

OF THE CALIFORNIA DENTAL ASSOCIATION

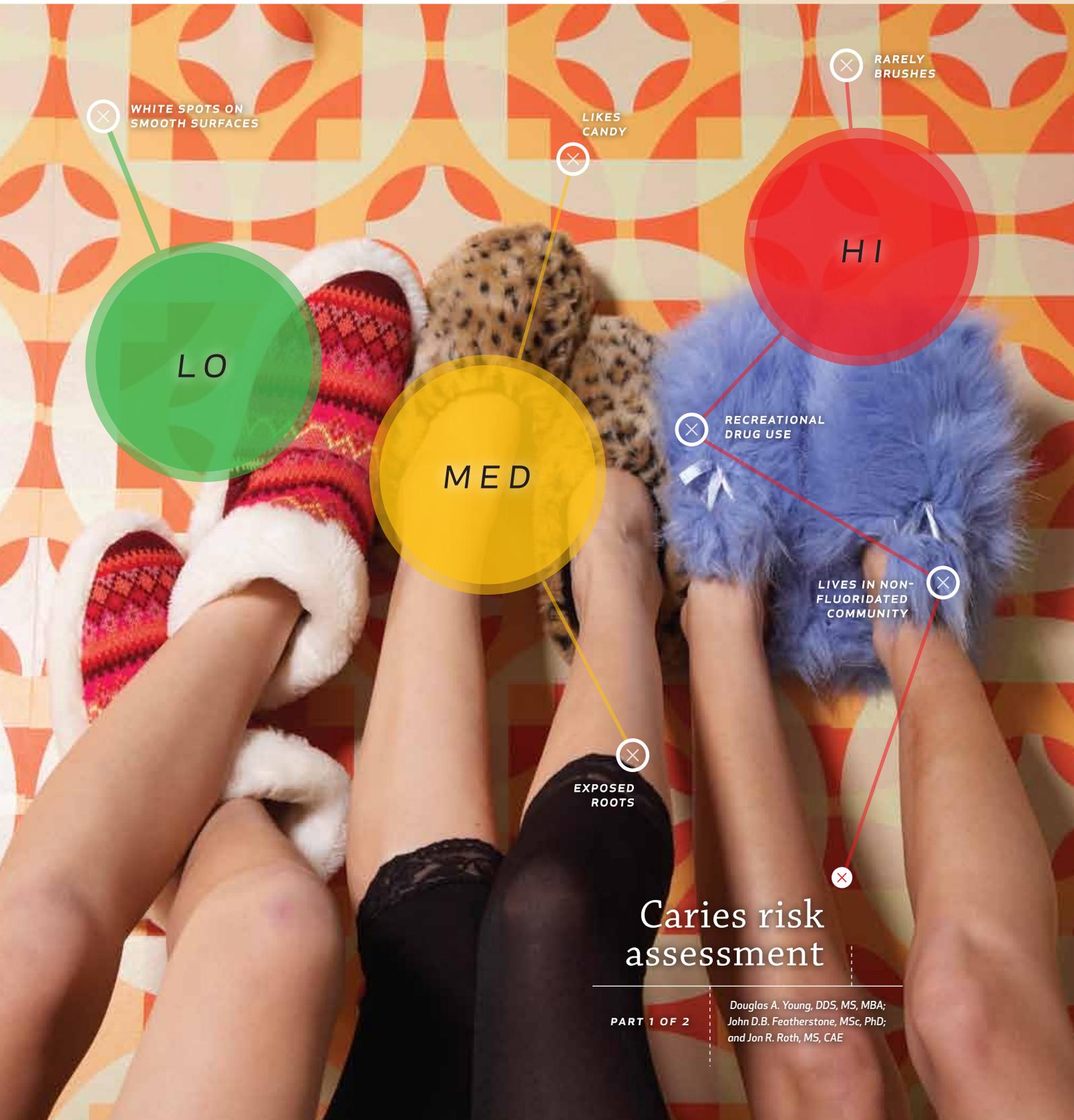
Journal

OCTOBER 2007

CAMBRA

Clinical Protocols

Products



WHITE SPOTS ON
SMOOTH SURFACES

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RECREATIONAL
DRUG USE

LIVES IN NON-
FLUORIDATED
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EXPOSED
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Caries risk
assessment

PART 1 OF 2

Douglas A. Young, DDS, MS, MBA;
John D.B. Featherstone, MSc, PhD;
and Jon R. Roth, MS, CAE



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Larry Jenson, DDS, MA; Alan W. Budenz, MS, DDS, MBA; John D.B. Featherstone, MSc, PhD; Francisco J. Ramos-Gomez, DDS, MS, MPH; Vladimir W. Spolsky, DMD, MPH; and Douglas A. Young, DDS, MS, MBA

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Vladimir W. Spolsky, DMD, MPH; Brian Black, DDS; and Larry Jenson, DDS, MS

Health Illiteracy

ALAN L. FELSENFELD, DDS

Much has been written about health literacy in recent months. The October 2006 issue of the *Journal of American Dental Association* had an editorial by Dr. Michael Glick supporting efforts to alleviate the increasing amount of health illiteracy.¹ That same year, the American Dental Association established a committee to study the problem and report back to the 2007 House of Delegates. The committee was charged to assist the Council on Access, Prevention and Interpersonal Relations in developing programs and identifying approaches to enabling this all-important concept. The Association took a good approach to the problem, not so much in the establishment of a group to look at the problem but rather their charge relative to the definition of the issue.

Illiteracy can be viewed at three levels. For some, there is difficulty in comprehending the necessity of good health practices. This level of illiteracy is difficult to overcome in that the individuals may not be able to understand the information they are given. For others, there may be a lack of education. These are individuals who have the capacity to learn but have not been taught or have learned erroneous things. Finally, there is ignorance for those who are educated and ignore that which they have learned. This ignorance is a blatant disregard of evidence in fact for various reasons.

Recipients of outreach programs are the poor, working poor, undocumented immigrants, language-challenged citizens, elderly and those who have limited or no



The promontora programs are an example of attempts to overcome the difficulty of health literacy in selected populations.

access to health care. These are people who may have substantial difficulty in the comprehension of health care concepts, a lack of individuals to attempt to teach them, or language barriers. As a result, there is likely to be a less aggressive use of available facilities and personnel for health care or lack of adequate preventive practices on their part. The promontora programs are an example of attempts to overcome the difficulty of health literacy in selected populations by using local community health care workers to educate the masses. Caregivers for the elderly or the infirm are another area where health literacy can be promoted. Additional programs such as these need to continue to be developed for future prevention and treatment of dental, as well as general health issues. Patients need to be educated on the need for proper diet, oral hygiene, and utilizing dental professionals and facilities to prevent problems and treat disease.

The uneducated groups might include those who deliver health care. Physicians, nurses, dentists, hygienists, dental assistants, and others certainly have the knowledge to inculcate health care values in their patients. Lacking may be cultural sensitivity and language skills that foster

their ability to communicate with their patients and ensure a depth of understanding. Providers need to understand cultural values and systems for their potential patient populations. Social mores and beliefs need to be addressed in the planning for health care programs and delivery. We need to update ourselves continually on techniques that enable us to relate to our patients who have cultural differences to be effective in educating them on health matters. The American Dental Association has charged the Council on Dental Education and Licensure to encourage development of programs to train health care professionals in preventive care for patients.

The final level of illiteracy is ignorance. The lack of ability to learn in our patients or lack of education for our health care providers, while unfortunate, is understandable and somewhat excusable. Ignorance, the process of ignoring what is known, is not. The programs for health care at the government level and with private carriers cannot be excused for ignoring the people who need health care at the most basic level. Federal, state, and local programs need to reassess their priorities for inclusion and reimbursement for dental and general health care.

Then, and only then, can we say that we are progressing from illiteracy to literacy.

Health literacy is a multilevel issue that has impact in California as well as nationally. It involves patients, providers, and payers. It reflects a meshing of values at all three levels that ultimately will improve the health of the population. This is a significant problem that needs to be addressed if we are to continue to address prevention of disease in the patient populations who most need it. ■■■■

REFERENCES

1. Glick M, The tower of Babel and health outcomes. *J Am Dent Assoc* 137(10):1356-8, 2006.

Address comments, letters, and questions to the editor at alan.felsenfeld@cda.org.

Kudos for the New AHA Endocarditis Prevention Guidelines

The *Journal of the California Dental Association* should be commended for the excellent article by Dr. Thomas Pallasch regarding the new AHA endocarditis prevention guidelines. Dr. Pallasch's analysis of the situation was excellent. But his article begs some needed issues and questions ...

1. Knowing that the evidence for antibiotic prophylaxis was lacking, why did we as a profession bow to the medical profession's demands for something that was truly dangerous for our patients? The needless antibiotic prescribing has certainly bred resistant bacteria and generated allergic reactions. We've had the science to support the "no-antibiotics-necessary" position for a number of years. Had ADA come up with an official position, I think we could have not only defended our position in court, but saved needless antibiotic exposure for thousands, possibly millions of patients.

2. Dr. Pallasch brings up a long-standing problem that exists between medicine and dentistry — they simply don't respect our very existence. Is there anything we can do to improve that? (That is, shy of withholding anesthetic when they need dental procedures?) While the argument can be made they are simply jealous of us as a profession (we work fewer hours, control those hours we do work, and we make more money), the reality is the medical profession's arrogant attitude toward dentistry has some very real practical consequences. We just ended a needless prophylaxis procedure, thanks to the AHA's wisdom. We are currently battling a new issue regarding bisphosphonates, and, right now, the medical profession's attitude is "... it's your problem — it doesn't affect me — I'm still going to pre-

scribe them — go away ... " At some point in time, I think dentistry needs to make the point that we are every bit as much "doctors" as they are, and we need to tell our patients what to do based on research and not based on what individual medical practitioners tell us what to do.

It is my prediction that it will take years for MDs to stop telling their patients they need antibiotics prior to dental procedures, in spite of the new AHA recommendations.

GUY G. GIACOPUZZI, DDS
Lake Arrowhead, Calif.

NO DOUBT
the word will
eventually spread
to everyone, but,
for right now,
we in dentistry are
in the lead.

Aids for Implementing New AHA Antibiotic Prophylaxis Guidelines

As recently published by the American Heart Association in *Circulation* and the *Journal of the American Dental Association*, recommendations for antibiotic prophylaxis to prevent infective endocarditis have changed substantially.^{1,2} These recommendations are more clearly based in scientific research than any previously, and substantially reduce the indications for prophylaxis.

The outcome is that only a small number of patients who are at high risk are now to receive antibiotic prophylaxis in conjunction with dental treatment. The

number of dental procedures for which prophylaxis is indicated has also enlarged from previous recommendation in this select high-risk group.

The American Academy of Oral Medicine supports these recommendations and would like to assist dentists in making the transition to the new guidelines as smooth as possible. This article then is not intended as a substitute for an in-depth review of these important changes but an aid in the process of making the transition to the new regimen.

Included are two documents that should assist in this process. The first is a summary for posting in one's office or in a clinical area as a reminder of just what conditions are now covered, for what procedures, and with what medications. This one-page sheet is intended to cue providers in their daily practice.

The second document is intended as a patient information sheet. In our limited experience with these changes, there are a number of patients who, we for years told them they needed antibiotic prophylaxis, want an explanation as to why their care is now changing. The attached patient information sheet should make this task easier. There are several ways this sheet can be used:

- It could be sent to individuals affected by the change in advance of their appointments so they can read through it.
- It could be used as a reference during the patient visit as an explanation for the changes.
- It could be taken by the patient to take to their physician as information.

What we are finding is that dentistry is much more aware of the changed recommendations than are most physicians. The sheet not only provides a concise synopsis of the changes but also has Web

sites anyone can access for additional information. No doubt the word will eventually spread to everyone, but, for right now, we in dentistry are in the lead.

These documents are also posted on our Web site for easy availability of both dental care providers and patients. We encourage practitioners to refer patients to our site not only for these documents but also for other patient information sheets that we have produced and are developing. The Web site of the American Academy of Oral Medicine is www.aaom.com. We encourage your and your patients' feedback and questions.

**THE AMERICAN ACADEMY OF ORAL
MEDICINE WRITING GROUP**

REFERENCES:

1. Wilson W, Taubert KA, et al, Prevention of infective endocarditis. Guidelines from the American Heart Association, a guideline from the American Heart Association rheumatic fever, endocarditis, and Kawasaki Disease Committee, Council on Cardiology, Cardiovascular Disease in the Young, and the Council on Clinical Care and Council on Cardiovascular Surgery and Anesthesia, and the Quality of Outcomes Research Interdisciplinary Working Group. This American Heart Association article can be directly downloaded from: <http://circ.ahajournals.org/cgi/reprint/CIRCULATIONAHA.106.183095>.
2. J Am Dent Assoc, 138(6):739-60, 2007 or download from <http://jada.ada.org>.

Matt Mullin



The Whole Tooth and Nothing But

BY PATTY REYES

In rugby, as in most sports, there is a common mentality to fight tooth and nail to score. However, in the case of Ben Czislowski, it went a scrum too far.

During the Queensland Cup, Czislowski collided noggins with opponent Tweed Heads' forward Matt Austin. Czislowski suffered a cut above his eye, a wound that was immediately stitched up. Austin, 22, lost several teeth and also broke his jaw.

Czislowski returned to the field for his team, Wynnum Manly, his eye swelling up instantly. By the end of the game, he could no longer see out of it and wouldn't be able to for another week.

"I've had a lot of cuts and bumps and bruises and that from playing rugby league, so it wasn't, it wasn't anything out of the ordinary. It was a heavy collision, but nothing different to what I've had before," said Czislowski in a broadcast

CONTINUES ON 676

Omron Healthcare Launches Patient Monitor →

Omron Healthcare of Bannockburn, Ill., announced the launch of a new portable, state-of-the-art patient monitor for use in hospitals, dentist offices, and regional surgery centers. The BP-S510 combines the best of Colin's leading noninvasive blood pressure technology



and Omron's user-friendly design capabilities to provide a versatile, lightweight monitor that will enable close watch of a patient's vital signs whether they are sedentary or being moved within a hospital. For more information, contact Chuck Crisafulli at Chuck.Crisafulli@Omron.com or 210-690-6203.

Dentists Can Be Scleroderma Specialists

An expert in the area of autoimmune disease scleroderma said he believes all dentists have the ability and knowledge to treat these patients.

David Leader, DMD, a general dentist and a faculty member at Tufts University School of Dental Medicine, said some dentists turn away scleroderma patients, hesitant they don't have the clinical knowledge needed to treat them.

Scleroderma may be systemic or localized and affects the cardiovascular system, kidneys, lungs, and skin. Microstomia, myofacial dysfunction, and xerostomia are some dental effects of the disease. Leader said that with a combination of physical therapy, proper equipment, and premedication with muscle relaxants, dentists can treat these individuals.

"By turning patients away, these dentists are creating barriers to care that need not exist," he said in the summer issue of the *Journal of the Massachusetts Dental Society*.





Contributing factors of tooth erosion can come courtesy of soft drinks and other low pH value foods, including fresh fruit, yogurt, pickles, and fruit juices.

Tooth Erosion is the Focus for New AGD Campaign

The Academy of General Dentistry recently announced a year-long sponsorship focusing on tooth erosion.

The sponsorship, made possible by an educational grant from GlaxoSmithKline Consumer Healthcare, will focus on the development and production of high-quality educational materials and opportunities for general dentists on acid erosion and tooth wear. Additionally, programs will be developed to boost the comprehension and management of oral health and the expectations of older patients.

Dentists, according to a survey of AGD members, believe tooth erosion is more common now than five years ago. Contributing factors of tooth erosion can come courtesy of soft drinks and other low pH value foods, including fresh fruit, yogurt, pickles, and fruit juices.

“At GSK Consumer Healthcare, we are committed to working with the AGD to

increase awareness and knowledge of these issues to ensure that information important to general dentists will be shared with a larger dental audience and a wider patient population,” said Ronald L. Rupp, DMD, GSK Consumer Healthcare senior manager, professional relations. “As a leader in continuing dental education and an advocate for lifelong learning, we are pleased to support the AGD in bringing initiatives such as this one to its member dentists.”

The AGD featured an educational track related to these oral health issues during its annual meeting earlier this year. A program at the event provided attendees with an objective overview aimed at increasing their awareness and knowledge of acid erosion, diagnosis, etiology, and clinical management. Another program updated attendees about denture care and offered guidance on how to improve the quality of life issues that older patients face.

