developmental problems/child has special care needs (CHSCN)
- Inadequate saliva flow and related medications, medical conditions or illnesses

**Self-management goals (discussed and agreed with parent/caregiver)**

1. ___________________________________________

2. ___________________________________________
10. Reassess and document the caries risk level at each recall and modify the caries management plan as necessary.

Steps 1–4 comprise the CRA, which informs the development and implementation of a personalized caries management plan. Hence, CAMBRA is a two-phase process involving both CRA and management of caries as a biologically determined, clinical disease. Steps 1, 3 and 4 are familiar elements of any conventional oral examination for this age group and form the basis of the CRA. Step 2 compiles a few simple questions (as listed in the CRA form in Table 2, Columns 2 and 3) to attempt to determine the cause of the ongoing disease or to determine whether it is under control. Those biological risk factors that have been shown to be statistically significantly related to ongoing caries in previous studies are included here.29,33 Table 2 is a ready-to-use CRA form that provides a visual summary of the factors that contribute to the overall caries risk assignment. Instructions for its use and definitions of terms follow here and are briefly summarized in the second page of the form (Figure 3).

Biological and Environmental Risk Factors (Pathological Factors) — Table 2, Column 2

Biological risk factors contribute directly to the initiation or progression of dental caries. They include an assessment of cariogenic bacteria and fermentable carbohydrates, the two required conditions for dental caries.21–23,33 Additional factors such as frequency of ingestion of fermentable carbohydrates and salivary-reducing medications have been established as important (Table 1). The following are the risk factors utilized in the updated CRA form.

1. Frequent snacking on fermentable carbohydrates at least three times daily outside of meal times.

Frequent carbohydrate intake results in a prolonged acidic environment in the plaque that dissolves the tooth mineral and can act as a driving force to reinforce the overgrowth of cariogenic bacteria and the suppression of oral commensal (beneficial) bacteria, leading to future caries development.34 Fermentable carbohydrates such as sucrose, fructose (high-fructose corn syrup), glucose and cooked starch are included.

Fruit juice (e.g., apple juice) is an important but often overlooked source of fermentable carbohydrates among young children.

2. Use of bottle or nonspill cup containing liquids other than water or milk.

This provides a continuous ingestion of carbohydrates, such as from fruit juices, that leads to a continual acid environment in the plaque. It should be stressed that the use of milk in a bottle overnight and nursing on demand in the presence of cariogenic bacteria provide a prolonged acid challenge that increases the risk for caries and should be strongly discouraged.

3. Mother/primary caregiver or sibling has current decay or a recent history of decay.

Presence of recent decay indicates they have high levels of cariogenic bacteria, especially mutans streptococci (MS), which can be transmitted to the child. Early colonization of MS by age 3 will increase the child’s risk for developing caries.34,35 Current or recent decay in the parent or caregiver is an important indicator of potential high caries risk for the child. This becomes more important in infants with few teeth present, where signs of additional risk factors are not yet evident, and is supported by the strong correlation found in numerous studies.36–39

4. Family has low socioeconomic/health literacy status.

Low socioeconomic status cannot usually be changed and is not a biological contributor to the caries process. However, as a social determinant of health for many other diseases, it is one of several statistically significant factors associated with high caries risk.29,31 Practitioners should account for a challenging family socioeconomic context in formulating a personalized caries management plan. Similarly, low health literacy is not a biological risk factor, but it is often associated with socioeconomic levels and contributes to increased risk of disease. Importantly, it is possible to educate the parent/primary caregiver regarding caries and caries prevention.

5. Use of medications that induce hyposalivation.

Hyposalivation is a side effect of some of the most commonly prescribed medications, such as those used to treat allergies, asthma, mental disorders and cancer.40 The risk of dry mouth increases with the number of medications prescribed.

In the risk-assessment procedure, any items on this list with a positive response are marked with a “yes” (Table 2, Column 2). Each yes adds to the risk level. Items 1 and 2 can be modified by behavioral management. A yes to item 3 may indicate a potentially very-high-risk patient who requires additional care and therapy.

Protective Factors — Table 2, Column 3

Protective factors are environmental factors or chemical therapy that help to swing the caries balance to caries prevention or reversal. The factors included in the newly proposed CRA form are:

1. Lives in a fluoridated drinking water area.

2. Drinks fluoridated water.

   The beneficial effect of drinking fluoridated water is well established.

3. Uses a fluoride-containing toothpaste at least twice daily.

   The beneficial effect of brushing
with fluoridated toothpaste has been well established in numerous clinical trials and is a major factor in reductions in caries over recent decades. The American Academy of Pediatric Dentistry (AAPD) recommends the use of a smear of fluoride toothpaste for ages 0 to 2 years and a pea-sized application for ages 3 to 6 years. For children aged 0 to 6 years, it is recommended that the parent/caregiver brushes the child’s teeth or supervises toothbrushing twice a day. Parent-supervised toothbrushing with fluoride toothpaste at least twice daily provides considerable added benefit greater than once daily.

4. Has had FV applied in the last six months.

The caries-reducing benefit of FV is well established, including when used in young children. Each of these items with a positive response receives a yes score in TABLE 2, COLUMN 3.

Note: Xylitol use by the caregiver is no longer listed as a protective factor in this revised CRA version as the evidence of its antimicrobial effects to achieve caries prevention is limited for adults or children.

**Biological Risk Factors — Clinical Exam — TABLE 2, Column 2**

1. **Cariogenic bacteria**

   quantitive assessment.

   There is ample evidence that cariogenic bacteria levels are strongly related to caries risk. However, at the time of writing there is no validated chairside test commercially available for measuring cariogenic bacterial levels. Therefore, cariogenic bacteria counts have been eliminated from the CRA form in this revised version, although a placeholder has been retained in **TABLE 2** to allow for a quantitative bacteria test to be added back at a later date when an evidence-based test becomes available.

2. **Heavy plaque on the teeth.**

   This simple measure, as observed by the clinician, has been shown in our clinical outcomes studies in children of all ages and in adults to be a strong indicator of cariogenic bacterial activity and it is strongly related to ongoing caries. This factor may indicate a combination of items that include high levels of cariogenic bacteria, ineffective plaque removal, food accumulation and inadequate brushing with fluoride toothpaste. Gingivitis, or gums that bleed easily, can be a sign of consistent presence of heavy plaque in specific areas and a clinical risk indicator related to the presence of plaque.

   In the risk-assessment procedure, any items on this list with a positive response are marked with a yes (**TABLE 2, COLUMN 2**). Each yes adds to the risk level. Item 2 can be modified by behavioral management.

**Disease Indicators — Clinical Exam — TABLE 2, Column 1**

This category replaces the “Clinical Indicators” category from the previous CRA form. Heavy plaque on the teeth is not an indicator of disease, but rather is a biological risk factor as described previously and likely indicates high levels of cariogenic bacteria as well as poor oral-hygiene practices. Therefore, it moves to the group of biological risk factors identified in the clinical exam.

Disease indicators are the clinically observed results of previous and/or ongoing dental caries destruction of the tooth mineral. They do not contribute to the disease; they are simply manifestations and clinical signs of the effects of dental caries at different stages. Disease indicators fit into two overall descriptions as evaluated in the outcomes assessments over several years of the original CAMBRA CRA form. They are strong indicators of ongoing disease.

   1. **Evident tooth decay or white spots.** This descriptor includes:

      a. Observed cavitation or radiographic evidence of progression into dentin.
      b. White spot lesions (that are new or active) on smooth surfaces.
      c. Radiographic or visual evidence of noncavitated demineralization into the enamel (usually by bitewing radiographs).

   2. **Existing restorations.**

   These are restorations that were placed due to caries in the last two years for a new patient or in the last year for a patient of record. For a new-patient visit, one or more of these disease indicators signals “high caries risk.” For a patient of record at a follow-up visit, any new appearance of indicators 1 or 2 signals “high caries risk.” If present, hyposalivation will require additional care and therapy.

**Determining the Caries Risk as Low, Moderate or High**

1. **High risk.** One or more disease indicators signals high risk. Even if there are no “yes” disease indicators, the patient can still be at high risk if the risk factors definitively outweigh the protective factors. Think of the caries balance: Visualize the modified caries balance as shown in **FIGURE 3**. If the balance is clearly to the left, then the patient is at high caries risk. Mother or primary caregiver with current or recent dental decay most likely indicates high caries risk for the child.

2. **Moderate risk.** If there are no disease indicators and the risk factors and protective factors appear to be balanced, then neither a high-risk nor a low-risk patient is present.
risk assignment is clear. In this case, a moderate determination is appropriate. If in doubt, move the moderate to a high classification.

3. **Low risk.** If there are no disease indicators, very few or no risk factors and the protective factors prevail, the patient is at low risk. If the balance is clearly swung to the right, the risk level is low. When evidence-based chairside quantitative cariogenic bacteria tests become available, a high cariogenic bacterial count will push a low-caries-risk individual to the high-risk category.

The yes indications are also used to modify behavior or determine additional therapy (as follows).

**Caries Management Based on Risk Assessment**

CAMBRA therapies for older children and adults place special importance on chemical therapy, because placing restorations can restore tooth form and function but does not affect the risk factors that caused the disease, such as a cariogenic diet or high levels of cariogenic bacteria in the rest of the mouth. The most evident antimicrobial chemical therapy in children aged 6 years and older and in adults is chlorhexidine mouth rinse. However, use of chemotherapeutic agents in infants and toddlers requires special considerations due to toxicity/safety and behavioral acceptance issues. For this reason, in this age group, most of the recommendations within a caries management plan rely heavily on a chronic-disease management model, where different strategies, such as education about the disease process, motivational interview-style counseling (to change diet practices and plaque-control routines) and periodic evaluation of self-management goals in conjunction with chemical therapy to modify the oral pH environment, are used to target the individual risk factors that can trigger the disease process on the individual patient (frequent snacking, bottle feeding, visible plaque accumulation, etc.). Several publications describe in detail this style of counseling and surveillance.