GlaxoSmithKline Introduces New Sensodyne Pronamel

GlaxoSmithKline, makers of Sensodyne, announced the arrival of new Sensodyne Pronamel Toothpaste, a multibenefit dentifrice designed to help rehardened softened tooth enamel and protect against sensitivity. Pronamel is formulated to be



pH-neutral and minimally abrasive, while providing high fluoride availability, caries protection, and fresh breath. Pronamel is designed to help protect against tooth wear. To help combat tooth wear and acid erosion, Pronamel's formulation includes highly available fluoride as compared to everyday toothpastes. For more information, go to www.dental-professional.com, or call 800-652-5625.

'Meth Mouth' Legislation Lauded

“Meth mouth is robbing people, especially young people, of their teeth and their oral and overall health,” said Robert Brandjord, DDS, recently at Capitol Hill, announcing the ADA's support for meth mouth legislation.

The ADA announced the introduction of the Meth Mouth Correctional Costs and Reentry Support Act and the Meth Mouth Prevention and Community Recovery Act. These bills, introduced in the House in late July are geared toward preventing youths from abusing meth and the subsequent need for extensive dental care, as well as to relieve the treatment burden on state corrections' budgets. Senators from Montana and Minnesota plan to introduce like bills in the Senate.

“Meth wreaks havoc on the bodies of the people who use it,” said Rep. Rick Larsen, who co-chairs the House Meth Caucus, along with fellow Washington state Rep. Brian Baird. “This drug is a chemical cocktail that literally rots away your teeth. Meth mouth is a disease that causes permanent damage for meth users and burdens our communities with the high cost of treatment.”

An ADA press kit on meth mouth is available at www.ada.org/goto/meth.



Amniotic Fluid Reveals Periodontal Bacteria in Some Women

A study that evaluated women at risk for premature labor found the presence of periodontal bacteria in some of the women's amniotic fluid.

The study, which appeared in the July issue of the *Journal of Periodontology* evaluated 26 pregnant women with a diagnosis of threatened premature labor, found *P. gingivalis*, in the amniotic fluid and oral cavity in 30 percent of the women.

"We evaluated women who were at risk of premature labor," said study author Gorge Gamonal, Faculty of Dentistry, University of Chile. "We know that there are many reasons a woman can be diagnosed with threatened premature labor, including bacterial infection. Past research has shown a relationship between adverse pregnancy outcomes and periodontal disease, a chronic bacterial infection."

"While this study's findings do not show a direct causal relationship between periodontal diseases and adverse pregnancy outcomes, it is still important for women to pay special attention to their oral health during pregnancy," explained Preston D. Miller, Jr., DDS, president of the American Academy of Periodontology. "Woman who are pregnant or considering becoming pregnant should speak with their dental and health care professionals about their oral health during pregnancy."

The AAP has a risk assessment test that is available online at www.perio.org or by calling 800-356-7736.



Possible Connection Periodontal Bacteria Has With Systemic Conditions

Periodontal bacteria, as small as it is, may have a huge impact on coronary artery disease and pre-eclampsia.

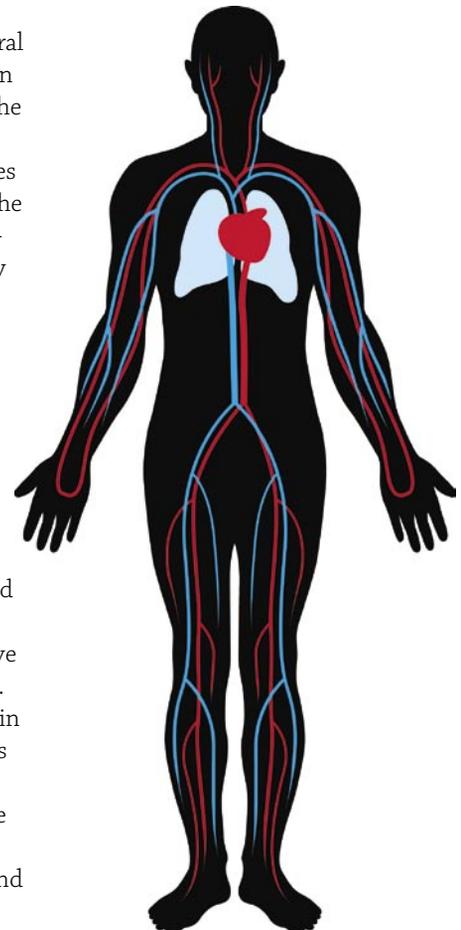
Two new studies, published in the *Journal of Periodontology* have explored the potential link between this particular bacteria and pre-eclampsia, as well as coronary artery disease.

"These studies are just a few in the growing body of evidence on the mouth-body connection. More research is needed to fully understand how periodontal bacteria travels from the mouth to other parts of the body as well as the exact role it has in the development of these systemic diseases," said Preston D. Miller, Jr., DDS, and president of the American Academy of Periodontology. "In the meantime it is important for physicians, dental professionals and patients alike to monitor the research in this area as it continues to grow so they can better work together to achieve the highest levels of overall health."

These studies found that periodontal bacteria, often invisible to the unaided

eye, may account for big effects on general health conditions. This bacteria has often been thought to play a role in many of the potential connections between overall health and oral health. Two of the studies in the *Journal of Periodontology* further the understanding of these possible connections. According to the article, one study looked at patients who had been diagnosed with coronary artery disease and examined the bacteria found in their arteries. They were able to identify periodontal pathogens in the coronary and internal mammary arteries in nine out of 15 of the patients examined.

A second study looked at women who had suffered from pre-eclampsia during their pregnancy. The study found that 50 percent of the placentas from women with pre-eclampsia were positive for one or more periodontal pathogens. This was compared to just 14.3 percent in the control group. Both of these studies support the concept that periodontal organisms might be associated with the development of other systemic conditions such as coronary artery disease and pre-eclampsia.



Oral-B introduces Oral-B Triumph with SmartGuide

→
New Oral-B Triumph with SmartGuide is Oral-B's most technologically advanced toothbrush. It is the first toothbrush to combine best-in-class cleaning and gum care with a wireless display that provides real-time navigation for your oral health. The wireless display feature (the first in the category) helps you



brush thoroughly, gently, and for the dental-recommended two minutes. Oral-B Triumph with SmartGuide is available department, retail, and specialty stores at a suggested retail price of \$149.99. For more information, contact Elizabeth Ming at ming.ej@pg.com or 513-622-4727.

"Antitrust laws cannot be ignored by dentists on the basis that they are not fair, are too complicated, or make no sense."

DANIEL SCHULTE

Honors

Allen Wong, DDS, assistant professor at the University of the Pacific, Arthur A. Dugoni School of Dentistry, has been honored by the Developmental Disabilities Councils of Alameda and Contra Costa Counties with its the Excellence in Service Award for Health Care.

He was recognized for his efforts to improve access to dental care for people with developmental disabilities over the past 18 years. Additionally, he also received several certificates of recognition from the state Legislature and U.S. Congress, including one from Speaker Nancy Pelosi.

Wong, who is assistant director for Pacific's Advanced Education in General Dentistry program, serves as regional vice president of the American Association of Hospital Dentists, is a diplomate with the American Board of Special Care



Allen Wong, DDS, (far right) receives the Excellence in Service Award for Health Care from the Developmental Disabilities Councils of Alameda and Contra Costa Counties.

Dentistry, and is the Northern California coordinator for the Special Olympics Special Smiles program.

Ove A. Peters, DMD, MS, PhD, FICD, of San Francisco, has been appointed to the position of professor of endodontics at University of the Pacific, Arthur A. Dugoni School of Dentistry.



Ove A. Peters, DMD, MS, PhD, FICD

Antitrust Laws: What Dentists Need to Know

With the U.S. Department of Justice and the Federal Trade Commission prosecuting dentists and physicians for antitrust violations, it is imperative health care providers be aware of antitrust laws in order to avoid violating them, said Daniel Schulte, legal counsel for the Michigan Dental Association, in the July issue of the *Journal of the Michigan Dental Association*.

He noted that for a violation of the Sherman Antitrust Act to occur, two things must take place: Two or more independent dentists or entities must engage

in joint activity, and that joint activity restrains competition.

The courts typically utilize two different standards in determining if a restraint on competition has occurred. The first, the "per se rule," which is a clear-cut determination. Is the plaintiff able to establish the existence of an agreement between the parties charged? "Under the per se analysis, it does not matter that the dentists did not intend to violate the antitrust laws, or that the agreement operates to lower consumer prices," Schulte said. Group boycotts and price-fixing could fall under this standard.

"Rule of reason" is the second standard. Is the agreement on balance, anti-competitive? If the answer is "yes," the courts apply the rule of reason.

"Antitrust laws cannot be ignored by dentists on the basis that they are not fair, are too complicated, or make no sense," Schulte cautioned.



UPCOMING MEETINGS

2007

Nov. 27-Dec. 1 American Academy of Oral and Maxillofacial Radiology 58th Annual Session, Chicago, aaomr.org.

2008

May 1-4 CDA Spring Scientific Session, Anaheim, 800-CDA-SMILE (232-7645), cda.org.

Sept. 12-14 CDA Fall Scientific Session, San Francisco, 800-CDA-SMILE (232-7645), cda.org.

Oct. 16-19 American Dental Association 149th Annual Session, San Antonio, Texas, ada.org.

To have an event included on this list of nonprofit association continuing education meetings, please send the information to Upcoming Meetings, CDA Journal, 1201 K St., 16th Floor, Sacramento, CA 95814 or fax the information to 916-554-5962.

It is one of the most beautiful compensations of this life that no man can sincerely try to help another without helping himself.

RALPH WALDO EMERSON

Award to Honor Member Dentist for Contributions

The American Dental Association has established the ADA Humanitarian Award to recognize a member for their exemplary contributions that improve and have an impact on the oral health of the underserved populace.

"We are very pleased to offer this award that recognizes those who have selflessly made a lasting impact on the oral health care of their fellow human beings," said, James B. Bramson, DDS, ADA executive director. "Acknowledging ADA members who give unselfishly of their time and professional skills not only recognizes their individual contributions, but encourages others to pursue similar activities and reflects positively on the profession."

The criteria for the annual award, according to an ADA press release, are those who have:

- made significant contributions to assist in alleviating human suffering and improving the quality of life and oral health of those served;
- exhibited leadership and outstanding humanitarian volunteer accomplishments bringing honor to the profession;
- served as an inspiration to the dental profession;

- demonstrated a commitment to humanity and selflessness in regard to direct personal or organizational gain or profit; and

- established a legacy of ongoing value and benefit to others.

The 2007 recipient will receive \$1,500 to be earmarked to the dental project or charity of the winner's own choosing, as well as feted at an award ceremony at the ADA's annual session in San Antonio, Texas, in 2008.

ADA members — active, life, or retired in good standing can nominate one candidate per year. Submissions, directed to the Office of the Executive Director, must be postmarked no later than Oct. 15, 2007. Nominations received after the deadline will be considered for the following year. To download the nomination packet, go to www.ada.org/goto/international. For more information, contact the ADA Center for International Development and Affairs via e-mail international@ada.org or 312-440-2726.



"We are very pleased to offer this award that recognizes those who have selflessly made a lasting impact on the oral health care of their fellow human beings."

JAMES B. BRAMSON,
DDS

RUGBY, CONTINUED FROM 671



"I feel so lucky that the worst that I got out of it was that my head looked uglier than it does normally."

BEN CZISLowski

interview. "The only difference was I've never had a tooth in my head before, that's for sure."

Following the April 1 cranium clash of the rugby league titans, Cziślowski, who had never spoken to Austin before, said "cause I knew he'd lost some teeth, I said 'Don't you wear a mouthguard?' And he'd said that he'd forgotten his mouthguard that day; so it was one of those things."

In a sport of unlimited body contact, Cziślowski — headaches aside — continued playing rugby league for almost three months postincident. He also suffered shooting pains in his head, fatigue, and an eye infection, according to various news reports.

Cziślowski said his doctors knew the cut was caused by a tooth and placed him on antibiotics. His physicians, however, didn't make the dentulous discovery of an embedded tooth in his forehead until mid-July: About 15 weeks after the collision between the rugby league players.

"A lot of the boys have been giving it to me, saying I was using it (embedded tooth) as an excuse for my poor form, but my eye looks a thousand times better already and I feel a lot better," said the 24-year-old rugby forward.

"I can laugh about it now, but the doctor told me it could have been serious, with teeth carrying germs," said Cziślowski in a previous interview. "I feel so lucky that the worst that I got out of it was that my head looked uglier than it does normally."

And in case anyone scoffs at his story, Cziślowski has the tooth for proof.

"I've got the tooth at home, sitting on the bedside table," Cziślowski said. "If (Austin) wants it back, he can have it. I'm keeping it at the moment as proof that it actually happened. It's a story I can tell for the rest of my life. It will get a bit more exaggerated over the years, but it's a good laugh."

For those who think this bizarre tale may be too much for them to bite on, they should consider that, in 2002, rugby league player Jamie Ainscough's arm had become so infected, there were concerns the Aussie would require an amputation, according to an article in the *Brisbane Times*. However, the source was discovered: an opponent's tooth embedded in Ainscough's arm. And, in 2004, "a foe's fang," according to the *Brisbane Times*, was removed from the noggin of Aussie rugby league player Shane Millard.

Even if one doesn't have a pension plan, but is likely to have an inheritance that includes a 401(k), provisions in the pension-strengthening law green-lighted by Congress last year may be of interest.

In an issue of *Membership Matters*, the publication of the Oregon Dental Association, Tom Domian, a financial expert, wrote that by the time many people retire, a 401(k) or other retirement account is often their single biggest financial asset, and can even be a large inheritable asset upon one's death. For spouses, it's never been a problem to simply roll the funds of an inherited 401(k) into an individual retirement account and continue to have the benefits of tax-deferred growth. But until now, children and other beneficiaries did not have this luxury.

Previously, Domian said, they were required to take a lump sum payout within five years of the account owner's death, which meant they also took a big tax hit. However, he continued, that since Jan. 1 this year, any nonspouse beneficiary can transfer an inherited 401(k) or other retirement plan into an IRA.

A beneficiary who would like to take advantage of the new rules needs to ensure the transfer is properly completed, he said, and financial and tax advisers can assist in that endeavor.



Carries Management by Risk Assessment

— A PRACTITIONER'S GUIDE

DOUGLAS A. YOUNG, DDS, MS, MBA; JOHN D.B. FEATHERSTONE, MSC, PHD; AND JON R. ROTH, MS, CAE

GUEST EDITORS

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Jon R. Roth, MS, CAE, is executive director of the California Dental Association Foundation.

In February and March 2003, two issues of the *Journal of the California Dental Association* were dedicated to reviewing the scientific basis for the most current approach to caries management using risk assessment protocols for diagnosis, treatment and prevention, including nonsurgical means for repairing — or remineralizing — tooth structure. The science behind Caries Management by Risk Assessment, CAMBRA, introduced in these *Journals* culminated with a consensus statement of national experts and the production of risk assessment forms for clinicians to use in practice. The California Dental Association, through the CDA Foundation, makes these *Journals* available to the public at www.cdafoundation.org/journal.

Since the science of CAMBRA has now been well-cited in the literature, clinicians are increasingly placing this knowledge into practice to the benefit of their patients. In this two-part series, this month and next, we will move from the scientific basis of CAMBRA into practical methods for dentists to incorporate the concepts into practice. The clinical protocols mentioned in this series are suggestions from experts in the field of cariology, dental practice, academic research, as well as practitioners who are already successfully using these concepts in their offices. The guidelines are suggestions for dentists who want to begin incorporating CAMBRA into their practice and are based on the best scientific evidence to date for CAMBRA. It is meant to be a starting point to aid those offices who

have a desire to begin incorporating the CAMBRA principles into their practice.

In Part 1 of this series, we asked the leading researchers in dental caries, dental academic practice, and practicing dentists to set the stage with updated information relating to the application of CAMBRA risk assessment guidelines and clinical protocols for children and adults, as well as a review of the latest products available for dentists to employ CAMBRA in their offices.

Douglas A. Young, DDS, MS, MBA; John D.B. Featherstone, MSc, PhD; and Jon R. Roth, MS, CAE, set the stage with a review of the principles of CAMBRA, as well as base line definitions used throughout the papers.

Francisco J. Ramos-Gomez, DDS, MS, MPH; James J. Crall, DDS, ScD; Rebecca L. Slayton, DDS, PhD; Stuart A. Gansky, DrPH; and Dr. Featherstone, present the latest maternal and child CAMBRA assessment tools for children age 0 to 5 and how practitioners use these tools when seeing children in their practice.

Dr. Featherstone; Sophie Domejean-Orliaguet, DDS; Larry Jenson DDS, MA; Mark Wolff, DDS, PhD; and Dr. Young, continue with an article regarding practical caries risk assessment procedures and form for patients age 6 through adult.

Dr. Jenson; Alan W. Budenz, MS, DDS, MBA; Dr. Featherstone; Vladimir W. Spolsky, DMD, MPH; and Dr. Young, provide a practical, everyday clinical guide for managing dental caries for any patient based upon the risk assessment protocols presented.

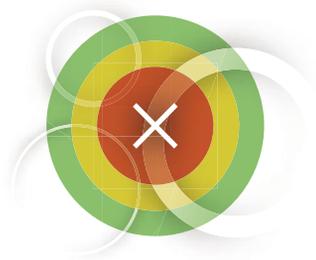
Dr. Spolsky; Brian P. Black, DDS;

and Dr. Jenson provide insights into the dental products that are currently available to assist the clinician in prudent recommendations for patient interventions using the CAMBRA principles.

Next month, we will provide practical implementation suggestions for dentists looking to begin CAMBRA in their practice, along with suggestions for educating dental team members and patients on the benefits of these approaches. That issue will culminate with a consensus statement demonstrating broad collaboration and support. ■■■■

The CDA Foundation will host a live Web cast featuring Drs. John D.B. Featherstone and Douglas A. Young, along with authors from this issue and next month's Journal, from 5 to 7 p.m. Dec. 5.

Participants will be able to submit questions on the topics covered in these issues for answers during the Web cast. This course is sponsored by CDA Foundation, through its grant from First 5 California, and is approved to confer two continuing education credits. To register for the event, to go: cdfoundation.org or first5oralhealth.org.



Curing the Silent Epidemic: Caries Management in the 21st Century and Beyond

DOUGLAS A. YOUNG, DDS, MS, MBA; JOHN D.B. FEATHERSTONE, MSC, PHD;
AND JON R. ROTH, MS, CAE

ABSTRACT Caries is the most prevalent disease of children and is epidemic in some populations. A risk-based approach to managing caries targets those in greatest jeopardy for contracting the disease, as well as provides evidence-based decisions to treat current disease and control it in the future. This paper outlines key concepts necessary to effectively manage and reduce caries based on the most current science to date. Subsequent articles will outline a roadmap to success in curing dental caries.

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The Silent Epidemic

“What amounts to ‘a silent epidemic’ of oral diseases is affecting America’s most vulnerable citizens: poor children, the elderly, and many members of racial and ethnic minority groups.”

— THE SURGEON GENERAL 2000
U.S. Department of Health and Human Services, 2000 Oral Health in America: A Report of the Surgeon General, Rockville, Md., U.S. Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institutes of Health.

Dental caries, also known as the process leading to tooth decay, is the pathologic progression of tooth destruction by oral microorganisms that can affect individuals of all ages, cultures, ethnicities, and socioeconomic backgrounds. In 2000, it was determined that dental caries was the most common chronic

disease of childhood, with a rate five times greater than that seen for the next most prevalent disease of childhood: asthma.¹ Because dental infections are common and usually nonlife-threatening in nature, the significance of dental caries in overall health has historically been minimized until recently. On Feb. 28, 2007, the *Washington Post* reported that a 12-year-old Maryland boy died from untreated tooth decay. This news received national attention, not only from the dental profession but the public in general. Although overall dental caries prevalence and severity has been notably reduced in several western countries over the past couple of decades, dental caries continues to be a major health issue in the United States.

The third National Health and Nutrition Examination Survey (NHANES III)-Phase 1, collected data from 1988 to 1994 that indicated 50 percent of 5- to 8-year-old children in the United States had experienced caries in the primary dentition.² Remarkably, when the data are examined,

approximately 25 percent of children and adolescents in the 5- to 17-year-old range accounted for 80 percent of the caries experienced in the permanent teeth. These data indicate that dental caries continues to be a major oral health concern in children in the United States and worldwide.³ This suggests that the population of individuals susceptible to dental decay continues to expand with increased age. It is evident from numerous other studies that dental caries continues to affect individuals through childhood and beyond.³

Much of the dentistry is focused on restoring the symptoms of this transmissible bacterial infection rather than treating its etiologic cause, the infectious cariogenic biofilm in a predominantly pathologic oral environment. The core principles supporting risk-based caries management are decades old, and many practitioners are already using this as their current standard approach in patient care. Many clinicians still need help getting started with employing these principles in their practice.

This issue of the *Journal* provides current information on how to assess caries risk, what to do as a result, and provides the protocols to implement it in practice. The articles emphasize practical suggestions on how these current management techniques may be efficiently incorporated into a dental practice. This paper will present key concepts necessary for the most current management of dental caries and sets the stage for subsequent papers in this issue to cover the clinical implementation of a caries management by risk assessment model, or CAMBRA.

Caries Management by Risk Assessment

For more than two decades, medical science has suggested that physicians identify and treat patients by risk rather than treating all patients the

same.⁴ Throughout this *Journal*, the authors will refer to an evidence-based disease management protocol for Caries Management by Risk Assessment, or CAMBRA.⁵ Evidence-based dentistry, as defined by American Dental Association Council on Scientific Affairs in 2006, is an approach to oral health care that requires the judicious integration of systematic assessments of clinically relevant scientific evidence relating to the

THE CORE PRINCIPLES
supporting risk-based caries management are decades old, and many practitioners are already using this as their current standard approach in patient care.

patient's oral and medical condition and history, with the dentist's clinical expertise and the patient's treatment needs and preferences (www.ada.org/prof/resources/pubs/jada/reports/index.asp).

Simply put, with the CAMBRA methodology the clinician identifies the cause of disease by assessing risk factors for each individual patient. Based on the evidence presented, the clinician then corrects the problems (by managing the risk factors) using specific treatment recommendations including behavioral, chemical, and minimally invasive procedures. Both the risk assessment and interventions are based on the concept of altering the Caries Balance (see Featherstone, et al. this issue). The Caries Balance is a model where pathological factors (bacteria, absence of healthy saliva, and poor dietary habits (i.e., frequent inges-

tion of fermentable carbohydrates) battle protective factors (saliva and sealants, antibacterials, fluoride, and an effective diet).⁶ With the use of CAMBRA, there is evidence that early damage to teeth from dental caries may be reversed and the manifestations of the disease perhaps prevented all together.

Transitioning From Science to Practice

In February and March 2003, two issues of the *Journal of the California Dental Association* were dedicated to reviewing the scientific basis for CAMBRA, culminating with a consensus statement of national experts and the production of risk assessment forms. The California Dental Association, through the CDA Foundation, has made these journals available to the public at www.cdafoundation.org/journal. These issues of the *Journal* present reviews of the scientific literature on the caries process starting with the infectious nature of the pathogenic bacterial organisms that are part of an extremely complex biofilm community.⁷ These organisms utilize fermentable carbohydrates as an energy source and create small molecule acids that then enter the tooth via diffusion channels between the mineral crystals. The diffusion of acid causes mineral loss below the tooth surface and, if the process is not halted, the surface will cavitate. In the case of a noncavitated lesion, it is possible to halt or reverse the caries process. In this case, using the Caries Balance, the protective factors overcome the pathological factors and remineralization of the lesion is possible and preferred.⁸ Remineralization is the natural repair process for dental caries. Several articles in those *Journals* reviewed the individual chemotherapeutic agents such as xylitol, chlorhexidine, iodine, fluoride, as well

as fluoride releasing dental materials.⁹⁻¹³

More recently, a pivotal randomized clinical trial by Featherstone et al. investigated CAMBRA protocols compared to conventional care.¹⁴ In the intervention group, patients were assessed at levels of caries risk based upon the Caries Balance described previously. Depending upon their risk status, patients were treated with antibacterial therapy (chlorhexidine) to reduce the bacterial challenge and topical fluoride (daily fluoride mouthrinse) to enhance remineralization. The control group received examination, customary preventive care and restoration as needed, but no risk assessment or chemical interventions. Results showed a significant reduction of cariogenic bacteria and future carious lesions in the CAMBRA test group compared to the conventional care control group.¹⁴

Since the science of CAMBRA has been well-cited in the literature, clinicians are increasingly placing this knowledge into practice to the benefit of their patients. This issue of the *Journal* will present ways to incorporate CAMBRA into practice and will be added as a resource to the previously mentioned Web site. Protocols mentioned in this *Journal* are suggestions based on the best available scientific evidence to date as well as clinical practice in offices currently using the CAMBRA approach. It is meant to be a starting point to aid the offices that have not yet incorporated CAMBRA principles. This issue also contains updated risk assessment forms and procedures that should be adopted by those currently utilizing CAMBRA as the changes are based upon experience to date. This effort will continue to be updated as new research science and dental products are incorporated into the dental marketplace.

Why Define Terminology?

Changing paradigms in caries management does not happen without global involvement and collaboration from several sources, including updating terminology to reflect new scientific advances. Existing terminology does not always accurately reflect new advances in science. However, new terminology is not always universally accepted as new concepts are often described with different definitions, names,

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dentistry and
minimal intervention
stand for
much more than
conservative cavity
preparation.

or labels. Some feel there should be globally accepted terminology, while others want the freedom to apply terminology that is more locally accepted. In any case, caries management by risk assessment accurately describes the new paradigm of treating the caries disease process and will be used throughout this *Journal*. Alternative terminology that has been used in the past includes the “medical model” or the “modern management of caries.” The limitations with these terms is that they do not describe the disease process.

CARIES

The term caries has been used to describe a multitude of manifestations, which may lead to confusion if not further defined.¹⁵ For purposes of this *Journal*, caries is defined as an infectious transmissible disease process where a

cariogenic biofilm in the presence of an oral status that is more pathological than protective leads to the demineralization of dental hard tissues.

Any resulting changes, visible on the teeth or not, are merely symptoms of this disease process. Therefore, caries is not a hole in the tooth, cavitation, nor should it be used to describe everything clinically detectable. Throughout this *Journal* there will be clear use of other descriptive terminology when referring to the symptoms of caries such as cavitation, carious lesions, radiographic caries, white or brown spot lesions, infected dentin, affected dentin, and so on.

CAMBRA, MID, AND MI

Minimally invasive dentistry, minimal intervention, and CAMBRA are relatively new terms developed in response to scientific advances in the field. They are used interchangeably by some, and by others a source of debate about which is the most proper term. For example, CAMBRA does not stop at prevention and chemical treatments; it includes evidence-based decisions on when and how to restore a tooth to minimize structural loss. In addition, minimally invasive dentistry and minimal intervention stand for much more than conservative cavity preparation. The term “minimal intervention” was endorsed by the Federation Dentaire Internationale in a 2002 policy statement and is globally recognized.¹⁶ The terms CAMBRA and MID are in 100 percent agreement with the FDI statement on minimal intervention. Thus, the authors support the interchangeability of all three terms and recognize the importance of local preferences as well as global collaboration.

DETECTION VERSUS DIAGNOSIS

Defining the terms detection and diagnosis as it relates to dental caries is best

done by example. Simply put, one *diagnoses* the caries disease but *detects* carious lesions. Detecting a white spot lesion, for example, is not diagnosing the disease of caries because the disease process involved with the lesion could be inactive and the lesion could be remineralized.

PREVENTION VERSUS MANAGING RISK FACTORS

Traditionally, the term “prevention” has become a common language term that has been blanded and simplified to only mean “brush and floss” and “don’t eat sugar.” That advice is historically what many consider when the term is used in the context of caries prevention. Utilizing CAMBRA archetype, managing risk factors is what is done after first performing caries risk assessment. Once the risk factors are identified, then evidence-based treatment decisions can be made to bring the balance of pathologic and protective factors positively back to favor health using an array of behavioral, chemical, minimally invasive surgical, and other techniques. Throughout this issue of the *Journal* the term prevention will be defined as risk factor management (by maximizing protective factors and minimizing pathological factors).

Western CAMBRA Coalition

The Western CAMBRA Coalition is a unique collaboration of diverse groups of independent organizations. This coalition represents an interorganizational collaboration that has evolved over four years and has led to significant progress in the clinical adoption of CAMBRA. The working group, assembled from different aspects of the dental profession, included unofficial representatives of education from all five California dental schools, as well as from Oregon, Washington, Nevada, and

Arizona. Additionally, representatives from research, industry, the California Dental Association Foundation, government, the Dental Board of California, third-party payers, and private practice clinicians were included in the working group. The strategy for including a diverse perspective of individuals was to break the traditional mold where only researchers, educators, and clinicians met for their specialties. The goal was

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to infuse new ideas into the conversation where no existing network for sharing this information existed.

Additionally, the cross-pollination provided support from nontraditional partners to implement changes in caries management. The coalition used this conduit of information based on reciprocity so that those in the network could share information freely and confidentially in the spirit of cooperation, collaboration, and coordination for the common good of improving the standard of caries management.

The coalition has used the World Congress of Minimally Invasive Dentistry annual meeting, attended mostly by clinicians, as a venue to gather each year because CAMBRA is a core value of the WCMID (www.wcmid.com). Recently,

new CAMBRA groups in the Eastern and Central United States have formed and begun to meet with the same agenda and principles as the Western CAMBRA Coalition. The regional groups have agreed to work together and collaborate with the newly formed ADEA Cariology Special Interest Group where opportunities exist.

Standard of Care

Standard of care involves many components and is more than just what a dentist does in his/her own practice, what a dental school teaches, or even what is published in refereed publications. Standards are never static, nor is there always complete agreement on the application. The California legal system defines the standard of care as what a reasonably careful dentist should do under similar circumstances. Reasonable care weighs the benefits versus the risks. If the benefits exceed the risks, then reasonable dentists should adopt these standards. The public expects that dentists and physicians will utilize current scientifically safe and effective practices.

CAMBRA procedures, as presented in this issue of the *Journal*, provide a framework for providing caries management by risk assessment for the benefit and improved dental health of the patient. Explaining the planned treatment to the patient and obtaining informed consent is, of course, necessary as part of this approach, as it is for any procedure. Although the CAMBRA protocols are based on the best available science we have now, there is much more involved in treatment decisions other than just science. As stated previously, the ADA definition of evidence-based dentistry implies that treatment decisions should also consider the clinical expertise of the clinician and, most importantly, the preferences of the fully informed patient just as much

as the science (www.ada.org/prof/resources/topics/evidencebased.asp).

Conclusions

It is the consensus of the Western CAMBRA Coalition that it is best for the profession to position itself for the future and embrace caries management by risk assessment. This means thinking of dental caries as a disease process with the possibility of intervention, arresting the progress of the disease, and even reversing it. Caries risk assessment should become a routine part of the comprehensive oral examination, and the results of the assessment should be used as the basis for the treatment plan.

This issue of the *Journal* provides caries risk assessment and treatment procedures for newborns to age 5 (Ramos-Gomez et al.); caries risk assessment for age 6 through adult (Featherstone et al.); caries management based on risk assessment (Jenson et al.); and dental products available for use in the CAMBRA approach (Spolsky et al.).