When addressing oral health in high-risk groups, early intervention and strategic disease management are key. The Disease Management and Risk Assessment (CAMBRA) tool, which provides a method of assessing caries risk in young children, thereby informing treatment plans, self-management goals and recall schedules.

**Low-Caries-Risk Management Protocol**

In evidence-based minimally invasive dentistry, which includes the use of CAMBRA, fluoride, sealants, remineralization substances such as casein phosphopeptide, prevention of early cariogenic bacteria colonization by xylitol product use for family members with caries and acid-neutralization agents such as baking soda wiping after meals/snacks, the patient/caregiver is encouraged to assume responsibility for the level of infection and is educated, instructed and monitored in the proper control techniques. It is the child who has the disease, but it is the health professional’s responsibility to provide the patient and parent/caregiver the appropriate tools to overcome it.

The following care pathways are summarized in Table 3.
patients do not benefit from in-office fluoride applications.56,57 Radiographic examinations, if necessary (contact areas closed and not visible) and feasible (if patient’s cooperation allows), should be performed at 12- to 24-month intervals as per AAPD and ADA guidelines.58,59

**Moderate-Caries-Risk Management Plan**

With no signs of caries lesions at any stage, moderate-risk children will present with several risk factors that indicate that their lifestyle routines can lead them to develop caries in the near future and that additional chemical therapy could prevent frequent acid exposure from tipping the balance to the establishment of disease. Caregivers and children (when appropriate) should be informed on the caries process and counseled on strategies to improve their individual dietary or home-care routines. Fluoride-toothpaste recommendations indicated previously should be stressed, additional forms of fluoride exposure (fluoride in drinking water) should be promoted and children at moderate risk should be recalled at six-month intervals for monitoring of adherence to the improvement of diet and home-care routines. These patients will also benefit from in-office FV applications at six-month intervals. Radiographic examinations should be performed every six to 12 months.

**High-Caries-Risk Management Plan**

Children with obvious signs of caries at any stage and children with several risk factors and minimal fluoride exposure are at high risk of developing more lesions in the future (FIGURE 2). In addition to the chemical therapy (fluoride-toothpaste recommendations and promotion of other forms of fluoride exposure as well as the use of agents that enhance remineralization and acid neutralization or inhibit MS transmission) and behavioral counseling to improve lifestyle changes as mentioned previously, patients at high risk benefit from additional in-office FV applications at three- to six-month intervals. Therefore, three- to six-month recall visits should include FV application, reinforce self-management goals to reduce specific risk factors, promote protective factors and perform active surveillance of lesions at all stages.

The caries management plan should include a restorative treatment plan that aims to limit tissue destruction, diminish sensitivity to allow adequate plaque-control measures and restore function and form, taking into

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**TABLE 3**

**Summary of Care Paths for Caries Management Based on Risk for Children Aged 0 to 5 (modified from Ramos-Gomez et al., 2010†)**

<table>
<thead>
<tr>
<th>Risk category</th>
<th>Diagnostic</th>
<th>Preventive interventions</th>
<th>Restoration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Periodic oral exams</td>
<td>Radiographs</td>
<td>Fluoride</td>
</tr>
<tr>
<td>Low</td>
<td>6–12 mos</td>
<td>2–24 mos</td>
<td>Brush twice daily with F toothpaste*</td>
</tr>
<tr>
<td>Moderate</td>
<td>6 mos</td>
<td>6–12 mos</td>
<td>Brush twice daily with F toothpaste* optimize F intake</td>
</tr>
<tr>
<td>High</td>
<td>3 mos</td>
<td>6 mos</td>
<td>Brush twice daily with F toothpaste* optimize F intake</td>
</tr>
<tr>
<td>High with extensive existing disease</td>
<td>monthly</td>
<td>6 mos</td>
<td>Brush three times daily with F toothpaste* optimize F intake</td>
</tr>
</tbody>
</table>

¥ Smear of fluoride toothpaste for 0- to 2-year-olds, pea-size of fluoride toothpaste for 3- to 6-year-olds.
£ Recommend drinking fluoridated water (from tap or bottled), parental brushing, spit and don’t rinse toothpaste.
* Wipe with baking soda/xylitol, use casein phosphopeptide — amorphous calcium phosphate (ACP/CPP) paste.

Abbreviations: FV = fluoride varnish; ITR = interim therapeutic restoration; SDF = silver diamine fluoride; mos = months.
consideration the cooperation and health status of the patient as well as the family situation. Following principles of minimally invasive dentistry, the choice of restorative treatment (which is typically needed in high-risk patients) could include traditional restorative treatment or nonsurgical therapies (interim therapeutic restorations with glass ionomer, caries arrest with silver diamine fluoride (SDF), etc.) after careful discussion explaining to the parents the risk and benefits of each option and trying to delay or defer more complicated and risky procedures like sedation and/or general anesthesia. The informed consent of the parent is essential following this discussion and the laying out of recommended options.

High-Risk Patients With Extensive Treatment Needs – Additional Guiding Principles

The outcomes studies described previously and the results of our studies of patients aged 6 years through adult show that in-office topical fluoride applications and home fluoride-toothpaste use may not be sufficient to prevent future caries in high-risk patients. A prolonged acidic environment in the plaque created by a frequent sugary/carbohydrate diet and poor oral hygiene leads to microbial dysbiosis and serves as the driving force for caries formation in children, resulting in high caries recurrence in high-risk children. Therefore, home-care behavior modification can be the key to caries management in children.

Children at high risk who already require extensive restorative treatment (more than four restorations, as illustrated in Figure 2B) may benefit from intensive care including protective sealants in surfaces at risk. As studies show that supervised brushing achieves much higher prevention results than brushing alone and supervised brushing should be a major point in the counseling sessions. Brushing three times a day (after every meal) and spitting the toothpaste with no rinsing are simple strategies that may maximize the protective action of fluoride in these children.

Additional possible antimicrobial regimens to consider are wiping/brushing teeth with xylitol and/or baking soda after feedings or meals. Xylitol is noncariogenic and baking soda is an effective acid-neutralizing agent, which can effectively neutralize the oral environment and have antiplaque and antimicrobial effects in children and adults.

For children with numerous cavitated lesions who may need multiple visits to complete restorative care and/or may have limited cooperation for treatment, SDF therapy to achieve caries arrest and desensitization of lesions with no pulpal involvement can be followed at subsequent visits by glass ionomer interim restorations to prevent plaque accumulation and combined with FV at three-month intervals to prevent new lesions. This combination therapy can help to delay or defer more complicated and risky procedures like sedation or treatment under general anesthesia, which is especially important for children under 3 years of age.

Conclusions

Successful management of ECC requires a risk-based approach to formulate an individualized treatment plan using a chronic disease management model, which aims at targeting the risk factors (biological, environmental and social) that contribute to the establishment and progression of this multifactorial disease. This paper provides a practical evidence-based updated CRA tool for the clinician to use in practice for young children aged 0 to 5 years. This updated CRA tool incorporates evidence from recent implementation studies to be used as the basis of such a risk-based caries management treatment plan that aims to restore oral health, as fluoride therapy alone is insufficient for high-risk patients. This approach is considered standard of care for children's oral health.

ACKNOWLEDGMENTS

The many people who have contributed to the development, utilization and the outcomes studies that have provided the evidence for the CAMBRA approach cited here are thanked sincerely. Thousands of patients have benefited to date. The authors would like to acknowledge their pediatric dental programs at UCSF and UCLA that are teaching these modalities to the new generation of pediatric dentists in California, across the U.S. and globally.

REFERENCES

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Caries Management by Risk Assessment — Guidelines To Improve Caries Risk Level Assignments

Douglas A. Young, DDS, EdD, MBA, MS; Susie P. Goolsby, DDS, MSHA; and Peter Rechmann, DMD, PhD

ABSTRACT Applying standard of care in the management of caries is very important. Consequently, a correct assigned caries risk level is paramount in managing caries disease. The objective of this paper is to disseminate guidelines and rationale used in previous studies to improve the performance and accuracy of assessing the caries risk of an individual. These guidelines will aid health care professionals to better understand how to determine the correct caries risk level of their patients. Consequently, these guidelines will foster the ability of properly recommending and prescribing appropriate interventions.

AUTHORS

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*CAMBRA is a registered trademark of the University of California, San Francisco Assessment Guidelines

Performing a risk assessment, used in various industries for centuries, is a scientific process in which variables are evaluated to determine their negative impact on a given situation in a given context. When a risk level has been determined, coordination of resources minimizes or controls the impact of the worst probable outcomes. Regardless of the specific circumstances, the management of risk relies on its proper assessment to prevent under- or overreaction to the unwanted situation in medical disciplines to avoid under- or overtreatment.