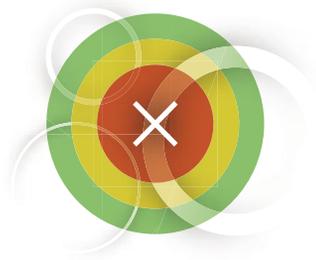
In summation, the Western CAMBRA Coalition urges that all dentists implement CAMBRA in their practices for the benefit of their patients and the improved oral health of the nation. The time to do it is now. The tools and rationale are provided in the following pages. ■■■■

REFERENCES

1. Mouradian WE, Wehr E, Crall JJ, Disparities in children's oral health and access to dental care. *JAMA* 284(20):2625-31, 2000.
2. Kaste LM, Selwitz RH, et al, Coronal caries in the primary and permanent dentition of children and adolescents 1-17 years of age: United States, 1988-1991. *J Dent Res* 75 Spec No: 631-41, 1996.
3. Macek MD, Heller KE, et al, Is 75 percent of dental caries really found in 25 percent of the population? *J Public Health Dent* 64(1):20-5, 2004.
4. Anderson MH, Bales DJ, Omnell K-A, Modern management of dental caries: the cutting edge is not the dental bur. *J Am Dent Assoc* 124:37-44, 1993.
5. Featherstone JDB, et al, Caries management by risk assessment: consensus statement. *J Calif Dent Assoc* 31(3):257-69, 2003.
6. Featherstone JD, The caries balance: the basis for caries management by risk assessment. *Oral Health Prev Dent 2 Suppl* 1:259-64, 2004.
7. Berkowitz RJ, Acquisition and transmission of mutans streptococci. *J Calif Dent Assoc* 31(2):135-8, 2003.
8. Featherstone JD, The caries balance: contributing factors and early detection. *J Calif Dent Assoc* 31(2):129-33, 2003.
9. Lynch H, Milgrom P, Xylitol and dental caries: an overview for clinicians. *J Calif Dent Assoc* 31(3):205-9, 2003.
10. Anderson MH, A review of the efficacy of chlorhexidine on dental caries and the caries infection. *J Calif Dent Assoc* 31(3):211-4, 2003.
11. DenBesten P, Berkowitz R, Early childhood caries: an overview with reference to our experience in California. *J Calif Dent Assoc* 31(2):139-43, 2003.
12. Donly KJ, Fluoride varnishes. *J Calif Dent Assoc* 31(3):217-9, 2003.
13. Weintraub JA, Ramos-Gomez F, et al, Fluoride varnish efficacy in preventing early childhood caries. *J Dent Res* 85(2):172-6, 2006.
14. Featherstone JDB, Gansky SA, et al, A randomized clinical trial of caries management by risk assessment. *Caries Res* 39:295 (abstract #25), 2005.
15. Young DA, Managing caries in the 21st century: today's terminology to treat yesterday's disease. *J Calif Dent Assoc* 34(5):367-70, 2006.
16. Tyas MJ, Anusavice KJ, et al, Minimal intervention dentistry -- a review. FDI Commission Project 1-97. *Int Dent J* 50(1):1-12, 2000.

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Caries Risk Assessment Appropriate for the Age 1 Visit (Infants and Toddlers)

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STUART A. GANSKY, DRPH; REBECCA L. SLAYTON, DDS, PHD;
AND JOHN D.B. FEATHERSTONE, MSC, PHD

ABSTRACT This article discusses caries management by risk assessment for children age 0-5. Risk assessment is the first step in a comprehensive protocol for infant oral care. The program includes opportunities to establish a “dental home” and provide guidance for improved health outcomes. Risk assessment forms, instructions for use, and guidance-related education points have been included. Collaboration among all health professionals regarding early and timely intervention to promote children’s oral health and disease prevention is emphasized.

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While the oral health of many children in the United States has improved dramatically in recent years, caries remains the most prevalent chronic childhood disease in the United States — five times more common than asthma.¹⁻³

Early childhood caries is prevalent among young children, particularly in underserved populations. For example, 8 percent of children age 2 to 5 have 75 percent of the caries experience.⁴ Moreover, the 2005 California Oral Health Needs Assessment of Children reported caries in kindergarten and third-grade children as disproportionately affecting children of migrants, in lower socioeconomic strata, and certain racial/ethnic groups such as Hispanics.⁵

INITIAL INFANT ORAL CARE VISIT

Evidence increasingly suggests that to be successful in preventing oral disease,

dentists and other health care professionals must begin preventive interventions in infancy.⁶ The American Dental Association, American Academy of Pediatric Dentistry, and the American Association of Public Health Dentistry currently recommend all children have their first preventive dental visit by 12 months of age.⁷⁻⁹

ESTABLISHMENT OF A DENTAL HOME

Parents and other care providers are encouraged to help every child establish a dental home for early dental care to provide caries risk assessment, education for parents/care givers and anticipatory guidance on the prevention of dental disease.¹⁰ In addition, periodic supervision of care interval (periodicity) should be determined by level of risk.¹¹ The “dental home” concept is derived from the American Academy of Pediatrics’ recommendation that every child should have a “medical home.”¹² The intention of the recommendation is to promote health

care for infants, children, and adolescents that ideally is accessible, continuous, comprehensive, family-centered, coordinated, compassionate, and culturally appropriate.

From the medical point of view, referring a child for an oral examination and risk assessment to a dentist who provides care for infants and young children, starting six months after the first tooth erupts or by 12 months of age, will establish the child's dental home, and provide an opportunity to monitor and implement preventive oral health habits that will meet each child's individual and unique needs. The intent of this effort is to maintain the child's cavity-free status and prevent other oral diseases. For this to become a reality, practicing clinicians must be committed to welcoming these young patients into their practices. If physicians are to refer children at age 1, the practicing dental community must take on the responsibility of being willing and well-prepared to accept them.

BENEFITS OF RISK ASSESSMENT

Risk assessment is an estimation of the likelihood that an event will occur in the future. An individualized caries risk assessment is the first step and an important part of a comprehensive protocol for the infant oral care visit by identifying characteristics that can help the health care providers and parents/caregivers to have a true understanding of the level of caries risk and oral health needs of infants and toddlers. Caries risk assessment guides the clinical decision-making process.¹³⁻¹⁵ Featherstone described a balance between pathological and protective factors that can be swung in the direction of early caries intervention and prevention utilizing the active role of the dentist and allied dental staff.¹⁶ To achieve the best management and outcomes for good dental health, an appropriate caries risk assessment screening must be executed as

early as possible and preferably prior to the onset of the disease process. Caries risk assessment and subsequent management of the disease in children is crucial due to the known fact that caries in the primary dentition is a strong predictor of caries in the permanent dentition.^{17,18}

CARIES MANAGEMENT BY RISK ASSESSMENT

In April 2002, a consensus conference was held in Sacramento, Calif., on caries management by risk assessment. A group

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of experts designed a caries risk assessment, CRA, form and proposed its use based upon the known literature at that time. One form was designed for patients 6-years-old through adulthood, and a second was for patients 0-5. All supporting review articles and summaries from this CAMBRA consensus, as well as the CRA forms and intervention procedures, were published in the *Journal of the California Dental Association* in February and March 2003. They are accessible in their entirety at www.cdafoundation.org/journal.^{19,20} Since then, our group has used and modified the form for infants and toddlers targeting 0-5, and has added a treatment protocol.²¹ Modifications include 0-5 age-specific threshold values for salivary, cariogenic bacterial assays, and both child and maternal caries risk and protective

factors. This article will present the considerably modified form and discuss our experiences with its use, as well as recommendations for managing different risk groups based on their individualized risk assessments. The 6-year-old through adult form is described in detail in a separate article by Featherstone et al. this issue.

Modified Caries Risk Assessment Form (CAMBRA 0-5) Targeted at Infants and Toddlers 0-5 Years-old

Featherstone and colleagues, at the California consensus conference in 2002, proposed that the progression or reversal of dental caries is determined by the balance between caries pathological factors and caries protective factors. The original age 0-5 form was designed to reflect the full range of pathological and protective factors.²⁰ The modified form presented here has been revised to improve ease of use while retaining essential components related to the caries balance.

The CAMBRA 0-5 form is a one-page questionnaire that is designed for use with children age 0-5 in a busy dental practice, and is laid out in a sequence that follows the normal flow from the patient/parent interview through the clinical examination of the child. The modified CAMBRA 0-5 form followed by a one-page revised summary of instructions is provided in **TABLE 1**. The form has interview questions comprising five subgroups:

- *Caries disease indicators — parent interview.* Disease indicators are observations that indicate the presence of disease symptoms or the presence of an environment that indicates the child is likely to have the disease called dental caries. For example, past dental restorations indicate disease in the past, which most likely is still progressing. The socioeconomic status of the fam-

TABLE 1

CAMBRA for Dental Providers (0-5) Assessment Tool

Caries Risk Assessment Form for Age 0 to 5

Patient name: _____ I.D.# _____ Age _____ Date _____

Initial/base line exam date _____ Caries recall date _____

Respond to each question in sections 1, 2, 3, and 4 with a check mark in the "Yes" or "No" column	Yes	No	Notes
1. Caries Risk Indicators — Parent Interview**			
(a) Mother or primary caregiver has had active dental decay in the past 12 months			
(b) Child has recent dental restorations (see 5b below)			
(c) Parent and/or caregiver has low SES (socioeconomic status) and/or low health literacy			
(d) Child has developmental problems			
(e) No dental home/episodic dental care			
2. Caries Risk Factors (Biological) — Parent Interview**			
(a) Child has frequent (greater than three times daily) between-meal snacks of sugars/cooked starch/sugared beverages			
(b) Child has saliva-reducing factors present, including: 1. Medications (e.g., some for asthma or hyperactivity) 2. Medical (cancer treatment) or genetic factors			
(c) Child continually uses bottle - contains fluids other than water			
(d) Child sleeps with a bottle or nurses on demand			
3. Protective Factors (Nonbiological) — Parent Interview			
(a) Mother/caregiver decay-free last three years			
(b) Child has a dental home and regular dental care			
4. Protective Factors (Biological) — Parent Interview			
(a) Child lives in a fluoridated community or takes fluoride supplements by slowly dissolving or as chewable tablets			
(b) Child's teeth are cleaned with fluoridated toothpaste (pea-size) daily			
(c) Mother/caregiver chews/sucks xylitol chewing gum/lozenges 2-4x daily			
5. Caries Risk Indicators/Factors — Clinical Examination of Child**			
(a) Obvious white spots, decalcifications, or obvious decay present on the child's teeth			
(b) Restorations placed in the last two years in/on child's teeth			
(c) Plaque is obvious on the child's teeth and/or gums bleed easily			
(d) Child has dental or orthodontic appliances present, fixed or removable: e.g., braces, space maintainers, obturators			
(e) Risk Factor: Visually inadequate saliva flow - dry mouth			
**If yes to any one of 1(a), 1(b), 5(a), or 5(b) or any two in categories 1, 2, 5, consider performing bacterial culture on mother or caregiver and child. Use this as a base line to follow results of antibacterial intervention.	Parent/Caregiver Date: _____	Child Date: _____	
(a) Mutans streptococci (Indicate bacterial level: high, medium, low)			
(b) Lactobacillus species (Indicate bacterial level: high, medium, low)			
Child's overall caries risk status: (CIRCLE) Extreme	Low	Moderate	High
Recommendations given: Yes _____ No _____ Date given _____ Date follow up: _____			

SELF-MANAGEMENT GOALS 1) _____ 2) _____

Practitioner signature _____ Date _____

Instructions for Caries Risk Assessment Form — Children Age 0-5

- 1. Answer the questions:** Respond to questions 1 to 5 with “yes” or “no” answers. You can make special notations such as the number of cavities present, the severity of the lack of oral hygiene, the brand of fluorides used, the type of bottle contents used, the type of snacks eaten, or the names of medications/drugs that may be causing dry mouth.
- 2. Determine the overall caries risk of the child:** Add up the “yes” answers to the disease indicators/risk factors from caries risk categories 1, 2, and 5. Then add up the number of “yes” answers for the protective indicators/factors identified in categories 3 and 4. Make a judgment as to low, moderate or high overall caries risk based on the balance between the pathological factors (caries disease indicators and risk factors) and the protective factors. **Note:** Determining the caries risk for an individual child requires evaluating both the number as well as the severity of the disease indicators and risk factors. Certainly a child with caries presently or in the recent past is at high risk for future caries. A patient with low bacterial levels would need to have several other risk factors present to be considered at moderate risk. Some judgment is needed while also considering the protective factors to determine the risk.
- 3. Bacteria testing:** If the answer is “yes” to any one of 1(a), 1(b), 5(a), or 5(b) questions regarding parent/caregiver’s recent active decay, or child’s recent restorations, or any obvious white spots, decalcifications or obvious decay; or any two of the questions in 1, 2, 5, consider performing bacterial cultures on parent/caregiver and child (see **notes on the form). See separate “Bacterial Testing” instructions for technique steps. Use the bacterial colony density level (low, medium, or high) to determine who would benefit from antibacterial therapy and to establish a base line to assess the impact of any prescribed antibacterial intervention(s) and whether to carry out antibacterial therapy for the parent/caregiver or child.
- 4. Plan for caries intervention and prevention:** Develop a caries control and management plan for the child and parent/caregiver based on completed assessments incorporating antibacterial therapy and fluoride delivery forms as indicated. (See “CAMBRA Clinical Guidelines for Patients 0-5 Years,” **TABLE 2**.) High caries risk status is generally an indication for the use of both antibacterial therapy and fluoride therapy. If the answer is “yes” to any one of questions regarding the presence of white spots, decalcification or obvious decay on the child’s teeth or parent/child restorations (1(a), 1(b), 5(a), or 5(b)), strongly consider using antibacterial therapy for the parent/caregiver as well as the child. Once strategies have been planned to aggressively deal with caries as a bacterially-based transmissible infection, determine which teeth have cavitation and treatment plan for minimally invasive restorative procedures designed to conserve tooth structure.
- 5. Home care recommendations:** Review with the parent/caregiver the individualized home care recommendations you have selected for them on the “Parent/Caregiver Recommendations for Control of Dental Decay in Children 0-5” form (**TABLE 4**). Use this interaction as an opportunity for a brief patient-centered approach to engage the parent/caregiver in two-way communication on strategies for caries control and management. During this motivational interviewing intervention, ask the parent/caregiver to commit to two goals and note them on the “Self-management goals 1) and 2)” area in the last section of the CAMBRA 0-5 form (**TABLE 1**). Inform the parent/caregiver that you will follow up with them on these goals at the next appointment. Give one copy of the signed recommendations form to the parent/caregiver and keep one in the child’s chart. Point out to the parent/caregiver that the back of the recommendations form includes additional information on “How Tooth Decay Happens” and “Methods of Controlling Tooth Decay” to help them further understand the caries disease process and ways to control it (**TABLE 4**).
- 6. Bacteria test results:** After the inoculated media sticks or culture tubes have incubated for 72 hours (see **TABLE 3** for instructions), determine the colony density level, and inform the parent/caregiver of the results of the bacteria tests. Since showing the parent/caregiver the bacteria grown from their own mouth can be a good motivator, show them the culture tube at the next visit (the culture keeps satisfactorily for some weeks) or provide them with a photograph or digital image of their bacterial colonies. If the parent/caregiver has high cariogenic bacterial counts then work with them to lower their caries risk and get their caries infection under control. The goal is to eliminate this source of infection and reinfection for the child.
- 7. Follow up:** After the parent/caregiver/child has been following your recommendations for three to six months, have them back to reassess how well they are doing. Some practicing clinicians report good motivational success in doing a bacterial culture immediately after the patient’s very first month of antibacterial treatment. Patients need encouragement early on when behavior change is required. Ask them if they are following your instructions and how often. If the bacterial levels were moderate or high initially, repeat the bacterial culture to see if bacterial levels have been reduced by antibacterial therapy. Make changes in your recommendations or reinforce protocol if results are not as good as desired or the parent/caregiver is not cooperating as much as expected. It is very important to inform patients that changing a pathogenic biofilm is not going to happen overnight. In fact, it may take several months to even years in some cases.

ily does not cause dental caries but has been associated strongly with its presence. Low health literacy of the primary caregiver is a good indicator that the environment is conducive to dental caries. Similarly, developmental defects and the absence of a dental home are indicators of a higher likelihood of the presence of dental caries.

■ *Caries risk factors (biological)* — *parent interview*. These are biological factors that explain why dental caries is in progress and helps us to determine how to arrest or reverse the process. These risk factors include frequency of ingestion of fermentable carbohydrates, sleep habits that provide a continual food source for the bacteria, medications that would reduce salivary flow, and continual bottle use.

■ *Protective factors (nonbiological)* — *parent interview*. These indicators, obtained during the parent interview, shed light on the possibilities of increasing or enhancing protective practices. Protective factors include such things as whether the mother/caregiver is free of decay (may not have cariogenic bacteria to transmit to the child), and the child's access to regular dental care (dental home).

■ *Protective factors (biological)* — *parent interview*. These are biological protective factors that can help arrest or reverse dental caries. They include the child's exposure to fluoride, or exposure to calcium phosphate paste or xylitol-based products by the mother/caregiver as well as the child.

■ *Caries disease indicators and risk factors* — *clinical examination of child*. Disease indicators include clinical observations such as obvious white spot lesions/descalcifications, obvious decay, and recent restorations. Biological risk factors include quantity of plaque and gingival bleeding (an indicator of heavy plaque),

dry mouth, and the presence of dental/orthodontic appliances. The presence of several disease indicators and risk factors indicates that the health care provider perform a bacterial culture for mutans streptococci and lactobacillus species on both the mother/caregiver and child to assess the need for antibacterial therapy.

A simple visual diagram of the interaction of the disease indicators and risk factors is presented by Featherstone et al. later in this issue of the Journal.

IDENTIFICATION OF
risk factors is essential
to understand why the
disease is where it is,
or whether
it is likely to manifest
symptoms in the future.

Desired Outcomes for the Caries Risk Assessment Form CAMBRA 0-5

The caries risk assessment form has been designed to ensure clear identification of disease indicators and caries risk factors. Identification of risk factors is essential to understand why the disease is where it is, or whether it is likely to manifest symptoms in the future. Risk assessment permits the dental health care provider to determine the balance of protective factors appropriate for the high, moderate, or low caries risk level in an individual. Findings from the child and parent/caregiver assessment regarding caries risk level and reasons for risk can be used to design and implement an intervention strategy that incorporates the appropriate protective factors. This permits the clinician

to use a more targeted approach in the management of the disease process.

IMPLEMENTATION OF CARIES RISK ASSESSMENT FOR CHILDREN 0-5 YEARS-OLD AS PART OF THE INFANT ORAL CARE VISIT

Protocol for a comprehensive CAMBRA 0-5/infant oral care visit includes the following components:

- Parent interview
- Examination of the child
- Assignment of caries risk level
- Individualized treatment based on risk level
 - If indicated, bacterial culture on parent or care giver and child
 - Show bacterial results to parent/care giver — effective motivator
 - Individualized home care recommendations
 - Motivational interview/strategies for caries control
 - Setting of self-management goals with parent/child
 - Anticipatory guidance according to a specific age category
 - Determine the interval for periodic re-evaluation (periodicity of examination)
 - Collaboration with other health care professionals

The CAMBRA 0-5 assessment components are further described below:

PARENT INTERVIEW

The parent interview before the child is examined will establish the presence of several important risk factors and disease indicators. It will also establish whether protective measures are already in place. If the mother and/or caregiver has active decay, this automatically places the child at high risk due to the high possibility of bacterial transmission and inoculation of the child's mouth at an early stage by the parent/caregiver.

CAMBRA Treatment Guidelines (0-5 years)
 Caries Management by Risk Assessment (CAMBRA) Clinical Guidelines for Patients 0-5 years

Risk Level	Saliva Test	Antibacterials	Fluoride	Frequency of Radiographs	Frequency of Periodic Oral Exams (POE)	**** Xylitol and/or Baking Soda	Sealants ***	Existing Lesions
Low risk	Optional (Base line)	Not required or if saliva test was performed; treat main caregiver accordingly	Not required	After age 2: Bitewing radiographs every 18-24 months	Every 6-12 months to re-evaluate caries risk AND ANTICIPATORY GUIDANCE**	Optional		
Moderate risk	Recommended	Not required or if saliva test was performed; treat main caregiver accordingly	OTC fluoride-containing toothpaste twice daily (a pea-sized amount) Sodium fluoride treatment gels/rinses	After age 2: Bitewing radiographs every 12-18 months	Every 6 months to re-evaluate caries risk AND ANTICIPATORY GUIDANCE	Xylitol gum or lozenges Two sticks of gum or two mints four times daily for the caregiver Xylitol food, spray or drinks for the child	Sealants for deep pits and fissures after two years of age. High fluoride ionomer is recommended	Lesions that do not penetrate the DEJ and are not cavitated should be treated with fluoride toothpaste and fluoride varnish
High risk*	Required	Chlorhexidine 0.12% 10 ml rinse for main caregiver of the infant or child for one week each month. Bacterial test every caries recall. Health provider might brush infant's teeth with CHX	Fluoride varnish at initial visit and caries recall exams OTC fluoride-containing toothpaste and calcium phosphate paste combination twice daily Sodium fluoride treatment gel/rinses	After age 2; Two size #2 occlusal films and 2 bitewing radiographs every 6-12 months or until no cavitated lesions are evident	Every 3 months to re-evaluate caries risk and apply fluoride varnish AND ANTICIPATORY GUIDANCE	Xylitol gum or lozenges. Two sticks of gum or two mints four times daily for the caregiver Xylitol food, spray, or drinks for the child	Sealants for deep pits and fissures after two years of age. High fluoride conventional glass ionomer is recommended	Lesions that do not penetrate the DEJ and are not cavitated should be treated with fluoride toothpaste and fluoride varnish ART might be recommended
Extreme risk*	Required	Chlorhexidine 0.12% 10 ml rinse for one minute daily at bedtime for two weeks each month. Bacterial test at every caries recall Health provider might brush infant's teeth with CHX	Fluoride varnish at initial visit, each caries recall and after prophylaxis or recall exams OTC fluoride-containing toothpaste and phosphate paste combination twice daily Sodium fluoride treatment gel/rinses	After age 2; Two size #2 occlusal films and 2 bitewing radiographs every 6 months or until no cavitated lesions are evident	Every 1-3 months to re-evaluate caries risk and apply fluoride varnish and anticipatory guidance	Xylitol gum or lozenges. Two sticks of gum or two mints four times daily for the caregiver Xylitol food, spray, or drinks	Sealants for deep pits and fissures after two years of age. High fluoride conventional glass ionomer is recommended	Holding care with glass ionomer materials until caries progression is controlled (ART) Fluoride varnish and anticipatory guidance/self-management goals

* Pediatric patients with one (or more) cavitated lesion(s) are high-risk patients.

** Pediatric patients with one (or more) cavitated lesion(s) and hyposalivary or special needs are extreme-risk patients.

*** Pediatric patients with daily medication such as inhalers or behavioral issues will have diminished salivary function.

**** Anticipatory guidance - Appropriate discussion and counseling should be an integral part of each visit for care. AAPD

***** CDAS protocol presented by Jensen et al. this issue may be helpful on sealant decisions.

***** Xylitol is not good for pets (especially dogs).

For all risk levels: Pediatric patients, through their caregiver, must maintain good oral hygiene and a diet low in frequency of fermentable carbohydrates.

Patients with appliances (RPDs, orthodontics) require excellent oral hygiene together with intensive fluoride therapy. Fluoride gel to be placed in removable appliances.

TABLE 3

Bacterial Testing Procedures

Bacterial tests for cariogenic bacteria, mutans streptococci and for lactobacilli species, can readily be done in a dental office or community clinic setting. There are two test kits currently available in the United States for chairside testing that tests for both MS and LB. One is the "Caries Risk Test" (CRT) marketed by Vivadent/Ivoclar (Amherst, N.Y.). The other is the "Dentocult SM" and "Dentocult LB" test, marketed by Edge Dental. Both are sufficiently sensitive to provide a level of low, medium, or high cariogenic bacterial challenge separately for MS and for LB. Each has selective media culture "sticks" that test MS and LB levels in saliva sampled from the patient.

The CRT kit has a single "media stick" with selective media for MS on one side and LB on the other. The Dentocult slides come as two separate sticks. The results obtained from the test sticks from either supplier can also be used as a motivational tool for patient compliance with an antibacterial regimen. Another system CariScreen/Caricult (Oral Biotech, Albany Ore.) uses a quick screening and culturing techniques targeting MS. Other bacterial test kits will likely be available in the near future.

The following is the procedure for administering the currently available caries risk test. The kit comes with two-sided selective media sticks that assess mutans streptococci on the blue side and lactobacilli on the green side. A starter kit that includes six "media sticks" in culture tubes, and an incubator is available (Ivoclar catalog #NA 6556001). Although the accompanying manufacturer's instructions recommend 48 hours of incubation, 72-hour incubation seems to give better results.

Procedure steps:

- a. For parent/caregiver and for children old enough to spit (probably 4 or 5 years-old), a bacterial culture should be taken as follows: The subject chews on the chewing gum (wax) provided in the kit for three minutes (accurately timed), and spits all mixed saliva into a measuring beaker. Measure the volume (in ml) and divide by 3 to give ml/minute stimulated saliva flow rate. Normal flow is greater than 1 ml/minute and low is less than 0.7 ml/minute. If the patient is unable to spit, collect a plaque sample using a sterile swab, agitate/vibrate in 2 cc of sterile saline and use the liquid to inoculate the culture tube as below.
- b. Remove the selective media stick from the culture tube. Peel off the plastic sheet covering each side of the stick. Pour the collected saliva over the media on each side until it is entirely wet.
- c. Place one of the sodium bicarbonate tablets (included with the kit) in the bottom of the tube.
- d. Replace the media stick in the culture tube, screw the lid on and label the tube with the patient's name, number, and date.
- e. Place the tube in the incubator at 37 degrees Celsius for 72 hours. (Incubators suitable for a dental office are sold by the company.)
- f. Remove the culture tube from the incubator after 72 hours and compare the densities of bacterial colonies with the pictures provided in the kit indicating relative mutans streptococci and lactobacilli bacterial levels, ranging from low to high. Colony densities in the middle of the range are medium. (The dark blue agar is selective for MS and the light green agar is selective for LB.) Record the level of bacterial challenge in the patient's chart as low, medium, or high.

Bacteria Testing for Young Children: Children age 0-3 are difficult to culture reliably in the fashion described previously. However, a good approximate indication for the child can be obtained by using a cotton swab to sample the surfaces of all teeth and gums in the mouth, thoroughly dispersing the sample in about 1 to 2 ml of sterile saline in a test tube (Fisher Scientific), and dispersing it for 1 minute on a laboratory vortex (Fisher Scientific, catalog 12-813-52). The suspension is then coated on the CRT stick as described previously for saliva samples and incubated for 72 hours. This will give a good estimate of the MS and LB challenge in the young child.²⁵ If this is not possible for whatever reason, the bacterial levels of the parent/caregiver could be used as a rough estimate of the child's likely bacterial challenge.

EXAMINATION OF THE CHILD

The examination of the child will complete the risk factor/disease indicator list. If the child has obvious decalcification (white spots) or cavities, this places the child at high risk for future cavities because caries can progress rapidly at this age.

ASSIGNMENT OF CARIES RISK LEVEL

Once the risk factors list has been checked (TABLE 1), the provider summarizes them and assigns a caries

risk level (low, moderate, or high). As stated previously, active decay in the parent/caregiver or in the child automatically places the child at high risk, signaling the need for antibacterial intervention and fluoride treatment for both parent/caregiver and child.

INDIVIDUALIZED TREATMENT BASED ON RISK LEVEL

An individualized treatment plan for each infant/caregiver is determined by items checked during the interview

process and the clinical examination of the child. A dual approach is essential for moderate and high caries risk children and their parent/caregivers. Strategies need to be employed to modify the maternal/caregiver transmission of cariogenic bacteria to infants through the potential use of chlorhexidine rinse, fluoride varnish, and xylitol-based products.

BACTERIAL CULTURE

If assessments reveal the presence of high-risk factors/indicators, providers

should consider performing a bacterial culture on the parent or caregiver and child. The salivary assay results should be shown to the parent/caregivers because seeing the bacterial growth may motivate behavioral change for them and their children. If the parents/caregivers have high cariogenic bacterial counts they should be advised to seek appropriate dental care to reduce their caries risk and control their caries by eliminating the infection source and reducing the early infant inoculation.

Relatively low bacterial levels have been demonstrated in several studies to be significantly associated with early demineralization and dental caries in infants and toddlers.^{23,24} As presented recently, children with significant levels of mutans streptococci and any level of lactobacilli were at greatest risk for developing early childhood caries.²⁴

INDIVIDUALIZED HOME CARE RECOMMENDATIONS

Home care recommendations are provided at the end of the infant oral care visit based on all information gathered through the assessment process. **TABLE 4**, first page for a “Parent/Caregiver Recommendations for Control of Dental Decay in Children 0-5 Years” form that includes a checklist for suggested home caries interventions and **TABLE 4**, second page, presents the suggested information designed to provide the parent or caregiver and patient with a simplified description of the dental decay process — “How Tooth Decay Happens,” as well as “Methods of Controlling Tooth Decay” (designed for the back page of the home care recommendations form).

MOTIVATIONAL INTERVIEWING AND STRATEGIES FOR CARIES CONTROL

Dental professionals can enhance the effectiveness of their preventive

communication by focusing on a patient-centered brief counseling approach called motivational interviewing.²⁶ Motivational interviewing relies on two-way communication that includes the following steps: establishing a therapeutic alliance (rapport and trust); asking questions to help parents identify the problem and listening to what they say; encouraging self-motivational statements; preparing for

WHEN PARENTS
hear themselves
acknowledging a problem
and voicing their
commitment to
solve the problem,
action is facilitated.

change (discussing the hurdles that interfere with action); responding to resistance; and scheduling follow-up, as well as preparing the parent for the inevitable bumps in the road. A patient/parent-centered approach to health promotion and caries prevention is showing promise in getting parents to engage in preventive parenting practices.²⁷ The more parents talk about their intent to act or change and their optimism, the better. When parents hear themselves acknowledging a problem and voicing their commitment to solve the problem, action is facilitated.²⁷ Peltier, Weinstein, and Fredekind discuss behavioral issues in greater detail later in the next issue of the *Journal*.²⁸

SETTING SELF-MANAGEMENT GOALS WITH PARENT AND CHILD

Following the brief motivational interviewing (counseling), the parent/caregiver is asked to select two self-management goals or recommendations as their assignments before the next re-evaluation dental visit. The parent/caregiver is asked to commit to the two goals selected and is informed that the oral health care providers will follow-up on those goals with them at the next appointment. (See **TABLE 5** for “Self-management Goals for Parent/Caregiver” with patient confidence scale and patient commitment signature section.)

How Tooth Decay Happens

Tooth decay is caused by certain types of bacteria (bugs) that live in your mouth. When they stick to the film on your teeth called dental plaque, they can do damage. The bacteria feed on what you eat, especially sugars (including fruit sugars) and cooked starch (bread, potatoes, rice, pasta, etc.). Within about five minutes after you eat or drink, the bacteria begin making acids as they digest your food. These acids can break into the outer surface of the tooth and melt away some of the minerals. Your spit can balance the acid attacks, as long as the acid attacks don't happen very often. However if: 1) your mouth is dry; 2) you have a lot of these bacteria; or 3) you snack frequently, then the acid causes loss of tooth minerals. This is the start of tooth decay and leads to cavities.

Methods of Controlling Tooth Decay

Diet: Reducing the number of sugary and starchy foods, snacks, or drinks can help reduce tooth decay. That does not mean you can never eat these types of foods. You should limit the number of times you eat these foods between main meals. A

TABLE 4

Parent/Caregiver Recommendations Form

Parent/Caregiver Recommendations for Control of Dental Decay in Children 0-5 Years

Daily Oral Hygiene/Fluoride Toothpaste Treatment

(These procedures reduce the bacteria in the mouth and provide a small amount of fluoride to guard against further tooth decay as well as to repair early decayed areas.)

- Brush child's teeth with a fluoride-containing toothpaste (small smear or pea-sized amount on a soft small infant-sized toothbrush) twice daily (gently brushed by parent or caregiver)
- Selective daily flossing of areas with early caries (white spots)
- Other: _____

Diet

(The aim is to reduce the number of between-meal sweet snacks that contain carbohydrates, especially sugars. Substitution by snacks rich in protein, such as cheese will also help.)

- OK as is
- Limit bottle/nursing (to avoid prolonged contact of milk with teeth)
- Replace juice or sweet liquids in the bottle with water
- Limit snacking (particularly sweets)
- Replace high carbohydrate snacks with cheese and protein snacks
- Other _____

Xylitol (Parent/caregivers)

Xylitol is a sweetener that the bacteria cannot feed on. Using xylitol-containing chewing gum or mints/lozenges is a way that parents/caregivers of high-risk children can reduce the transfer of decay-causing bacteria to their baby/toddler. This is most effective when used by the parent/caregiver starting shortly after the child's birth. Parents/caregivers with dental decay place their children at high risk for early childhood caries. Xylitol is not good for pets (especially dogs).

- Parents/caregivers of children age 3 and under with high bacterial levels should use xylitol mints/lozenges or xylitol gum two to four times daily.

Antibacterial Rinse (Parents/caregivers)

(In addition, parents/caregivers of high-risk children may require antibacterial treatment to decrease the transmission of cariogenic bacteria and lessen the infant/child's risk of early childhood caries.)

- Parents/caregivers of children age 3 and under with high bacterial levels should rinse with 10 ml of chlorhexidine gluconate 0.12 percent (Periogard, Peridex, Oral Rx by prescription only). Rinse at bedtime for 1 minute 1x/day for one week. Repeat each month for one week until infection is controlled. Separate by one hour from fluoride use. Continue for six months or until bacterial levels remain controlled.

Practitioner signature _____ Date _____

Parent/caregiver signature _____ Date _____

TABLE 5

Self-management Goals for Parent/Caregiver

Patient Name _____ DOB _____



Regular dental visits for child



Family receives dental treatment



Healthy snacks



Brush with fluoride toothpaste at least twice daily



No soda



Less or no juice



Wean off bottle (At least no bottle for sleeping)



Only water or milk in sippy cup



Chew gum with xylitol



Drink tap water



Less or no candy and junk food

IMPORTANT:
The last thing that touches your child's teeth before bedtime is the toothbrush with fluoride toothpaste.