In dentistry, a caries risk assessment (CRA) is recommended for identifying the risk for acquiring the disease. Consequently, it is used in developing individualized strategies for prevention and management of the disease. Many CRA tools have been published for clinical use including the American Dental Association (ADA) CRA forms, the caries management by risk assessment (CAMBRA®) CRA form, the American Academy of Pediatric Dentistry (AAPD) CRA tool (CAT) and a computerized program called the Cariogram. However, the evidence for the validity for most of these existing systems is limited. The CRA process is often not standardized for the clinics. Several studies confirmed that in the absence of specific instructions and calibration, different clinicians will assign different and thus incorrect risk levels when using the same CRA form on the same patient.
Caries Risk Assessment Form for Patients Aged 6 Through Adult (available as a download at cda.org/CAMBRA5)

**Patient name:** ___________________ **Chart #:** ___________________ **Date:** ___________________

**Assessment date:** ___________________ **is this (please circle) baseline or recall**

### Disease indicators
(Any one YES signifies likely “high risk” and to do a bacteria test*)

<table>
<thead>
<tr>
<th>YES = CIRCLE</th>
<th>YES = CIRCLE</th>
<th>YES = CIRCLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>New/progressing visible cavitations or radiolucencies into dentin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New/progressing approximal enamel lesions by radiograph</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New/active white spots on smooth surfaces</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restoration for caries lesion in the last three years (only for initial CRA exam; one year for recare)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Risk factors (biological predisposing factors)

<table>
<thead>
<tr>
<th>YES = CIRCLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS and LB both medium or high (by culture or other testing methods*)</td>
</tr>
<tr>
<td>Visible heavy plaque on teeth</td>
</tr>
<tr>
<td>Frequent snacking (&gt; 3x daily between meals)</td>
</tr>
<tr>
<td>Deep pits and fissures</td>
</tr>
<tr>
<td>Recreational drug use</td>
</tr>
<tr>
<td>Inadequate saliva flow by observation or measurement (*if measured note the flow rate below)</td>
</tr>
<tr>
<td>Saliva-reducing factors (medications/radiation/systemic)</td>
</tr>
<tr>
<td>Exposed roots</td>
</tr>
<tr>
<td>Oral appliances (i.e., orthodontic/prosthetics)</td>
</tr>
</tbody>
</table>

### Protective factors

<table>
<thead>
<tr>
<th>YES = CIRCLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lives/works/school in fluoridated community</td>
</tr>
<tr>
<td>Fluoride toothpaste at least once daily</td>
</tr>
<tr>
<td>Fluoride toothpaste at least 2x daily</td>
</tr>
<tr>
<td>Fluoride mouthrinse (0.05% NaF) daily</td>
</tr>
<tr>
<td>5,000 ppm F fluoride toothpaste daily</td>
</tr>
<tr>
<td>Fluoride varnish in last six months</td>
</tr>
<tr>
<td>Office F topical in last six months</td>
</tr>
<tr>
<td>Biofilm modification (antibacterials/pH) as directed in the last six months</td>
</tr>
<tr>
<td>Xylitol gum/lozenges 4x daily last six months</td>
</tr>
<tr>
<td>Calcium/phosphate supplementation during last six months</td>
</tr>
<tr>
<td>Adequate saliva flow (&gt; 1 ml/min stimulated)</td>
</tr>
</tbody>
</table>

* Bacteria/saliva test results: ___________________ **Date:** ___________________

Count the number of “yes” responses and use the instructions in FIGURE 1B to determine overall caries risk level and circle below.

### Overall caries risk level (CIRCLE):

**EXTREME** **HIGH** **MODERATE** **LOW**

**Note:** extreme risk = high risk + severe salivary gland hypofunction.

**Health care provider signature:** ___________________ **Date:** ___________________

**Patient signature:** ___________________ **Date:** ___________________

---

FIGURE 1A. Caries risk assessment form for patients aged 6 through adult. (Adapted from Young DA, Featherstone JD. Caries management by risk assessment. Community Dent Oral Epidemiol 2013;41:e1–e12.)
The CRA helps to determine the probability of getting a new caries lesion over a period of time.12 The multifactorial nature of the caries process requires determination of the risk factors, which are contributing and supporting the state of disease for each individual patient. Understanding the caries process then allows for either reduction or complete elimination of the risk factors. The identification of the risk factors of the patients permits a targeted approach to disease management, thereby eliminating either waste or underutilization of the resources available. Consequently, an improper assessment can result in patients who require the least management being overly and unnecessarily burdened with protective procedures and products. Even worse, patients who need intervention to stop the progression of their disease will not receive the prescription of proper treatment regimens and will later return with new and progressing caries lesions.

In 2016, McAndrew stated that calibration is performed in order to achieve standardization, which is the consistent application of protocols, techniques and philosophies.13 Applying this standard of care in the management of caries is as important as in any other discipline. The primary objective of this manuscript is to disseminate guidelines and rationale used in previous studies to improve the performance and accuracy of assessing the caries risk. These guidelines will aid health care professionals to better understand how to determine the correct caries risk level of their patients, which in turn should result in the ability to properly recommend and prescribe appropriate interventions.

### A Simplified Guide To Determine Overall Caries Risk Levels

Simply note the “yes” responses on the caries risk assessment form and use the guide to determine overall caries risk at the bottom of the form.

<table>
<thead>
<tr>
<th>Caries Risk Level</th>
<th>Rubric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>No disease indicators (no new or progressing caries lesions) and no risk factors</td>
</tr>
<tr>
<td>Extreme</td>
<td>Inadequate saliva flow by observation or measurement * in addition to high caries risk</td>
</tr>
</tbody>
</table>
| High              | 1) One or more disease indicators ** (new or progressing caries lesions)  
2) Or three or more risk factors in the absence of any disease indicators  
3) Or just high acidogenic bacterial load by measurement alone in the absence of any disease indicators |
| Moderate          | One or two risk factors in the absence of any disease indicators |

*Note: If the patient used the recommended preventive treatment and shows no progression of existing lesions and no new lesions for at least one year, the patient may be considered as “extreme caries risk – controlled;” however, they should remain on the treatment protocol unless saliva flow levels return to normal.

**Note: If there are any disease indicators, in addition make sure you look for the risk-factor question “I = inadequate saliva flow by observation or measurement” to rule out extreme caries risk.

### Adjustment of Overall Caries Risk on Subsequent Recare Caries Risk Assessment Exams

Patients who use their prescribed products as directed showing improved oral health outcomes should have the caries risk levels adjusted accordingly if there is no progression of existing lesions and no new lesions for at least one year from their last CRA/exam. Simply subtract one risk factor for each protective factor listed below.

<table>
<thead>
<tr>
<th>Protective Factors (for each of these subtract one risk factor) ***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluoride mouthrinse (0.05% NaF) daily</td>
</tr>
<tr>
<td>5,000 ppm fluoride toothpaste daily</td>
</tr>
<tr>
<td>Fluoride varnish in last six months</td>
</tr>
<tr>
<td>Office F topical in last six months</td>
</tr>
<tr>
<td>Antibacterial rinse prescribed/used as directed in last six months</td>
</tr>
<tr>
<td>Xylitol gum/lozenges 5–10 grams throughout the day in last six months</td>
</tr>
<tr>
<td>pH neutralization throughout the day in last six months</td>
</tr>
<tr>
<td>Calcium and phosphate paste during in last six months</td>
</tr>
</tbody>
</table>

***Note: For purposes of changing overall caries risk of a patient, we want to consider recommended interventions only (not baseline behaviors). Therefore, there is no “adjustment” for the following baseline protective factors:
- Lives/works/school in fluoridated community.
- OTC fluoride toothpaste at least once daily.
- OTC fluoride toothpaste at least two times daily.
- Adequate saliva flow (> 0.7ml/min stimulated).
The CAMBRA CRA Form and Elements of Assessing Caries Risk

The original CRA form used in this guideline was first published in the Journal of the California Dental Association in 2003 and later updated with very minor wording revisions in 2013. Here we will refer to it as the “CAMBRA CRA form.” FIGURE 1A shows the CAMBRA CRA form followed by the guidelines to determine risk levels (which were designed to be printed on the back of the form) (FIGURE 1B). The guidelines are discussed in more detail in subsequent sections. The questions contained in the CAMBRA CRA form have been validated multiple times by Doméjean-Orliaguet et al. The form has been widely adopted by dental schools, federally qualified health centers (FQHC) and private offices. Studies demonstrating the implementation of and calibration to use this assessment form have concluded that risk-assignment training and recalibration are required and should be an ongoing process.


There are three sections in the CAMBRA CRA form: disease indicators, risk factors and protective factors. Their influence is represented visually by the caries balance/imbalance diagram shown in FIGURE 2.

Disease Indicators

Past caries experience has been established as the most powerful single definitive predictor of future caries lesions. Past caries experience is the summary of the cumulative effect of all known and unknown risk factors to which the patient has been exposed. The term “disease indicator” is used to refer to clinical observations that tell about the past or present caries activity. Disease indicators (active white spot lesions, radiographic radiolucencies, cavitation, recent restorations due to dental decay) are physical proof of a past or present caries disease. Disease indicators do not indicate what caused the caries disease or how to treat it.

Risk Factors

Caries risk factors are biological factors that contribute to the level of risk for having new carious lesions. Patients with high caries risk are more likely to manifest a new caries lesion in a short period of time while patients with low caries risk are less likely to acquire a new caries lesion in the near future. The risk factors are pathological factors that have contributed to the disease or will contribute to the future manifestation of the disease. These pathologic factors not only determine how the healthy balance is disturbed but also suggest how the imbalance can be corrected. A randomized clinical trial has confirmed that reducing caries risk factors results in a reduction in dental caries.

The CAMBRA CRA lists several risk factors (totaling nine) identified as having high odds ratios related to new caries lesions in outcomes measures of CRAs. They are 1) high acidogenic bacterial challenge, 2) visible heavy plaque on teeth, 3) frequent (> three-times daily) snacking between meals, 4) deep pits and fissures, 5) recreational drug use, 6) inadequate saliva flow by observation or measurement, 7) saliva-reducing factors (medications/radiation/systemic), 8) exposed roots and 9) plaque-retentive appliances.

Protective Factors

Caries protective factors are biological or therapeutic factors that can collectively attempt to offset the pathologic challenge presented by caries risk factors. The CRA process identifies the risk factors unique for each patient and thus can suggest a targeted approach to corrective therapies. The more severe the caries risk factors, the more intense the protective factors must be to keep the patient’s caries risk in balance or to even reverse the caries process. Protective factors include adequate saliva flow, sealants, antibacterials, topical fluoride and other remineralizing agents intended to support, but not replace, topical fluoride, effective behavioral change to promote healthy lifestyle habits and a risk-based recare schedule.