Circle the goals you will focus on between today and your next visit.

On a scale of 1-10, how confident are you that you can accomplish the goals? 1 2 3 4 5 6 7 8 9 10

Not likely

Definitely

My promise: I agree to the goals circled and understand that staff may ask me how I am doing with my goals.

Date: _____ Signed by: _____

Review Date: _____ Comments: _____ Staff Initials: _____

Review Date: _____ Comments: _____ Staff Initials: _____

good rule is three meals per day and no more than three snacks per day.

Fluorides: Fluorides help to make teeth stronger and to protect against tooth decay, and to heal tooth decay if it has not gone too far. Fluorides are available from a variety of sources such as drinking water, toothpaste, and rinses you can buy in the supermarket or drug store. They may also be prescribed by your dentist or applied in the dental office. Daily use of fluoride is very important to help protect against the acid attacks.

Plaque Removal: Plaque is a yellowish film that sticks to the surface of teeth. Toothbrushing removes plaque and should be done twice every day. Bacteria live in plaque, so removing the plaque from your teeth on a daily basis helps to control tooth decay. Plaque is very sticky and may be hard to remove from between the teeth and in grooves on the biting surfaces of back teeth. If your child has an orthodontic retainer be sure to remove it before brushing your child's teeth. Brush all surfaces of the retainer also.

Spit: Spit (saliva) is important for healthy teeth. It balances acids and provides other ingredients that protect the teeth. If one cannot brush after a meal or snack, one can chew sugar-free gum. This will stimulate the flow of saliva to help reduce the effect of acids. Sugar-free candy or mints can also be used, but some of these contain acids themselves. Acids in sugar-free candy will not cause tooth decay, but can slowly dissolve the tooth surface over time (a process called erosion). Some sugar-free gums are made to help fight tooth decay. Some gums contain baking soda that neutralize the acids produced by the bacteria in plaque.

Gum that contains xylitol as its first listed ingredient is the gum of choice. This type of gum has been shown to

protect against tooth decay and to reduce the decay causing bacteria.

Antibacterial mouthrinses: Rinses that your dentist can prescribe are able to reduce the number of bacteria that cause tooth decay and can be useful in patients at high risk for tooth decay. These rinses are only recommended for children who can rinse and spit.

Sealants: Sealants are plastic or glass ionomer coatings bonded onto the

**ACIDS IN SUGAR-FREE
candy will not
cause tooth decay,
but can slowly dissolve
the tooth surface
over time (a process
called erosion).**

biting surfaces of back teeth to protect the deep grooves from decay. In some people the grooves on the surfaces of the teeth are too narrow and deep to clean with a toothbrush. They may decay even if you brush them regularly. Sealants are an excellent preventive measure used for children and young adults at risk for this type of decay. They do not last forever and should be inspected once a year and prepared if needed.

**ANTICIPATORY GUIDANCE
(EARLY PARENTAL EDUCATION
AND TIMELY INTERVENTION AND/
OR REFERRAL)**

In addition to caries risk assessment and parent/caregiver commitment to specific caries prevention self-manage-

ment goals, the infant oral care appointment should include anticipatory guidance about age-specific, oral hygiene, growth and development issues (i.e., teething, digit, or pacifier habits), oral habits, diet, and nutrition and injury prevention. See **TABLE 6** for "Age-specific Anticipatory Guidance Table" for the age categories of prenatal, birth to first year, 2- to 3-years-old, and for the child age 3 to 5. The anticipatory guidance approach is designed to take advantage of time-critical opportunities to implement preventive health practices and reduce the child's risk of preventable oral disease.²⁹

**DETERMINE THE INTERVAL FOR
PERIODIC RE-EVALUATION
(PERIODICITY OF EXAMINATION)**

The clinician must consider each infant and child's individual needs and caries risk assessment to determine the appropriate interval and frequency for oral examination.²⁹ Some infants and toddlers with white spot lesions and caregivers with high-risk behaviors should be re-evaluated on a monthly basis. Most children at high risk should be seen on a three-month interval for re-evaluation; those in the moderate risk category should be placed on a six-month interval and the low-risk child at a six- to 12-month range interval. At each of these infant oral care visits, it is essential to reassess the risk status and monitor improvement on the previously set self-management goals.

If the bacterial levels were moderate or high initially, repeat the bacterial culture to see if bacterial levels have been reduced by the antibacterial therapy recommended to the parent/caregiver and the multiple fluoride varnish applications on the infant. Make changes in recommendations or keep reinforcing the protocol if results are not as good as desired, or the

TABLE 6

Age-Specific Anticipatory Guidance (from Ramos-Gomez, reference 21)

	PRENATAL	BIRTH TO ONE YEAR	TWO TO THREE YEARS	THREE TO FIVE YEARS
Take home message for caregivers	<ul style="list-style-type: none"> • Baby teeth are important. • Parents'/caregivers' oral health affects baby's oral health. • Parents'/caregivers should obtain regular dental check-up and get treatment if necessary. • Schedule child's first dental appointment by age 1. • Use of fluorides, including toothbrushing with fluoride toothpaste, is the most effective way to prevent tooth decay. 	<ul style="list-style-type: none"> • Baby teeth are important. • Parents'/caregivers' oral health affects baby's oral health. • Parents'/caregivers should obtain regular dental check-up and get treatment if necessary. • Parents'/caregivers should avoid sharing with their child things that have been in their mouths. • Schedule child's first dental appointment by age 1. • Prevention is less costly than treatment. • Use of fluorides, including toothbrushing with fluoride toothpaste, is the most effective way to prevent tooth decay. 	<ul style="list-style-type: none"> • Baby teeth are important. • Parents'/caregivers' oral health affects baby's oral health. • Parents'/caregivers should obtain regular dental check-up and get treatment if necessary. • Parents'/caregivers should avoid sharing with their child things that have been in their mouths. • Schedule child's first dental appointment by age 1. • Prevention is less costly than treatment. • Use of fluorides, including toothbrushing with fluoride toothpaste, is the most effective way to prevent tooth decay. 	<ul style="list-style-type: none"> • Baby teeth are important. • Parents'/caregivers' oral health affects child's overall health. • Parents'/caregivers should obtain regular dental check-up and get treatment if necessary. • Parents'/caregivers should avoid sharing with their child things that have been in their mouths. • Prevention is less costly than treatment. • Use of fluorides, including toothbrushing with fluoride toothpaste, is the most effective way to prevent tooth decay.
Oral health and hygiene	<ul style="list-style-type: none"> • Encourage parents'/caregivers to obtain dental check-up and, if necessary, treatment before birth of baby to reduce cavity-causing bacteria that can be passed to the baby. • Encourage parents'/caregivers to brush teeth with fluoride toothpaste. 	<ul style="list-style-type: none"> • Encourage parents'/caregivers to maintain good oral health and get treatment, if necessary, to reduce spread of bacteria that can cause tooth decay. • Encourage parents'/caregivers to avoid sharing with their child things that have been in their mouths. • Encourage parents'/caregivers to become familiar with the normal appearance of child's gums. • Emphasize using a washcloth or toothbrush to clean teeth and gums with eruption of the first tooth. • Encourage parents'/caregivers to check front and back teeth for white, brown, or black (signs of cavities). 	<ul style="list-style-type: none"> • Encourage parents'/caregivers to maintain good oral health and get treatment, if necessary, to reduce spread of bacteria that can cause tooth decay. • Encourage parents'/caregivers to avoid sharing with their child things that have been in their mouths. • Review parent's/caregiver's role in brushing toddler's teeth. • Discuss brush and toothpaste selection. • Problem solve on oral hygiene issues. • Schedule child's first dental visit by age 1. 	<ul style="list-style-type: none"> • Encourage parents'/caregivers to maintain good oral health and get treatment, if necessary, to reduce spread of bacteria that can cause tooth decay. • Encourage parents'/caregivers to avoid sharing with their child things that have been in their mouths. • Discuss parents'/caregivers continued responsibility to help children under age 8 to brush their teeth. • Encourage parents'/caregivers to consider dental sealants for primary and first permanent molars.
Oral development	<ul style="list-style-type: none"> • Describe primary tooth eruption patterns (first tooth usually erupts between 6-10 months old). • Emphasize importance of baby teeth for chewing, speaking, jaw development and self-esteem. 	<ul style="list-style-type: none"> • Discuss primary tooth eruption patterns. • Emphasize importance of baby teeth for chewing, speaking, jaw development and self-esteem. • Discuss teething and ways to soothe sore gums, such as chewing on teething rings and washcloths. 	<ul style="list-style-type: none"> • Emphasize importance of baby teeth for chewing, speaking, jaw development, and self-esteem. • Discuss teething and ways to soothe sore gums, such as teething rings and washcloths. 	<ul style="list-style-type: none"> • Emphasize importance of baby teeth for chewing, speaking, and jaw development.

TABLE 6

Age-Specific Anticipatory Guidance (from Ramos-Gomez, reference 21) *continued*

	PRENATAL	BIRTH TO ONE YEAR	TWO TO THREE YEARS	THREE TO FIVE YEARS
Fluoride adequacy	<ul style="list-style-type: none"> Evaluate fluoride status in residential water supply. Review topical and systemic sources of fluoride. Encourage mother to drink fluoridated tap water. 	<ul style="list-style-type: none"> Evaluate fluoride status of residential water supply. Review topical and systemic sources of fluoride. Encourage drinking fluoridated tap water. Consider topical needs (e.g., toothpaste, fluoride varnish). 	<ul style="list-style-type: none"> Re-evaluate fluoride status of residential water supply. Review topical and systemic sources of fluoride. Encourage drinking fluoridated tap water. Review need for topical fluorides. 	<ul style="list-style-type: none"> Re-evaluate fluoride status in residential water supply. Review sources of fluoride. Review need for topical or other fluorides..
Oral habits	<ul style="list-style-type: none"> Encourage mother to stop smoking. 	<ul style="list-style-type: none"> Encourage breastfeeding. Advise mother that removing child from breast after feeding and wiping baby's gums/teeth with damp washcloth reduces the risk of ECC. Review pacifier safety. 	<ul style="list-style-type: none"> Remind mother that removing child from breast after feeding and wiping baby's gums/teeth with damp washcloth reduces the risk of ECC. Begin weaning of non-nutritive sucking habits at 2. 	<ul style="list-style-type: none"> Discuss consequences of digit sucking and prolonged non-nutritive sucking (e.g. pacifier) and begin professional intervention if necessary.
Diet and nutrition	<ul style="list-style-type: none"> Emphasize eating a healthy diet and limiting number of exposures to sugar snacks and drinks. Emphasize that it is the frequency of exposures, not the amount of sugar that affects susceptibility to caries. Encourage breastfeeding. Remind parents/caregivers never to put baby to bed with a bottle with anything other than water in it or to allow feeding 'at will'. 	<ul style="list-style-type: none"> Remind parents/caregivers never to put baby to bed with a bottle with anything other than water in it or allow feeding 'at will'. Emphasize that it is the frequency of exposures, not the amount of sugar that affects susceptibility to caries. Encourage weaning from bottle to cup by 1 year of age. 	<ul style="list-style-type: none"> Remind parents/caregivers never to put baby to bed with a bottle or allow feeding 'at will'. Discuss healthy diet and oral health. Emphasize that it is the frequency of exposures, not the amount of sugar that affects susceptibility to caries. Review snack choices and encourage healthy snacks. 	<ul style="list-style-type: none"> Review and encourage healthy diet. Remind parents/caregivers about limiting the frequency of exposures to sugar. Review snacking choices. Emphasize that child should be completely weaned from bottle and drinking exclusively from a cup.
Injury prevention	<ul style="list-style-type: none"> Review child-proofing of home including electrical cord safety and poison control. Emphasize use of properly secured car seat. Encourage caregivers to keep emergency numbers handy. 	<ul style="list-style-type: none"> Review child-proofing of home including electrical cord safety and poison control. Emphasize use of properly secured car seat. Encourage caregivers to keep emergency numbers handy. 	<ul style="list-style-type: none"> Review child-proofing of home including electrical cord safety and poison control. Emphasize use of car seat. Emphasize use of helmet when child is riding tri/bicycle or in seat of adult bike. Remind caregivers to keep emergency numbers handy. 	<ul style="list-style-type: none"> Emphasize use of properly secured car seat. Have emergency numbers handy. Encourage safety in play activities including helmets on bikes and mouthguards in sports. Remind caregivers to keep emergency numbers handy.

parent/caregiver is not cooperating. Many have reported value in bacterial testing after the first month of antibacterial treatment. By doing so it motivates patients to keep on the regimen when they see positive results. Pathogenic biofilms do not change immediately and patients/caregivers should be informed that it could take months or years to re-establish a healthy normal flora in the family unit.

COLLABORATION

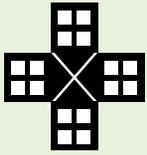
The overall objective of the *Journal of the California Dental Association's* February and March 2003 issues and current documents in this issue on caries management by risk assessment is to reduce or eradicate dental caries in children in every county, community, and culture in California by the year 2010.^{19,20} It will take a cross-disciplinary approach among

medicine, dentistry, nursing, and other agencies that affect dental health to reach that objective. In order to support collaborative approaches, to more aggressively deal with dental caries as a bacterially based transmissible disease, instruments have been developed specifically for medical/nondental professionals to provide appropriate tools (TABLE 7 — "Medical CAMBRA Risk Assessment Form 0-5

TABLE 7

CAMBRA Form for Medical Providers (0-5 year patients), Assessment Tool

(Adapted from UCSF/San Francisco General Hospital Department of Family and Community Medicine.)



Family Health Center
Pediatric Oral Health Screening
Progress Notes

Name
DOB
**Community Health Network
San Francisco General Hospital
Medical Center**

MRN
PCP
Patient ID/Addressograph

MEDICAL CAMBRA RISK ASSESSMENT FORM 0 TO 5 INFANTS & TODDLERS

Chief complaint or reason for referral Initial

Follow-up

Caries risk indicators — based on parent interview	Y	N	Notes
(a) Mother/ primary caregiver has had active dental decay in past 12 months			
(b) Older siblings with history of dental decay			
(c) Continual use of bottle containing beverages other than water/milk. Bottle use > 24 months old.			
(d) Child sleeps with a bottle or nurses on demand			
(e) Frequent (greater 3x/day total) candy, carbohydrate snacks (junk food), soda, sugared beverages (including processed juice)			
(f) Medical Issues 1. Saliva-reducing meds (asthma, seizure, hyperactivity etc.) 2. Developmental problems etc. 3. H/O anemia or Fe+ Rx:			
Protective factors — based on parent interview	Y	N	Notes
(a) Child lives in fluoridated community AND drinks tap water daily			
(b) Teeth cleaned with fluoride toothpaste (pea-size) daily			
(c) Fluoride varnish applied to child's teeth in last 6 months			
Oral examination	Y	N	
Obvious white spots (decalcifications), or obvious decay present on the child's teeth: NOTE ON DIAGRAM			
(b) Plaque is obvious on the teeth and/or gums bleed easily ECC (Early Childhood Caries) Diagnosis: <input type="checkbox"/> No visible Early Childhood Caries (ECC) <input type="checkbox"/> Non-cavitated ECC <input type="checkbox"/> Cavitated ECC			
Assessment: Child's caries risk status (cavities in the mother/caregiver, white spots or cavities in the child indicate high caries risk. The balance between the checked shaded areas (risk indicators) and the checked un-shaded areas (protective factors) provides the risk status as high or low): <input type="checkbox"/> LOW <input type="checkbox"/> HIGH			
Plan: <input type="checkbox"/> Health education handouts <input type="checkbox"/> Self-management Goals 1. _____			
<input type="checkbox"/> Dispense fluoride toothpaste and toothbrush <input type="checkbox"/> Prophylaxis and fluoride varnish <input type="checkbox"/> FHC Oral Health Clinic follow-up appointment (high risk) ____ months <input type="checkbox"/> Urgent outside dental referral (high risk, needs tracking) <input type="checkbox"/> Routine dental referral for dental home (all others)			

Signature of Rendering Provider: _____ Name: _____ CHN # _____

Supervising Attending: _____ CHN # _____ Date of Service: _____

Infants & Toddlers/Self-management Goals”) to assess and assist infants/toddlers and their caregivers according to their caries risk status. Please share this form with your medical colleagues.