Currently, the protective factors listed in the CAMBRA CRA form are:
Lives in or work/school located in a fluoridated community.
- Fluoride toothpaste used at least once daily.
- Fluoride toothpaste used at least two times daily.
- Fluoride mouthrinse applied (0.05% NaF) daily.
- Prescription 5,000 ppm F fluoride toothpaste used daily.
- Fluoride varnish applied in the last six months.
- Office fluoride topical applied in the last six months.
- Antibacterial agents to reduce high acidogenic bacterial load in the last six months.
- Xylitol gum/lozenges used four times daily in the last six months.
- Calcium and phosphate supplement paste used during last six months.
- Adequate saliva flow (> 1 ml/min stimulated) (FIGURE 1). Fluoride toothpaste frequency is included because studies have shown that brushing twice daily or more is significantly more effective against the formation of caries lesions than once a day or less.22,23 Any or all of these protective factors can contribute to keep the patient’s caries risk “in balance” and to enhance remineralization, which is the natural repair process of the early carious lesion.

After the CRA has been performed and the overall caries risk is determined (see Determining Overall Caries Risk in next section), individualized treatment options unique to the patient can then be discussed with the patient. The treatment plan is based on the patient’s risk level with the underlying intention to bring a potential out-of-control caries imbalance back into control.13,19 An example treatment protocol is provided in the TABLE.

Determining Overall Caries Risk

Based on the presence or absence of the disease indicators, risk and protective factors, practitioners can use a simple countdown approach to quickly assess the level of caries risk of their patient.

The assessment process begins by deciding first if the patient is “at risk” and, if so, to what extent. The presence of one single disease indicator serves as a strong predictor of future or progressing caries lesions and suggests the patient is at least high caries risk. In addition, in the absence of adequate saliva volume, the patient’s risk level is elevated and should be considered as being at extreme caries risk.

In the absence of disease indicators, the risk factors and protective factors listed on the CAMBRA CRA form will help assess the risk level by counting them against each other and by subtracting the number of registered protective factors against the risk factor count (see Determining Caries Risk in next section). This will lead to the assignment of low or high caries risk. Moderate caries risk is assigned when there is doubt whether or not the patient is at either high or low risk.10

Originally, the CAMBRA CRA form was published without detailed instructions on how to exactly determine the caries risk. It was assumed that a visual assessment of the marked responses on the form would result in consistent determination of overall caries risk regardless of who was interpreting the form.9–11 Further, it was also assumed that the visual assessment of the balance between disease indicators, risk factors and protective factors on the form would be simple and lead to consistent risk assignment results. This was meant to give room for professional decision-making, both on risk assignment level and the subsequent caries management protocols.5,18 Nevertheless, concerns about the correct risk-level assignments when not giving more detailed guidelines initiated research concerning how to correctly assign risk chairside in a quick, reliable and reproducible way.10,11

Previous Studies Related to Caries Risk Assignment

In 2014, a study at the University of California, San Francisco, (UCSF) reported that clinical faculty who had been using the CAMBRA CRA form for 10 years showed obvious difficulties in correctly and consistently determining caries risk levels. The faculty demonstrated only low to moderate interexaminer reliability when assigning caries risk levels on 22 prefilled CRA forms of simulated patients.9

Subsequently, a study at the Virginia Commonwealth University (VCU) used a similar methodology to test whether a set of guidelines and an additional calibration would improve faculty performance in correctly determining overall caries risk on CRA forms for simulated patients.10 In the VCU study, faculty were given precalibration and postcalibration tests for simulated patient cases. The pretest results confirmed the poor results found in the UCSF study, but in addition, the posttest demonstrated that a single calibration session using a set of guidelines significantly improved faculty members’ CRA decision-making.10 In 2017, a third related study using the exact same 22
prefilled CRA forms used in the original UCSF study tested the same guidelines used in the VCU study. This time the pre- and postcalibration test was done with faculty as well as students at the University of the Pacific (UOP).\textsuperscript{11} The precalibration test results confirmed for the third time that without additional guidelines, faculty, and now students, performed poorly on the simulated cases, yet calibration with the guidelines significantly improved results in both faculty and students.\textsuperscript{11} Thus, the use of the guidelines and calibration should result in subsequent improvements in patient caries management and oral health.

Consequently, the purpose of this paper is to disseminate the guidelines used in these studies in order to benefit reliable and reproducible assignment of caries risk when using the CAMBRA CRA form (FIGURE 1B).

### Determining Caries Risk

Previous studies related to correctly assigning caries risk levels identified two particular risk factors, the amount of acidogenic bacteria and the salivary flow, to cause clinicians difficulties to accurately determine the caries risk.\textsuperscript{10,11} In the absence of conclusive evidence in the literature on bacterial load and hyposalivation, some clinicians previously attempted to solve the issue by stating 1) if a high bacterial load is measured, patients are assigned as having high caries risk, even in the absence of disease indicators, and 2) if in addition to being at high caries risk hyposalivation is determined by observation or measurement, patients are assigned to be at extreme caries risk. The guidelines are illustrated more simply in the top of FIGURE 1B.

These recommendations were necessary to ensure consistency with recommended treatment suggestions presented to these patients. Using this suggested protocol, high bacterial load should always trigger an antibacterial therapy. Hyposalivation in a high-caries-risk patient is considered as an extreme caries risk because the lack of saliva may significantly affect the ability to neutralize acid and provide calcium and phosphate for remineralization. The example treatment protocol in the TABLE suggests that patients with hyposalivation by observation or measurement should supplement topical fluoride with pH neutralization and calcium and phosphate-providing sources. Assigning a Different Risk Level Over Time

The caries risk status of a patient is not static and thus can change over time (bottom of FIGURE 1B). This makes the assessment of the caries risk at each subsequent recare visit necessary. The results of the recare CRAs alert clinicians and patients about the effectiveness of recommended therapies and, most important, may reward patients for compliance and improving their oral health.

When a patient returns for a recare appointment and has been stable with regard to caries disease activity with no new or progressing caries lesions (disease indicators) for at least one year and has been using the prescribed therapies, they can be reclassified to a lower category (bottom of FIGURE 1B). In this case, it is very important that the patient is rewarded for successfully modifying their behaviors and improving their oral health by actually "celebrating" the assignment of a lower caries risk status.

The guidelines presented in the bottom of FIGURE 1B use the concept of “canceling out” or “subtracting” the count of protective factors from risks factors with the use of prescribed therapies on a one-for-one basis. Not included in this count are the protective factors such as living in a fluoridated-water community and brushing once or twice a day with over-the-counter fluoridated toothpaste, respectively, and normal saliva flow because these factors were likely present at baseline. Only interventions that had been consistently used as prescribed to

### TABLE

<table>
<thead>
<tr>
<th>Risk level</th>
<th>Home care recommendations</th>
<th>Recare interval</th>
<th>Radiographs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Oral hygiene instruction, individualized dietary counseling (frequency and exposure), over-the-counter fluoride toothpaste</td>
<td>12 months</td>
<td>24–36 months</td>
</tr>
<tr>
<td>Moderate</td>
<td>All the above plus: • Xylitol gum/mints throughout the day • 0.05% NaF rinse after meals if possible Alternative therapy would be to use a 5,000 ppm F toothpaste twice daily instead of over-the-counter toothpaste and no mouth rinse</td>
<td>4–6 months</td>
<td>18–24 months</td>
</tr>
<tr>
<td>High</td>
<td>All the above plus: • 5,000 ppm toothpaste instead of over-the-counter F toothpaste morning and night • Antibacterial /pH neutralization before bedtime*</td>
<td>3–4 months</td>
<td>6–18 months</td>
</tr>
<tr>
<td>Extreme</td>
<td>All the above plus: • pH neutralization throughout the day • Ca/PO₄ supplementation throughout the day and right before bedtime</td>
<td>3 months</td>
<td>6 months until no new caries lesions</td>
</tr>
</tbody>
</table>

*Note: It is helpful to retest the bacteria after initial antibacterial treatment (about one month) to help motivate the patient.
enhance the protective factors of the oral environment to optimize the arrest and reversal of lesions are considered to potentially lower a caries risk level. The prescribed factors canceling out risk factors include the following substances used in the last six months: Use of fluoride mouthrinse, 5,000 ppm fluoride toothpaste, fluoride varnish application, office topical fluoride treatment, antibacterial rinse prescribed/used as directed, xylitol gum/lozenges 5–10 grams throughout the day, pH neutralization throughout the day and topical calcium and phosphate supplementation.

The only caveat to lowering caries risk status is related to the extreme-caries-risk level. Extreme-caries-risk patients require special consideration. By definition, high-caries-risk patients who also have hyposalivation by observation or measurement should be considered to remain at extreme caries risk unless the saliva flow returns to normal. An extreme-caries-risk patient with inactive caries disease (no new or progressing lesions for one year) who is successfully using prescribed therapies rather than lowering their risk level because at a lower level they would not receive their needed intervention products for hyposalivation. Congratulating the patient for controlling an extreme condition should not be underemphasized.

**Conclusion**

By using simple guidelines, accuracy of assessing the caries risk of an individual can be improved while the assignment process is simplified. These guidelines aid health care professionals to properly recommend and prescribe appropriate interventions to their patients to reduce or eliminate the risk of future caries disease and subsequent caries lesions.

**REFERENCES**

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Caries Identification, Management and Prevention in a Unique Model Program: A Report

John L. Blake, DDS

ABSTRACT The Children’s Dental Health Clinic in Long Beach, Calif., instituted an early caries management protocol that included a family meeting with a hygienist and a dental screening. The clinic reports some first and promising results. Of the children who returned for recall visits, 53 percent presented without decay. Apparently, the younger the children were at the time they participated, the greater were their benefits in terms of reduced caries experience. This was not a controlled study.

AUTHOR

John L. Blake, DDS, has been the executive director and dental director of the Children’s Dental Health Clinic in Long Beach, Calif. for the past 14 years. This nonprofit program helps the comprehensive dental needs of underserved children and medically complex patients in multiple clinic and hospital-based programs. He is a fellow of the American College of Dentists, a part-time faculty member at the Herman Ostrow School of Dentistry of USC School and president of the Living Hope Clinical Foundation. Dr. Blake is the chair of CDA’s Government Affairs Council and legislative chair of the Harbor Dental Society. Conflict of Interest Disclosure: None reported.

As an intercity nonprofit comprehensive care dental program, the Children’s Dental Health Clinic in Long Beach, Calif., sees a diverse population of patients aged 0 to 21. Our main hospital-based clinic operates out of an 8,500-square-foot facility. In 2010, a separate oral health education center (OHEC) was added. This dedicated room looks more like a preschool classroom than a dental operatory, with the exception of the three multilevel sinks for toothbrushing.

The program was originally launched via a grant from the tobacco tax-funded First 5 LA Commission. Our proposal was based on something most all oral health professionals do daily — teach and preach prevention. But we added a few extras that we thought would make an impact on our typically lower-income families. For screenings and education, we partnered with local Women, Infants and Children (WIC) programs and a large pediatric medical community clinic that is also on our hospital campus. We hired a part-time receptionist and a registered dental hygienist for, initially, three days a week.

Our concept is simple: a dedicated 30-minute visit with the parents/caregivers, the 0- to 5-year-old patient and any other siblings who wish to attend. The RDH provides a dental screening, education, a nutrition...
discussion, a toothbrush prophylaxis and fluoride varnish application. There is a nominal, flat, sliding-scale-based charge for the visit if the patient has no insurance. For those with Medi-Cal coverage (Denti-Cal), we bill for the toothbrush prophylaxis and fluoride varnish application. This is often the patient’s first visit to “the dental office,” and it is typically a very positive, informative, noninvasive 30-minute experience. For infants, the RDH works with the parent and does a “knee-to-knee” oral screening. Infants with any suspicious or frank lesions are directly referred to our pediatric dental teams for further evaluation, diagnosis and treatment. During the 30-minute session, the RDH guides the parent through a simple, graphics-based caries risk assessment. Automatically, this meeting becomes a positive, motivational interview and a discussion on diet and nutrition ensues. The parent is then asked to identify a goal to work on (such as to reduce juice intake) and report back at a recall visit. Proper home care is outlined and demonstrated. These 30 minutes are a valuable and rare time with any health care professional. Our RDH often catches significant medical/health issues (not reported on the health history form) during this time period.

Since 2010, this program has screened 3,295 patients during 6,931 visits. Of those patients, we have referred 1,871 to our pediatric dental teams due to suspicious carious lesions, special medical/physical needs of the patient or the patient turning 6 and aging out of the program. Three years ago, we mandated that any 2- to 5-year-old patient who needed definitive treatment under sedation (light, moderate or deep/general anesthesia) would also have to attend an OHEC 30-minute education/prevention visit. At the Children’s Dental Health Clinic, we discourage “frequent flyers” in our I.V. sedation program. In 2017, the RDH in the program saw an average of 75 patients per month (900 per year) with a mix of 60 percent recall and 40 percent new-patient visits. Of those 900 patients, 95 were referred to the pediatric dentist for a thorough diagnosis and possible treatment.

Of the total children who had a first visit, 53 percent who returned for a recall visit had no decay while 20 percent who returned continued to experience decay. Twenty-seven percent did not have a return visit and they were unable to figure into the measurements. (FIGURE 1). Apparently, the younger the children were at the time they participated in this program, the greater were their benefits in terms of reduced caries experience (FIGURE 2). As the program has matured and parents/patients return, we have seen less early childhood caries, more attentive and motivated caregivers and healthier children!

Two years ago, we added silver diamine fluoride (SDF) to our program’s treatment arsenal as an option for a difficult decision-making process typically for instances where a 2- to 4-year-old patient presents with multiple mild to moderate carious lesions. The question posed is: Do we use light to moderate sedation or perhaps bring in an anesthesiologist to do deep sedation so that we can surgically treat the caries and restore the teeth? Or do we apply SDF directly on the lesions, arrest the caries process, monitor the lesions and perhaps definitively treat at a later date when the child’s behavior and guidance may be more successful?

At first, our clinicians and pediatric dental residents were slow to adopt the option of SDF use into their treatment planning discussions. Then they noticed that our young patients’ parents and caregivers were open to this less-invasive, yet not definitive treatment option. At least in our program, we have found SDF treatment to be a welcomed tool and option when facing
these difficult treatment planning discussions. Parents are made aware of the risks (such as dark staining of carious lesions/teeth) and the need for follow-up, re-applications and/or definitive treatment. When facing the decision to sedate their child or at least arrest the decay process, the application of SDF continues to gain in popularity.

What was started as a grant-funded pilot project has now become an integral part of our practice. In our private nonprofit environment serving mostly low-income children and patients with special needs, we are constantly prioritizing which programs to fund, grow or shrink. With our patient base and current Denti-Cal reimbursement rates, this program is not sustainable on patient fees alone, but it will continue to be a cornerstone of our practice due to its effectiveness and value to the patients and communities we serve.

I envision a future where our allied oral health professionals are working to the full potential of their licensing. We should use and embrace enhanced technologies, as have been demonstrated with the virtual dental home projects. The more we can integrate dental team members into community programs for early screening and prevention, the more informed and healthier our youngest patients will be. We have and should continue to work with pediatricians in our communities and give their staffs training on early childhood caries identification and demonstrate the value of a “knee-to-knee” dental exam. Regardless of the size of a dental practice or location, some or all of these methods described can easily be integrated in a practice. All dental team members can partner in building healthier “caries scarce” communities.

THE AUTHOR, John L. Blake, DDS, can be reached at jblake@cdhc.org.

WE ARE A COMMUNITY

We are a community of dentists who trust in each other. To our friends and peers affected by the California wildfires: You are in our hearts. But we’re also putting our hands to work to help you recover.

At CDA’s family of companies, we thank our volunteers, members and staff who are making a difference with their hands-on response to disaster relief.
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**LOS ANGELES COUNTY**

**CANAĞA PARK**—25+ years of goodwill GP w/ 4 eq ops and 1 plmbd not eq op. Located in a single story bldg.  Proj. approx. $394K for 2018. Property ID #5241.


**LANCASTER**—GP + Real Estate! Long established practice w/ 4 eq ops in a single standing bldg. On a major downtown street. Net $243K. Property ID #5222.

**SOUTHGATE**—Leasehold Improvements & Equipment with Real Estate. 4 eq ops and 4 plmbd not eq in free standing building. Excellent street visibility.  Prop. #5250.

**WOODLAND HILLS**—Well established GP in a 5 story med/dent bldg w/ 3 eq ops and 1 plmbd not eq. Projecting $1M for 2018. Property ID #5246.

**KINGS & VENTURA COUNTIES**

**GOLETA**—GP w/ 27 yrs of gdwill in a 2 story mix bldg. 4 eq ops. Grossed $572K. Prop. #5205.

**LEMOORE**—GP + Real Estate. 33 years of goodwill with 5 eq ops in a 1,655 sq ft office. Averaging 35-40 new patients/mo. Grossed $1.4M in 2017. Net $377K. Property ID #5232.

**RIVERSIDE & SAN BERNARDINO COUNTIES**

**CORONA**—Beautiful GP w/ 6 eq ops / 4 plmbd not eq for expansion in a 3,700 sq ft office. Located on a one story standing building next to a busy shopping center. Grossed $346K in 2017. Great potential for a full time dentist. Property ID #5224.


**TEMECULA**—Pedo and Ortho Practice + Real Estate!! It’s located in a duplex single story building.  Projecting approximately $1.7M with a Buyer’ net of $975K. PPO/Cash/Dental. Has 8 eq ops in a 3,500 sq ft. Property ID #5243.

**ORANGE COUNTY**

**FULLERTON**—Leasehold Improvements and Equip Only!! This GP is located in a multi story professional building. Has 6 eq ops in a 1,941 sq ft suite. Selling “as-is”. Property ID #5248.

**GARDEN GROVE**—LH & Equip Only! Has 3 eq ops, 1 plmbd not equip in a 2 story professional bldg. Great for a Perio or GP. Property ID #5239.

**IRVINE**—Well established Cash Only GP w/ 5 eq ops and 1 plmbd not eq. Projecting approx. $482K 2017. Prop. ID #5193.

**ORANGE**—LH & Equip Only! Beautiful office w/ 4 eq ops in a 1,915 sq ft office. Grossed approx. $353K for 2018. Property ID #5247.

**SAN ANA**—GP w/ 3 eq ops and 1 plmb not eq in 4 story med bldg. Property ID #5133.

**TUSTIN**—Well established GP in a 2 story busy shopping center. Projecting $1.8M in 2018. Has 3 eq ops in 1,222 sq ft suite. Property ID #5236.

**TUSTIN**—LH & EQUIP ONLY! Beautiful remodeled office with 3 eq op and 1 plmbd not eq. Located in a single story professional building. Has two price points. Property ID #5244.


**SAN DIEGO COUNTY**

**LA MESA**—Beautiful GP office in shopping center w/ 5 eq ops / 2 plmbd not eq. Sees 80-100 new patients/mo. Grossed $1.5M in 2017. Net $368K. Prop. #5228.


**SAN DIEGO**—Beautiful GP in a 2 story professional bldg w/ 6 eq ops and 2 plmbd not eq in a 2,250 sq ft suite. Proj. approximately $1.2M for 2018. Property ID #5251.

Some dentists agree to trade their work for other professional services or items of value. Bartering is nothing new; it was the only method for exchanging goods and services until hard currency became the norm thousands of years ago. But for dentists, bartering can lay the groundwork for a liability claim should things not go as planned.

The Dentists Insurance Company’s Risk Management Advice Line reports a case in which a dentist bartered with a patient for landscaping services in exchange for full-mouth reconstruction. The patient had compromised occlusion, poor oral hygiene and hadn’t seen a dentist in many years. The dentist and patient verbally discussed the treatment, the patient agreed to the treatment plan and the dentist began the treatment — with nothing more than a handshake to seal the deal.