Traditionally, the first contact an infant has with a health care provider is with the pediatrician or family health care practitioner. It is therefore crucial these practitioners be trained to identify children at high risk for caries. There is some evidence these providers have knowledge in early dental preventive interventions.^{30,31} Some effective caries control programs have been addressed by Rozier and colleagues where they demonstrated that nondental professionals were able to successfully integrate preventive dental services into their practices.³² However, Ismail et al. concluded that a majority of United States physicians do not screen for early signs of early childhood caries nor do they look for white spot lesions which are the precursors of cavitation.³³

It is our ethical and moral responsibility to ensure the best prevention management model for this vulnerable group of young children. By being proactive on prevention, we can surely decrease the prevalence of early childhood caries and ensure healthy kids with healthy smiles.³⁴

Summary

Determining a child’s caries risk level (high, moderate, low) is the primary goal of utilizing an appropriate caries risk assessment instrument that is age specific. The caries risk assessment process for the infant/toddler is comprised of parent/caregiver interview, examination of the child, assignment of caries risk level, and bacterial cultures, if indicated. Completing a caries risk assessment (CAMBRA 0-5) is the critical element in the infant oral care visit and vital com-

ponent of caries management. Once risk level is determined, the provider develops an individualized treatment plan, customizes home care recommendations, engages the parent/caregiver in the process by conducting a motivational interview, involves the parent/caregiver in setting their self-management goals, educates the parent/caregiver about age-specific interventions for prevention (anticipatory guidance), and determines

**A MAJORITY OF
United States physicians
do not screen for early
signs of early childhood
caries nor do they look
for white spot lesions
which are the precursors
of cavitation.**

the interval for periodic re-evaluation.

In order to effectively treat early ECC, we need to treat the disease rather than just the results of the disease. Rather than abdicating the responsibility for addressing this growing epidemic to the pediatric dental specialists, the profession must expand the approach to infant/toddler caries risk assessment and prevention to include general dental practices as well as medical care providers. As stated previously, the study by Ismail and colleagues found that although physicians in the United States would refer a child with a high caries risk level for a dental visit, the majority of respondents did not regularly screen for signs of ECC. Expansion of opportunities for addressing ECC also means increasing risk assess-

ment awareness among public health programs and community clinics as well.

Dental providers need to be trained and educated to utilize an age-appropriate risk assessment tool that can assist them to monitor and manage their patients individually and effectively to prevent future dental disease for their pediatric population. In addition, physicians, as well as other nondental providers, need to be trained and educated in appropriate screening, risk assessment of infants and toddlers and referral to a dental home.

Further information to assist in expansion of related knowledge and skills may be found on the “First Smiles” Web site, www.first5oralhealth.org, part of a statewide oral health initiative funded by First 5 California and managed by the California Dental Association Foundation and the Dental Health Foundation regarding oral health of children 0-5.³⁴ Web site resources include complementary continuing education courses (2 C.E. units) designed specifically for dental and medical professionals to address the “silent epidemic” of ECC affecting children age 0-5.

The program reflects changes in the modern management of caries and improved diagnosis of noncavitated, incipient lesions and treatment for prevention and arrest of these lesions.³⁵ Additional skills emphasized for the initial infant oral care visit (within six months of eruption of the first tooth and no later than 12 months of age) include: infant/toddler positioning (knee to knee exam), when to treat/refer, parent/caregiver education and managing behavior of very young children.

The authors have provided caries risk assessment forms (CAMBRA 0-5) for dental and medical (nondental) providers as models for use or modification. The one-page forms are designed for use with infants/toddlers age 0-5. Instructions for

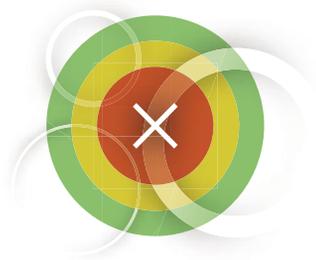
the clinician have been included to guide the health care providers through the risk assessment process. Supplemental forms for use following caries risk assessment (CAMBRA 0-5) are included as well. For example, once the pathological and protective factors are assessed to determine if the patient is at risk of progression or initiation of dental caries, decisions need to be made regarding indications for bacterial cultures, and home care recommendations for the parent/caregiver and child. With this easily identifiable information, both health care providers and guardians can be made aware of the treatment needs, set self-management goals, anticipate age-specific concerns, as well as refer the child to the correct resources and, most importantly, prevent the development of future dental disease. ■■■■

REFERENCES

- Vargas CM, Crall JJ, Schneider DA, Sociodemographic distribution of pediatric dental caries: NHANES III, 1988-1994. *J Am Dent Assoc* 129:1229-38, 1998.
- Poland C 3rd, Hale KJ, Providing oral health to the little ones. *J Indiana Dent Assoc* 82:8-14, 2003.
- Health and Health Care in Schools, Health disparities experienced by racial/ethnic minority populations. *MMRW* 73:3, 2004.
- Macek MD, Wagner ML, et al, Survey of oral health status of Maryland school children 2000-2001. *Pediatr Dent* 26(4):329-36, 2004.
- Dental Health Foundation, The 2006 oral health needs assessment of children. <http://www.dentalhealthfoundation.org/topics/public/>. Accessed April 10, 2007.
- Nowak AJ, Rationale for the timing of the first oral evaluation. *Pediatr Dent* 19:8-11, 1997.
- American Dental Association, ADA statement on early childhood caries 2004. <http://www.ada.org/prof/resources/position/caries/>. Accessed Aug. 17, 2007.
- American Academy of Pediatric Dentistry, infant oral health. *Pediatr Dent* 22:82, 2000.
- American Association of Public Health Dentistry, First oral health assessment policy. 2004. <http://www.aaphd.org/default.asp?page=policy.htm>. Accessed Aug. 22, 2007.
- American Academy of Pediatric Dentistry, Policy on early childhood caries (ECC): classifications, consequences, and preventive strategies, 2003. <http://www.aapd.org>. Accessed Aug. 17, 2007.
- American Academy of Pediatric Dentistry, Policy on the dental home, 2004. <http://www.aapd.org>. Accessed Aug. 17, 2007.
- American Academy of Pediatrics, Recommendations for preventive pediatric health care. *Pediatrics* 105:645, 2000.
- Featherstone JDB, The science and practice of caries prevention. *J Am Dent Assoc* 131:887-99, 2000.
- Featherstone JDB, The caries balance: the basis for caries management by risk assessment. *Oral Health Prev Dent* 2 Suppl 1:259-64, 2004.
- Hansel Petersson G, Fure S, Bratthall D, Evaluation of a computer-based caries risk assessment program in an elderly group of individuals. *Acta Odontol Scand* 61:164-71, 2003.
- Featherstone JDB, Caries prevention and reversal based on the caries balance. *Pediatr Dent* 28:128, 32; discussion 192-8, 2006.
- Peretz B, Ram D, et al, Preschool caries as an indicator of future caries: a longitudinal study. *Pediatr Dent* 25(2):114-8, 2003.
- Tagliaferro EP, Pereira AC, et al, Assessment of dental caries predictors in a seven-year longitudinal study. *J Public Health Dent* 66(3):169-73, 2006.
- Featherstone JDB, The caries balance: contributing factors and early detection. *J Calif Dent Assoc* 31(2):129-33, 2003.
- Featherstone JDB, Adair SM, et al, Caries management by risk assessment: consensus statement, April 2002. *J Calif Dent Assoc* 31(3):257-69, 2003.
- Ramos-Gomez FJ, Clinical considerations for an infant oral health care program. *Compendium* 26(5) suppl 1: 17-23, 2005.
- American Academy of Pediatric Dentistry Council on Clinical Affairs, Policy on use of a caries-risk assessment tool (CAT) for infants, children, and adolescents. *Pediatr Dent* 27:25-7, 2005.
- Seki M, Yamashita Y, et al, Effect of mixed mutans streptococci colonization on caries development. *Oral Microbiol Immunol* 21(1):47-52, 2006.
- Ramos-Gomez F, Bacterial salivary markers' role in ECC risk assessment in infants. *J Dent Res Issue* 85B:0516, 2006. www.dentalresearch.org. Accessed Aug. 17, 2007.
- Fujino T, Zhan L, et al, Comparative enumeration of cariogenic bacteria by two sampling techniques. *J Dent Res Issue* 83A:3455, 2004. www.dentalresearch.org. Accessed Aug. 17, 2007.
- Weinstein P, Harrison R, Benton T, Motivating parents to prevent caries in their young children. *J Am Dent Assoc* 135:731-8, 2004.
- Weinstein P, Provider versus patient-centered approaches to health promotion with parents of young children: what works/does not work and why. *Pediatr Dent* 28:172-6, 2006.
- Peltier B, Weinstein P, Fredekind RE, Risky Business: Influencing People to Change, (in process of being published), *J Cal Dent Assoc*.
- American Academy of Pediatric Dentistry, Clinical guideline on periodicity of examination, preventive dental services, anticipatory guidance and oral treatment for children 2003. <http://www.aapd.org>. Accessed Aug. 17, 2007.
- Bader JD, Rozier RG, et al, Physicians' roles in preventing dental caries in preschool children: a summary of the evidence for the U.S. preventive services task force. *Am J Prev Med* 26:315-25, 2004.
- de la Cruz GG, Rozier RG, Slade G, Dental screening and referral of young children by pediatric primary care providers. *Pediatrics* 114:642-52, 2004.
- Rozier RG, Sutton BK, Prevention of early childhood caries in North Carolina medical practices: implications for research and practice. *J Dent Educ* 67(8):876-85, 2003.
- Ismail AI, Nainar SM, Sohn W, Children's first dental visit: attitudes and practices of U.S. pediatricians and family physicians. *Pediatr Dent* 25:425-30, 2003.
- California Dental Association Foundation and the Dental Health Foundation, First Smiles. <http://www.first5oralhealth.org>. Accessed Aug. 17, 2007.
- National Institutes of Health, Diagnosis and management of dental caries throughout life. Bethesda, Md, National Institutes of Health, 2001.

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Caries Risk Assessment in Practice for Age 6 Through Adult

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LARRY JENSON, DDS, MA; MARK WOLFF, DDS, PHD; AND DOUGLAS A. YOUNG, DDS, MS, MBA

ABSTRACT The aim of this article is to present a practical caries risk assessment procedure and form for patients who are age 6 through adult. The content of the form and the procedures have been validated by outcomes research after several years of experience using the factors and indicators that are included.

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Caries risk assessment is the first step in caries management by risk assessment, CAMBRA. The level of risk should be used to determine the need for therapeutic intervention and is an integral part of treatment planning. The management of caries following risk assessment for 6-year-olds through adult is described in this issue in detail in the paper by Jenson et al. A separate form and procedures for use for newborns to 5-year-olds is presented in the paper by Ramos-Gomez et al. in this issue.

A group of experts from across the United States convened at a consensus conference held in Sacramento, Calif., in April 2002. This group produced a caries risk assessment form and procedures based upon literature available up to that time. The results were published in 2003.¹ The consensus statement and supporting review articles are available on the net: www.cdafoundation.org/journal. This form, or some variation of it, has been in use in dental schools and private practices for as long as four years. Recent out-

comes research based upon the use of the procedures in a large cohort of patients at the School of Dentistry at the University of California, San Francisco, was recently published, validating the form and procedures.² The results from this study are the basis for the current revisions to the caries risk assessment form and procedures presented here. The successful components of the previous version have been re-grouped according to the outcomes results and are presented in **TABLE 1**. The form can be readily adapted for use in electronic record systems, as has been done at UCSF.

The background, rationale, and step-by-step procedures are described as follows.

Background

Successful and accurate caries risk assessments have been a dream for decades. Numerous research papers have been written on the topic, such as the reviews by Anderson et al. and Anusavice.^{3,4} Several forms and procedures have been suggested, some of which are summarized in a recent review by Zero et al.⁵ Individual contrib-

TABLE 1

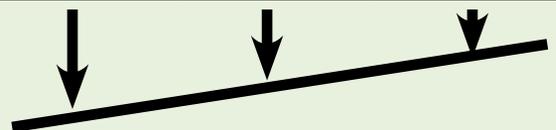
Caries Risk Assessment Form — Children Age 6 and Over/Adults

Patient Name: _____ Chart #: _____ Date: _____

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

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

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



Doctor signature/#: _____ Date: _____

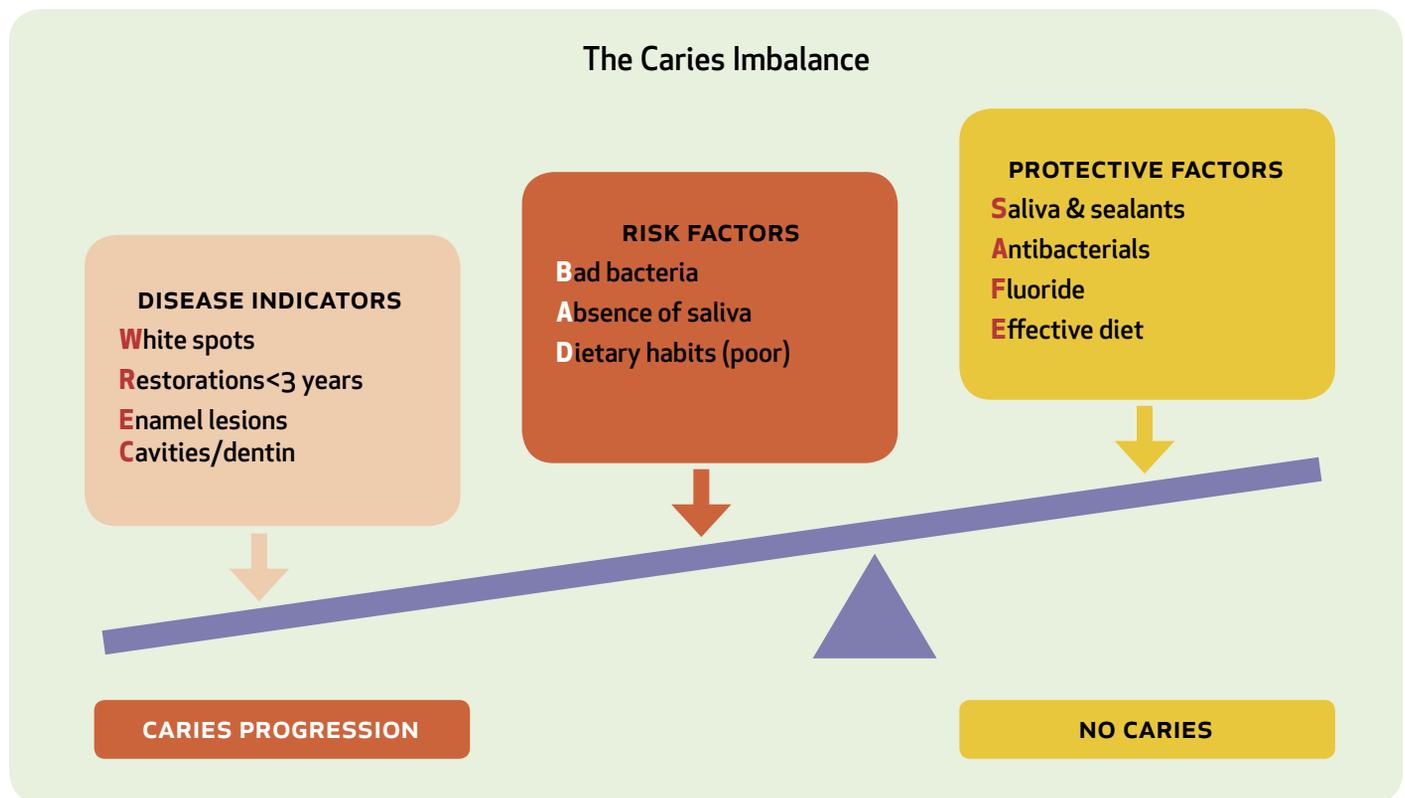


FIGURE 1. The caries “imbalance.” The balance amongst disease indicators, risk factors and protective factors determines whether dental caries progresses, halts, or reverses. Refer to **TABLE 1** and the text for more detail on disease indicators. Cavities/dentin refers to frank cavities or lesions to the dentin by radiograph. Restorations < 3 years means restorations placed in the previous three years. This figure has been updated from previous versions of the “caries balance” with the very important addition of the disease indicators.⁶ If these indicators are present they weigh heavily on the side of predicting caries progression unless therapeutic intervention is carried out. The leading letters that help to remember the imbalance (WREC; BAD; SAFE) have been added, as well as sealants as a protective factor. Dietary habits (poor) indicates frequent ingestion of fermentable carbohydrates (greater than three times daily between meals).

uting factors to caries risk have been identified over the last 30 years or so, and a review of these was published in two special issues of the *Journal of the California Dental Association*, February and March 2003 (www.cdafoundation.org/journal), together with the consensus statement referred to above.⁶ Much of the information has been available for 10 to 20 years or more, but has not been put into everyday clinical practice, primarily because the information has not been gathered together in a simple form and procedure, and such combinations have not been validated until recently.² Utilization of risk assessment to determine therapeutic modalities was successful at a level of about 70 percent in an adult population. The authors

anticipate that, with the updated form presented here, the success will be even higher as all of the contributing factors have been validated and ranked in order of the odds ratios found they were related to the formation of cavities.