After completion of the first phase of the treatment, which included crowns on 10 teeth and several implants to replace missing teeth on the lower arch, the patient started to complain about his bite. The dentist offered to redo the work; however, the patient refused due to a loss of confidence in the dentist’s abilities. The patient canceled his upcoming appointments and asked the office to stop contacting him.

The patient ultimately went to a prosthodontist who recommended redoing the treatment on 28 teeth, which would total $55,000. The patient contacted the dentist and requested he pay for the treatment by the specialist. The dentist refused and reminded the patient that the landscaping job still wasn’t finished, which was part of the original agreement. Two months later, the patient retained an attorney and filed a lawsuit. The demand to settle was $450,000.

The dentist’s records did not substantiate much of his recollection of events. He failed to document a comprehensive treatment plan. He did not produce any study models or a wax up. The defense experts could not support the case due to inadequate documentation. The court ordered the case to mediation and the defendant agreed to a settlement. The matter was resolved for a low six-figure amount.

In another call reported to the Advice Line, a dentist made a deal with a contractor. The contractor agreed to remodel the dentist’s house in exchange for full-mouth reconstruction for his wife. Both parties agreed to the proposal based on a handshake agreement.

The dentist treated the patient at a prosthodontist’s office so that the specialist could oversee the case and place implants. The dentist placed several crowns and paid the prosthodontist to place the implants. While the patient was in provisional crowns on a few teeth, one of which needed root canal therapy, her husband abandoned the remodeling...
job and failed to hold up his end of the agreement. Because of this, the dentist was no longer willing to treat the patient unless the contractor resumed working on his home. The dentist contacted the Advice Line to discuss patient dismissal. The analyst advised the dentist that he could not abandon the patient midtreatment and recommended he complete the treatment prior to the formal dismissal and collection process.

When considering whether to barter with patients, it’s important to weigh the risks. If you decide to proceed, the first step is drafting a bartering agreement. The agreement must outline the specifics of the services to be traded. This should include the estimated value of each service. It should also include the inclusions and exceptions. For example, a dentist could agree only to a cleaning and bridge, with a stipulation that any additional required or requested treatments would be at the patient’s expense. Similarly, the patient should outline exactly what is included on his or her end. For example, rather than “landscaping,” it could specify square footage, types of plants used, lighting, watering system, hardscapes, etc. Sample bartering agreements are available online.

“In order for a barter to be successful, each party must uphold his or her end of the agreement,” said Taiba Solaiman, senior TDIC Risk Management analyst. “The details of the agreement must be clear, concise and documented on paper.”

Agreements should also address what to do if things go sideways. What happens if the treatment plan changes due to unforeseen circumstances? What happens if there’s a problem with the treatment and the patient wants a refund? What happens if the contractor uncovers faulty wiring or a water leak that needs addressing? What happens if either party is unhappy with the final result?

Unlike contractors or landscapers, dentists hold a legal and ethical obligation to protect a patient’s health. Treatment and payment arrangements should always be two separate considerations. Recommended treatments should be based on clinical findings and treatment plans should be based on the value of the job, Solaiman said.

“A patient’s ability to pay, or failure to hold up their end of an agreement, does not relieve dental professionals from their responsibility to provide a detailed diagnosis of a patient’s treatment needs,” she said. “Nor does it allow a dentist to abandon a patient midtreatment.”

Bartering agreements also require dentists to keep accurate documentation, just as they would with any other patient. This includes thorough treatment plans outlining the risks, benefits and alternatives to treatment, expected timelines for treatment and services to be completed and recommendations based on clinical findings — not based on what the agreement dictates.

It’s also important to note that the Internal Revenue Service has rules addressing bartered income. For more information, contact a tax professional or refer to the Bartering Tax Center guidance at irs.gov/businesses/small-businesses-self-employed/bartering-tax-center.

Bartering is a common practice among many professionals, and it may be beneficial in a dental setting, as it allows patients to receive treatment they may not otherwise easily access or afford. However, bartering is not without significant risk. Documenting the details of such agreements can help protect dentists should such a bartering agreement turn sour.

For more information or advice on bartering, call the TDIC Advice Line at 800.733.0633.
4261 CAPITOLA GP Retiring doctor offering an established practice in professional office complex built around a garden setting. Beautiful and modern 1,465 square foot facility with 4 fully-equipped operatories. Average gross $743K+ with 3 doctor days and 6 hygiene days per week. Approximately 1,800 active patients. Asking $562K.

4172 NAPA GP Amazing opportunity to own the practice of your dreams in one of the world’s premier wine destinations! Situated in a prime neighborhood close to many amenities. 1,200 square foot office with 4 fully-equipped and updated operatories. Over 1,000 active patients. Average annual gross receipts over $700K. Asking price for practice $484K. Building available for purchase.

4316 SARATOGA GP Vibrant and active practice located in beautiful 4 op, fully-equipped, facility at upscale residential, professional, and commercial neighborhood. 10 new pts./month. 4 doctor days & 4 hygiene days per week. $464 avg. Gross Receipts. Asking price $357K.

4233 SF GP Seller offering 26+ year general practice in SF Financial district. Ground floor office with high volume foot traffic. Approx. 1,200 sq. ft. facility with 4 fully-equipped ops. $930K+ avg. annual GR. Seller willing to help for a smooth transition. Asking $840K.

4210 UNION CITY GP Retiring GP offering 40+ years of goodwill. Excellent location in Professional Bldg on major thoroughfare. 5 ops in 1,100 sq. ft. 350 active patients, all fee-for-service. 2 yr average GR $177K. Seller willing to help for smooth transition. Asking $85K.

4225 EUREKA GP & BUILDING Established since 1981 in charming Northern California port city. Retiring doctor is offering practice and building. Practice has approximately 1,200 active patients with new patients accepted on a selective basis. Average Gross Receipts of $765K+ with 61% average overhead. Beautiful 1,400 square foot office with four (4) fully-equipped operatories. Asking price for practice $468K.

4178 SONOMA COUNTY PERIO Seller retiring from 21 year practice with trained, seasoned staff and great location. Exceptional 2,100 sq. ft. ample office with 6 fully equipped ops. Majority of equipment purchased in 2002. 4 doctor-days & 3 hygiene days per week. Average gross receipts $1M+. Asking $677K.

4198 PETALUMA DENTAL BUILDING Condominiumized dental office. Approximately 1,600+ square feet with five (5) fully-equipped operatories set up for right hand delivery. There is a reception area, business office, consult room, staff lounge, lab, sterilization area, private office and separate storage area. Asking $495K.

4344 SF GP Prime & convenient location in Laurel Heights neighborhood. 9 year practice averaging $500K+ with approx. 50% overhead in fully-equipped 2 op. modern facility. Motivated seller relocating out-of-area.

4214 FREMONT GP Retiring Seller is offering an established practice in ample 2,000 s.f. facility that includes 9 operatories, 2 bathrooms, a reception area, private office, staff lounge, lab area, sterilization area and storage area. Average Gross Receipts $681K+ Asking $275K.

4216 SIERRA NEVADA FOOTHILLS 23 year practice located in the heart of the Sierra Nevada foothills in modern building close to downtown area. 1,024 square foot office with 4 fully-equipped ops., upgraded major equipment and digital radiography. Average Gross Receipts $890K+ with 56% average overhead. Asking price for practice $604K. Seller is offering real estate for sale to the buyer of his practice.

4324 SF GP Seller offering 33 years of goodwill in busy financial district bldg. Gorgeous 890 sq. ft. office with 3 fully equipped ops (plumbed for 4). Incredible panoramic views with amazing natural light pouring into each window. 500+ active patients. 2 days of hygiene/wk. Current average GR approx. $410K with adj net of $115K. Asking $199K.

4331 SF GP Downtown SF practice in gorgeous, remodeled 1,300 office with panoramic views. Suite includes 4 fully equipped ops, reception area, business office, private office, staff lounge, lab area, and sterilization area. Beautiful, modern cabinetry, and equipment. 1,600 active patients with 15-20 new patients/month. Owner/doctor works 3 days/wk with 5 hygiene days/wk. Average gross receipts $738K with average adj. net of $305K. Asking $495K.

4340 WEST SONOMA COUNTY GP Charming and growing community practice with over 40 years goodwill in seller owned building. Busy corner location adjacent to several retailers. Well appointed, 4 op office with several Recent leasehold improvements and upgrades. Approximately 1,000 active patients. Average Gross Receipts $788K with consistent growth. 2018 on schedule for $822K with 65% overhead and 3.5 doctor days per week. Primarily Restorative dentistry with no implant placement. Average 4 days of hygiene per week. Owner willing to help for smooth transition. Asking $538K.

4336 SAN BRUNO GP Legacy practice centrally located in a combined commercial & residential neighborhood convenient to highways 101, 280, and 380 and close to the BART station. Elegant, remodeled 1,463 sq. ft. office with 5 fully-equipped ops. & digital radiography. 5 year average Gross Receipts $922K+. 1,000 active patients with an average of 10 new patients per month. Asking $661K.

4343 SANTA CRUZ COUNTY GP Ample 3,000 sq.ft. facility w/5 fully-equipped operatories., Terrific opportunity to own the facility and well-established community practice with quality and seasoned staff. Average Gross Receipts $870K+. Asking $643K.

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If a dental practice plays music in the office or offers patients a distraction by allowing them to watch a recorded movie or television program, be aware that the practice may need to have a performance license. Such a license is issued under U.S. copyright law, which allows owners of original movies, shows and music to collect license fees from individuals, organizations and other entities for public performances of their movies, shows or music. School districts, event organizers, libraries, nonprofit organizations and universities are some of the entities that need performance licenses. Health care facilities such as dental practices are considered public places and therefore must have performance licenses to play music, movies or shows within their facilities.

Infringement of copyright law carries significant penalties. “Willful” infringement could subject a practice to statutory damages as high as $150,000 for each infringed work. Even if infringement is considered inadvertent, statutory damages can range from $750 to $30,000 for each infringed work. A dental practice could be subject to other costs, including reasonable attorneys’ fees to the prevailing party.

The cost of compliance is small compared to the potential penalties. The license fee is dependent on the size of the facility. Additionally, a practice with multiple offices must have a license for each location. The license fees are collected by entities that distribute them to the owners of the music, movies and shows. Performing rights societies license facilities to play all songs (audio only) in their respective catalogs for relatively small annual fees. The performing rights societies take care of apportioning the fees among the owners of the songs; you will not need to worry about the allocation.

The primary entities that handle movie and show licenses include:
- Motion Picture Licensing Corporation (MPLC): mplc.com
- Swank Motion Pictures Inc.: swank.com
- Criterion Pictures: criterionpicusa.com

The cost of compliance is small compared to the potential penalties. The license fee is dependent on the size of the facility. Additionally, a practice with multiple offices must have a license for each location. The license fees are collected by entities that distribute them to the owners of the music, movies and shows. Performing rights societies license facilities to play all songs (audio only) in their respective catalogs for relatively small annual fees. The performing rights societies take care of apportioning the fees among the owners of the songs; you will not need to worry about the allocation.

The performing rights societies and their websites are listed in the box.

Obtain a music license from:
- The American Society of Composers, Authors and Publishers: ascap.com
- Broadcast Music Inc.: bmi.com
- SESAC: sesac.com

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Music

Music is delivered to listeners through a variety of means — radio, streaming, digital player and CDs. Individuals who purchase music may play it for their own personal enjoyment wherever they may be and on their own devices. However, if the music is played for the enjoyment of others at a business or public event, then a performance license is required. If a dentist has a digital music subscription service, such as Spotify or Amazon Prime Music, they should check the service’s terms of use with regard to public performance. The dentist likely will find that the service prohibits the public performance or broadcast of the provided content.

Not all music subscriptions prohibit public performance. Satellite radio offers a business subscription that includes the required performance license.

Playing the radio over the office sound system may require a public performance license. Under the Copyright Act, there is an exemption for radio broadcasts if 1) the establishment in which the communication occurs has less than 2,000 gross square feet of space (excluding space used for customer parking and for no other purpose) or 2) the establishment in which the communication occurs has 2,000 or more gross square feet of space (excluding space used for customer parking and for no other purpose) and the audio performance is communicated over no more than six loudspeakers, of which no more than four are located in any one room or adjoining outdoor space.

Movies and Shows

The rules are similar no matter if you own a DVD or digital version of a movie or show or if you subscribe to a service that allows you to stream movies and shows — the purchase of content and a subscription to a streaming service do not normally include a performance license. When an individual agrees to Netflix’s terms of service, for example, the individual agrees not to use the service for public performances. If a dental office wants to make watching movies or shows available to their patients, then a performance license is required. An option that does not require a performance license is to have a television set to show only network and basic cable programming.

Patient-Owned Content and Devices

A patient who uses their own device to listen to their own music or watch movies or shows through a streaming service account they subscribe to can do so without the dental practice obtaining a performance license.

The MPLC now offers, in partnership with the American Dental Association (ADA) and American Academy of Pediatric Dentistry (AAPD), an umbrella license for dentists to show movies and television programming in their practices. The license is available to ADA and AAPD members at a discounted rate. MPLC also offers a discount for offices with multiple locations. Download the application form from the ADA website or complete it online at the MPLC website.


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6158 FORTUNA
Relaxed lifestyle in Humboldt County’s Banana Belt. Perfect for Dentist seeking small town living. Collects $390,000, 6-weeks off. Lots of work referred. Full Price $75,000.

6157 SOUTH SACRAMENTO COUNTY
Looking for a sure bet? This is it! 2018 shall top $925,000 on Owner’s 3-day week. Should be 6-days as practice is rich in patients. 25+ new patients per month. Stand-alone building with great curb appeal is optional purchase.

6156 SANTA ROSA
Sited on Sonoma Highway near Oakmont. Strong foundation evidenced by 4-days of Hygiene. Well-designed 5-op office. 2017 shall collect $740,000. Over $650,000 invested in equipment and technology. Attractively priced.

6155 LAKEPORT
5-days of Hygiene. Revenues of $800,000. Lakeside location and nicely equipped. Seller happily looks forward to retirement.

6154 MARIN COUNTY
Sterling opportunity. No competition within 2-radial miles. Strong Hygiene Department. Well-liked DDS limits New Patients due to wanting to control his schedule. Collects near $500,000. Can do more.

6152 SAN RAFAEL
Across the street from Marin Academy. Does $500,000+ per year. Stand-alone building also “For Sale.” Nearby practitioner who desires their own building should vertically integrate their practice here and have an instant $1+ Million practice in a better location.

6151 MODESTO
Located on north end of Coffee Road where new development is occurring. Attractive 3-op office. 2 018 tracking $445,000 in collections on 2-day week. Did $700,000+ in 2016 when Owner was full time with $240,000 in Profits.

6150 HAYWARD
Strong Dental DNA. Well-designed 5-op office. Digital radiography and computers. 2018 trending $850,000+. 5-days of hygiene. Full Price $200,000.

6149 NOVATO - PERFECT START-UP OPPORTUNITY
Stand-alone building at busy stop light intersection off Highway 101. All new 2-years ago. 4-ops, digital, paperless, Pano with Ceph at cost of $180,000. At doorway to Hamilton with 100s of homes. No competition. Perfect for Group seeking that next perfect location! Scott McDonald from Doctor Demographics states: “Well, I have to say that you were right, Ray. This is an interesting and viable location.” Scott's report is available upon request.

6148 SAN LEANDRO

6147 SAN FRANCISCO BAY AREA - OUT-OF-NETWORK
2018 tracking $2.15 Million. Hygiene produces $1+ Million. $700,000+ in profits. Unique in so many ways! Seller available for long transition.

6143 BERKELEY’S ALTA BATES VILLAGE
Perfect for nearby Dentist to relocate their practice into stand-alone building on Webster Street. 3-day week collected $550,000 in 2017. 4-days of Hygiene.

6142 OAKLAND’S PIEDMONT - OUT-OF-NETWORK
3-ops, paperless and digital Pano. Does mid $600,000 with very strong Profits. Successor should be proficient in Ortho or willing to learn. Seller available for long transition.

6141 NAPA VALLEY’S CALISTOGA
3-day per week PPO practice. 3-days Hygiene. 2018 shall collect $350,000. Attractive 3-ops. 15 new patients per month. Full Price $100,000.

6139 SAN FRANCISCO BAY AREA PROS PRACTICE - "OUT-OF-NETWORK"
2017 billed $1.2 Million, collected $1.19 Million. 4-days of Hygiene. Owner available for long transition. Condo is an optional purchase.

ALTA LOMA
Great exposure. Grossing $700,000. Five ops, 3-equipped.

BAKERSFIELD
Will do $1 Million. Full Price $650,000 includes building.

BAKERSFIELD AREA
Grossing $1.2. Owner works 16-hours. Nets $300,000.

BAKERSFIELD AREA
Grossing $40,000/month on 2-days. 5-ops.

BAKERSFIELD
Practice and building. Has done $500,000. Full Price for both $350,000.

CAPISTRANO BEACH
Senior DDS Grosses $200,000. Full Price $150,000.

DEL MAR - ENCINITAS HMO
Grossing near $400,000. 4-ops.

DENTURE PRACTICE
Needs Western Boards. Grossing $750,000. Did $1.2 Million with OS. Prosthodontist / Implant Specialist will do very well.

DIAMOND BAR
High identity Asian center. Will do $1 Million. Hundreds of people walk by each day.

ENDODONTIST
Join Periodontist in Santa Clarita. Only $35,000 or GP who wants a good reliable job.

GLendale / Burbank
Grosses $840,000. Includes apartment.

INLAND EMPIRE
DentCial grossing near $300,000. Full Price $150,000.

INLAND EMPIRE
Union Practice can do $1+ Million. 5-ops.

INLAND EMPIRE
On Highway 215 Exit. 2-practices, 1-mile apart. Merge and do $1 Million first year.

INLAND EMPIRE
Includes building. 7+ ops, Adeq equipped, cone beam. Grossing $1.3 Million. Full Price $2.5 Million.

INLAND EMPIRE HMO
HMO checks average $8-to-10K per month. Grossing $500,000. Hispanic patients. Full Price $450,000.

IRVINE
Female Grossing $1.2 Million. 5-ops.

LA HABRA
Shopping mall. Female Grossing $330,000. 6-ops, 5 equipped. Million Dollar location. Full Price $270,000.

LA MIRADA
Like new 5-ops, 3-equipped. Grossing $450,000.

NORTH LONG BEACH
Hi Identity. 50% Latino. Part-time. Only $85,000.

NORTH PASADENA
Million Dollar practice. 5-op free-standing building across from Starbucks.

OC BEACH
6-ops, Dentrix, digital, computerized. Full Price $150,000.

OC BEACH
Absentee owned, grossing $350,000. 4-ops. New Doc does $1 Million.

OC BEACH
Grossed $100,000 last month. Full Price $900,000.

OC’S FASHION ISLAND
Grossing $650,000. Rare opportunity.

ORANGE COUNTY- INLAND-EMPIRE
Two practices grossing $1.8 Million. Right Buyer does $3 Million.

PEDO
Chinese & Latino. Grosses $450,000. Full Price $285,000.

RIVERSIDE Female grossing $250,000. 30-new patients/mth. FP $165,000.

SANTA CLARITA
Hi identity center. DDS wants to share office and remain 1-day in 2 ops. 8 ops available. 70,000 autos pass each day. This location did almost $2 Million in past.

TUSTIN - SANTA ANA
Just opened. $450,000 invested. Cone Beam.

TORRANCE
Entrance to Palos Verdes. Grossing $300,000+. Full Price $290,000.

UPLAND
Grossing $135,000 part-time. 3-ops. Full price $65,000.

VAN NUYS
2 Ops, room for more. Hi identity medical building. On first floor. Full Price $150,000.

VENTURA
3 practices HMO grossing $2.6 million.

WEST COVINA
Grossing $650,000. 2 days hygiene. Refers lots of work!
Over $34.5M in 2017 sales

Extensive Buyer Database & Unsurpassed Exposure allows us to offer you

Better Candidate
Better Fit
Better Price

800.641.4179

WPS@SUCCEED.NET
Over $34.5M in 2017 sales

Extensive Buyer Exposure allows Candidate us to offer you Unsurpassed Northern Database & Largest Better Price

AG-871 SAN FRANCISCO
AC-893 SAN FRANCISCO (Facility):
AC-782 SAN FRANCISCO:
CC-802 SANTA ROSA:
CC-798 PETALUMA:
BN-906 OAKLAND:
BG-929 WALNUT CREEK
BG-925 HAYWARD:
BC-926 ANTIOCH:
AN-939 REDWOOD CITY:

$675k AG-933 SAN FRANCISCO Prosthodontics
$295k
$85k
$135k
$635k

800.641.4179 WPS@SUCCEED.NET

$575k

CC-891 SACRAMENTO:
EC-729 GREATER SACRAMENTO AREA:
DN-938 SUNNYVALE:
DN-937 SAN JOSE: $500k
DN-914 SANTA CLARA:
DN-898 SAN JOSE:
DG-892 SAN JOSE:
DG-842 FREMONT:
DG-785 SANTA CRUZ:
DN-771 SOQUEL Facility:
DG-862 MID-PENINSULA:
DC-812 REDWOOD CITY Facility:
CG-859 SONOMA:
CG-616 NAPA:

$395k
$165k
$545k
$395k
$250k
$195k
$38,500
$295k
$38,500
$295k
$30k

NORTHERN CALIFORNIA CONTINUED

FG-841 Arcata:
EN-885 Roseville Facility:
EN-836 Citrus Heights:
EN-831 Sacramento:
GN-799 Paradise:
EG-788 Roseville:
EG-887 Folsom Facility:
EN-899 Dixon:
EN-932 Sacramento:
GN-904 Chico Area:
HN-941 Gold Country/CalaVeras Co:
HN-733 Sutter Creek:
HN-879 Sonora:
HG-934 Grass Valley:
HN-941 Gold Country/CalaVeras Co:

CENTRAL VALLEY

IG-832 Oakhurst: Rare Opportunity. 2048 sf w/ 3 ops + 1 add’l. $325k/
Real Estate 375k
IG-881 Turlock: Consistently growing practice ~3500 sf w/ 10 Ops (shared). $360k
IN-764 Stockton: Well-established, fully computerized, paperless, digitalized. 5,000 sf w/10 ops. Only: $150k!
IN-917 Merced Area: Well established practice with a stable, loyal patient base! 1300 sf w/ 3 Ops. $325k
JC-811 Fresno County: Amazing Opportunity! Considerable Goodwill in Community! 3,000 sf w/ 6 ops $350k
JC-823 Los Banos: Heavy emphasis on hygiene. Growth potential by increasing DDS days. 1000 sf w/ 3 ops $80k

IG-821 San Joaquin County:
IN-766 Stockton:
IN-764 Stockton:
IN-917 Merced Area:
IG-811 Merced Area:
IG-823 Merced Area:
IN-917 Merced Area:
IN-764 Stockton:
IG-821 San Joaquin County:
IN-766 Stockton:
IN-764 Stockton:

SOUTHERN CALIFORNIA

KG-779 San Clemente Ortho: Huge growth potential by expanding relaxed work week! 2896 sf w/ 6 open bay chairs Price Slashed $150k
KL-909 San Diego: Remarkable Opportunity. Long established in vibrant North Park. 2400 sf w/ 5 ops & 2 Peds chairs $1,05M
KG-921 Santa Maria: Live and practice in this desirable collegiate coastal community! 930 sf w/ 3 ops Seller Motivated $315k

BC-784 Central Contra Costa Co Perio: Seasoned Staff. Office runs like well-oiled machine! 3 ops $395k
BG-843 Walnut Creek Perio: Collections over $1M! Great gross and profit for only 2 ½ days per week! 1085 sf w/ 4 ops Reduced Price: $595k
DC-835 Tri-Valley Perio: Professional office bldg in highly desirable location. Owner available to work back to assist w/ transition. Collections over $1.2M, 2,100 sf $800k
DG-912 Sunnyvale Ortho: Premier ORTHO practice opportunity in the Silicon Valley today! ~2030 sf w/ 5 chairs in open bay $925k
DN-908 San Jose Perio: Amazing Location! Providing affordable pediatric dentistry to families! 3600 sf w/ 4ops + 3 add’l $275k
EG-903 Carmichael Oral Surgery: Gross receipts were over $1.1 million in 2017! Stable patient base won’t be affected by transition! 2282 sf w/ 5 ops Amazingly Priced: $450k
EN-822 Sacramento Perio: This practice is known throughout Sacramento for its stellar reputation! 2200 sf w/ 5 ops + 1add’l $790k
JG-757 Visalia Perio: 9 Hygiene days per week, this practice is a rare gem! On track to do almost 800k this year! ~2,000 sf w/ 5 ops $350k

SPECIALTY PRACTICES

We are a proud member of:

* Western Practice Sales is a member of American Dental Sales (ADS Transitions), a nationally recognized organization of dental practice brokers throughout the United States. ADS members have a strategic alliance & combined marketing efforts with other practice brokerage firms, financial companies & lending organizations. All ADS companies are independently owned and operated.

“Ask the Broker” can now be found at www.westernpracticesales.com
Microsoft Whiteboard (Free)

Collaboration among team members is essential for the success of any business or organization. Technology has brought teams spread across great distances closer together through virtual online-presence tools such as video conferencing and screen sharing. Despite the many advantages of a collaborative online presence, novel ideas from working groups are primarily created organically on a canvas, or whiteboard, where all team members can contribute free-form style without the limitations and constraints of digital boundaries. Microsoft Whiteboard for iOS is the digital-canvas app that seeks to bring this free-form team collaboration online to businesses and organizations.

Whiteboard for iOS requires a free Microsoft account or an Office 365 (personal, work or school) account. All Whiteboards, or digital canvases, created are stored in the cloud for easy retrieval with the associated account and can be shared with invited participants within the same organization or with anyone else using a shareable web link. The digital canvas can be edited in real time with all shared users using a vast array of tools, which include markers of various colors, a highlighter, an eraser, a ruler to measure and make straight-edge lines and a lasso to select specific content from parts of the whiteboard. Text sticky notes, pictures, mobile-device camera images and content copied from other apps can be pasted to the whiteboard. Any content can be cut, duplicated, zoomed, rotated and deleted with intuitive tools that appear unobtrusively when selected with the lasso tool. Whiteboards can be exported and shared as PNG images. Depending on internet connection speed, users may experience a lag when editing or viewing a whiteboard in real time. Custom marker-stroke sizes and highlighter colors are not available. Editing a whiteboard using an Apple Pencil with an iPad provides the best experience. While creating free-form content with finger gestures on an iPhone or iPad is possible, users will find it more difficult without a stylus.

Free-form creative brainstorming of ideas on an open canvas with real-time synchronization makes Whiteboard for iOS an incredible tool to collaborate with teams beyond physical walls of businesses and organizations. Even with some of its limitations across different mobile devices, its integration with the rest of the Microsoft Office suite of apps makes this a powerful tool to maximize the potential for teams to generate new and successful ideas.

GoodRx (Free)

Based out of Santa Monica, Calif., and founded by former Facebook executives, GoodRx is a website and mobile app that tracks prescription-drug prices, offers locations to fill prescriptions and helps identify prescriptions. For this review, the mobile-app version of GoodRx was evaluated on an iPhone X. On launch, GoodRx declares, “Save time, Save Money.” Users are greeted with a simple prescription search bar for medications at the top and three navigation options at the bottom: Home, My Coupons and Settings. The search functionality combs through not only the generic and brand-name drugs, but also common conditions for which medications are prescribed. Search results pop up as users type and categorize them by drug name and health condition. For example, typing in “hyper” results in a page populated by all drugs with a generic or brand name containing “hyper,” as well as the conditions hyperkalemia, hypertension and hyperthyroidism. Selecting a drug displays a breakdown of the medication: its brand name, generic name, common forms, common dosages, quantities and pharmacies that carry it. Selecting a health condition displays a brief overview of the condition and the various drugs that are commonly used to treat the condition. At the bottom of the screen is the “find the lowest price” button and pressing it yields a list of local pharmacies with the lowest price for the selected prescription. Users can then choose to save the medications to a list, save the pharmacy, view the list as a map, find electronic coupons to lower the price of prescriptions further and manage their optional GoodRx accounts. Buried within the “Settings” menu is a surprisingly robust feature that helps users identify pills by shape, color and imprint. With its intuitive and useful features, free (and advertisement-free) price point and money-saving potential, GoodRx is a good option for any patient looking for more information on their prescriptions.

Would you like to write about technology?

Dentists interested in contributing to this section should contact Andrea LaMattina, CDE, at andrea.lamattina@cda.org.
Find your wonder at CDA Presents in Anaheim. From exploring sandy beaches to team building at the happiest place on earth, you’ll make bright memories at the convention and outside its doors.

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Nadie, from Uzbekistan—a painter, hiker, and production worker—smiles because she loves to brighten people’s day. Opalescence Go® prefilled whitening trays are a convenient way she can whiten on her own schedule. A whiter smile is sure to brighten your patient’s day. That’s the power of a smile. Find out more at ultradent.com/mysmileispowerful.