Determining Caries Risk

Assigning a patient to a caries risk level is the first step in managing the disease process. A step-by-step guide how to do this is laid out later in this article. Before moving to the details some overall discussion and definition of terms are needed. This assessment occurs in two phases: the first is to determine specific disease indicators, risk factors, and protective factors each patient has. The second step is

to determine the level of risk that the sum of these factors indicates.⁷ Specific pathologic and protective factors for dental caries contribute to determining the balance between progression, arrestment, or reversal of the disease. For example, a young patient may have poor oral hygiene but no other caries risk factors. We would want to address the oral hygiene issue, but this, in and of itself, is not sufficient to put the patient in a high-risk category. We know that patients with high plaque levels frequently demonstrate no evidence of dental caries. On the other hand, a patient with a cavitated caries lesion is immediately put into the high-risk category because this is a well-documented predictor of future caries lesions.

The second phase of caries risk assessment is by no means a mathematical formula; it is better characterized as a judgment based on the likely balance between the indicators and factors identified in the risk assessment form (**TABLE 1**) and illustrated visually in **FIGURE 1**. The risk assessment form (**TABLE 1**) is comprised of a hierarchy of disease indicators, risk factors, and protective factors that are based on the best scientific evidence we have at this time. As mentioned previously, the risk assessment procedures published in 2003 have been assessed over more than three years and the outcomes led to the elimination of some items and to the validation of those included here, together with validation of the tool to assess caries risk.^{1,2} The determination of high-risk status is fairly clear. The decision to place someone in the moderate-risk category is sometimes not clear and different practitioners may reasonably come to different conclusions. It is better to err on the conservative side and place a patient in the next higher category if there is doubt. As we get more clinical data the accuracy of these risk assessment forms will no doubt increase even further.

Rationale and Instructions for Age 6 Through Adult Caries Risk Assessment Form

The following section presents the rationale and instructions for the use of the form presented in **TABLE 1**: "Caries Risk Assessment Form — Children Age 6 and Over/Adults."

Caries Disease Indicators

Caries disease indicators are clinical observations that tell about the past caries history and activity. They are indicators or clinical signs that there is disease present or that there has been recent

disease. These indicators say nothing about what caused the disease or how to treat it. They simply describe a clinical observation that indicates the presence of disease. These are not pathological factors nor are they causative in any way. They are simply physical observations (holes, white spots, radiolucencies). The outcomes assessment described previously and prior literature, highlight

IT IS BETTER
to err on the
conservative side
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category if
there is doubt.

that these disease indicators are strong indicators of the disease continuing unless therapeutic intervention follows.

The four caries disease indicators outlined in **TABLE 1** are: (1) frank cavitations or lesions that radiographically show penetration into dentin; (2) approximal radiographic lesions confined to the enamel only; (3) visual white spots on smooth surfaces; and (4) any restorations placed in the last three years. These four categories are strong indicators for future caries activity and unless there is nonsurgical therapeutic intervention the likelihood of future cavities or the progression of existing lesions is very high.

A positive response to any one of these four indicators automatically places the patient at high risk unless therapeutic intervention is already in place and progress has been arrested. A patient

with frank cavities has high levels of cariogenic bacteria, and placing restorations does not significantly lower the overall bacterial challenge in the mouth.⁸

Caries Risk Factors

Caries risk factors are biological factors that contribute to the level of risk for the patient of having new carious lesions in the future or having the existing lesions progress. The risk factors are the biological reasons or factors that have caused or contributed to the disease, or will contribute to its future manifestation on the tooth. These we can do something about.

There are nine risk factors recently identified in outcomes measures of caries risk assessment² listed in **TABLE 1**: 1) medium or high MS and LB counts; 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) orthodontic appliances. If there are no positive caries disease indicators (see above), these nine factors in sum become the determinants of caries activity, unless they are offset by the protective factors listed below.

Caries Protective Factors

These are biological or therapeutic factors or measures that can collectively offset the challenge presented by the previously mentioned caries risk factors. The more severe the risk factors, the higher must be the protective factors to keep the patient in balance or to reverse the caries process. As industry responds to the need for more and better products to treat dental caries, the current list in **TABLE 1** is sure to expand in the future. Currently, the protective factors listed in **FIGURE 1** are: 1) lives/work/

school located in a fluoridated community; 2) fluoride toothpaste at least once daily; 3) fluoride toothpaste at least two times daily; 4) fluoride mouthrinse (0.05 percent NaF) daily; 5) 5,000 ppm F fluoride toothpaste daily; 6) fluoride varnish in last six months; 7) office fluoride topical in last six months; 8) chlorhexidine prescribed/used daily for one week each of last six months; 9) xylitol gum/lozenges four times daily in the last six months; 10) calcium and phosphate supplement paste during last six months; and 11) adequate saliva flow (> 1 ml/min stimulated). Fluoride toothpaste frequency is included since studies have shown that brushing twice daily or more is significantly more effective than once a day or less.⁹ Any or all of these protective factors can contribute to keep the patient “in balance” or even better to enhance remineralization, which is the natural repair process of the early carious lesion.

What to Do

1. Take the patient details, the patient history (including medications) and conduct the clinical examination. Then proceed with the caries risk assessment.

2. Circle or highlight each of the “YES” categories in the three columns on the form (TABLE 1). One can make special notations such as the number of carious lesions present, the severity or the lack of oral hygiene, the brand of fluorides used, the type of snacks eaten, or the names of medications/drugs causing dry mouth.

3. **If the answer is “yes” to any one of the four disease indicators in the first panel, then a bacterial culture should be taken using the Caries Risk Test (CRT) marketed by Vivadent, (Amherst, N.Y.). (*—See below or equivalent test.)**

4. Make an overall judgment as to whether the patient is at high-, moderate- or low-risk dependent on the balance between the disease indicators/risk

factors and the protective factors using the caries balance concept (see bottom of TABLE 1 and FIGURE 1). **NOTE:** Determining the caries risk for an individual requires evaluating the number and severity of the disease indicators/risk factors. An individual with caries lesions presently or in the recent past is at high risk for future caries by default. A patient with low bacterial levels would

FLUORIDE TOOTHPASTE

frequency is included since studies have shown that brushing twice daily or more is significantly more effective than once a day or less.

need to have several other risk factors present to be considered at moderate risk. Some clinical judgment is needed while also considering the protective factors in determining the risk.

5. **If a patient is high risk and has severe salivary gland hypofunction or special needs, then they are at “extreme risk” and require very intensive therapy.**

6. Complete the therapeutic recommendations section as described in the paper by Jenson et al. this issue, based on the assessed level of risk for future carious lesions and ongoing caries activity. Use the therapeutic recommendations as a starting point for the treatment plan. The products that can be used are described in detail in Jenson et al. and Spolsky et al. in this issue.

7. Provide the patient with therapeutic and home care recommenda-

tions in the form of a letter, based on clinical observations and the Caries Risk Assessment result.

8. Give the patient the sheet that explains how caries happens (FIGURE 2) and the letter with your recommendations. Sample letters are given. More details about these recommendations and procedures are laid out in Jenson et al. in this issue. Products that should be used are described in detail in Spolsky et al.

9. Copy the recommendations and the letter for the patient chart (or if you have electronic records the various form letters and recommendations can be generated to be printed out custom for each patient).

10. Inform the patient of the results of any tests. e.g., showing the patient the bacteria grown from their mouth (CRT test result*) can be a good motivator so have the culture tube or digital photograph of the test slide handy at the next visit (or schedule one for this purpose — the culture keeps satisfactorily for some weeks), or give/send them a picture (digital camera and e-mail).

11. After the patient has been following your recommendations for three to six months, have the patient back to reassess how well they are doing. Ask them if they are following your instructions, how often. If the bacterial levels were moderate or high initially, repeat the bacterial culture to see if bacterial levels have been reduced. Some clinicians report improved patient motivation when a second bacterial test is done initially immediately after the first month of antibacterial treatment. Documenting a “win in your column” early on is a valuable tool to encourage patients. Make changes in your recommendations or reinforce protocol if results are not as good as desired, or the patient is not compliant. Refer to Jenson et al. this issue for more detail on protocols and procedures.

CONTINUES ON 710

AGE 6 THROUGH ADULT, CONTINUED FROM 707

How Tooth Decay Happens

Tooth decay is caused by certain types of bacteria (mutans streptococci and lactobacilli) that live in your mouth. When they attach themselves to the teeth and multiply in dental plaque, they can do damage. The bacteria feed on what you eat, especially sugars (including fruit sugars) and cooked starch (bread, potatoes, rice, pasta, etc.). Within just a few minutes after you eat, or drink, the bacteria begin producing acids as a by-product of their digesting your food. Those acids can penetrate into the hard substance of the tooth and dissolve some of the minerals (calcium and phosphate). If the acid attacks are infrequent and of short duration, your saliva can help to repair the damage by neutralizing the acids and supplying minerals and fluoride that can replace those lost from the tooth. However, if: 1) your mouth is dry; 2) you have many of these bacteria; or 3) you snack frequently; then the tooth mineral lost by attacks of acids is too great, and cannot be repaired. This is the start of tooth decay and leads to cavities.

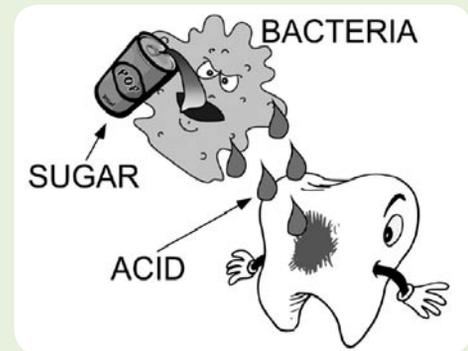


FIGURE 2. How tooth decay happens (to be given to each patient).

*Test procedures — Saliva Flow Rate and Caries Bacteria Testing

*1. *Saliva Flow Rate:* Have the patient chew a paraffin pellet (included with the CRT test — see below) for three to five minutes (timed) and spit all saliva generated into a measuring cup. At the end of the three to five minutes, measure the amount of saliva (in milliliters = ml) and divide that amount by time to determine the ml/minute of stimulated salivary flow. A flow rate of 1 ml/min and above is considered normal. A level of 0.7 ml/min is low and anything at 0.5 ml/min or less is dry, indicating severe salivary gland hypofunction. Investigation of the reason for the low flow rate is an important step in the patient treatment.

*2. *Bacterial testing:* An example (others are currently available) of a currently available chairside test for cariogenic bacterial challenge is the Caries Risk Test (CRT) marketed by Vivadent. It is sufficiently sensitive to provide a level of low, medium, or high cariogenic bacterial challenge.

It can also be used as a motivational tool for patient adherence with an antibacterial regimen. Other bacterial test kits will likely be available in the near future. The following is the procedure for administering the currently available CRT test. Results are available after 72 hours (note: the manufacturer's instruction states 48 hours, but more reliable results are achieved if the incubation time is 72 hours). The kit comes with a two-sided selective media stick that assess mutans streptococci on the blue side and lactobacilli on the green side.

a) Remove the selective media stick from the culture tube. Peel off the plastic cover sheet from each side of the stick.

b) Pour (do not streak) the collected saliva over the media on each side until it is entirely wet.

c) Place one of the sodium bicarbonate tablets (included with the kit) in the bottom of the tube.

d) Replace the media stick in the culture tube, screw the lid on and label the tube with the patient's name, registra-

tion number, and date. Place the tube in the incubator at 37-degrees Celsius for 72 hours. Incubators suitable for a dental office are also sold by the company.

e) Collect the tube after 72 hours and compare the densities of bacterial colonies with the pictures provided in the kit indicating relative bacterial levels. The dark blue agar is selective for mutans streptococci and the light green agar is selective for lactobacilli. Record the level of bacterial challenge in the patient's chart, as low, medium or high. Some find it helpful for documentation to number the pictures 1 through 4.

Sample Patient Letters/ Recommendations for Control of Dental Decay (Age 6 and Over/Adult)

One of the following letters (FIGURES 3-6) including home care recommendations should go to each patient depending on the risk category and the overall treatment plan (refer to Jensen et al. this issue for treatment plan details). ■■■■

Dear (Patient X),

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

- Brush twice daily with an over-the-counter fluoride-containing toothpaste.
- Review with us your dietary and oral hygiene habits and receive oral hygiene instructions. If good, continue with your existing dietary and oral hygiene habits unless there is a change in status, such as new medications.
- Get a thorough professional cleaning as needed for your periodontal health. We will be happy to provide these cleanings for you.
- Return for a caries recall exam (when requested) in six to 12 months to re-evaluate your current caries risk.
- Have new bitewing radiographs (X-rays) taken about every 24 to 36 months to check for cavities.
- Consider using xylitol gum/candies and over-the-counter fluoride rinse (0.05 percent sodium fluoride) instead of regular gum/candy or mouthwash.
- Get fluoride varnish after teeth cleanings, base line bacterial test, sealants if your dentist recommends it. You may or may not need this. It depends on your oral conditions.
- Other recommendations:

FIGURE 3. Low caries risk.

Dear (Patient Y),

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

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

FIGURE 4. Moderate caries risk.

Dear (Patient Z),

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

- Complete a caries bacterial test with us today (as a base line before antibacterial therapy). We will have the results of this test in three days.
- Complete a saliva flow measurement to check for dry mouth. This is a very simple test that we will do today as part of the bacterial assessment.
- Review with us your dietary and oral hygiene habits and receive instructions on both. The most important thing is to reduce the number of between-meal sweet snacks that contain carbohydrates, especially sugar. Substitution by snacks rich in protein, such as cheese, will also help as well as the xylitol gum or candies described below.
- Brush twice daily with a high fluoride toothpaste, either Control RX or Prevident Plus toothpaste (5,000 parts per million fluoride). We will provide some for you today. This is to be used twice daily in place of your regular toothpaste.
- Rinse for one minute, once a day with a special antibacterial mouthrinse we will provide for you today. It is called Peridex or Periogard and has an active ingredient called chlorhexidine gluconate at 0.12 percent. You should use this once daily just before bed at night (10 ml for one minute), but only for one week each month. You must use this at least one hour after brushing with the 5,000 ppm fluoride toothpaste.
- Have the necessary restorative work done, such as fillings or crowns, as needed, in a minimally invasive fashion.
- Suck or chew xylitol candies or gum four times daily. You can obtain supplies from us today or we can help you buy these elsewhere.
- Get sealants applied to all of the biting surfaces of your back teeth to keep them from being reinfected with the bacteria that cause dental decay. We will be happy to do this for you.
- Return when requested for a caries recall exam in three to four months to re-evaluate your progress and current caries risk.
- Participate in another caries bacterial test at your caries recall exam or earlier to compare results with your first visit. This will allow us to check whether the chlorhexidine is working satisfactorily.
- Allow us to review your use of chlorhexidine and Control RX/Prevident and oral hygiene at that visit.
- Get a thorough professional cleaning as needed for your periodontal health.
- Get new bitewing radiographs (X-rays) about every six to 18 months to check for cavities.
- Get a fluoride varnish treatment for all of your teeth every three to four months at your caries recall exams.
- Other recommendations:

FIGURE 5. High caries risk.

REFERENCES

1. Featherstone JD, Adair SM, et al, Caries management by risk assessment: consensus statement, April 2002. *J Cal Dent Assoc* 31(3):257-69, March 2003.
2. Domejean-Orliaguet S, Gansky SA, Featherstone JD, Caries risk assessment in an educational environment. *J Dent Educ* 70(12):1346-54, 2006.
3. Anderson MH, Bales DJ, Omnell K-A, Modern management of dental caries: the cutting edge is not the dental bur. *J Am Dent Assoc* 124:37-44, 1993.
4. Anusavice KJ, Efficacy of nonsurgical management of the initial caries lesion. *J Dental Education* 61:895-905, 1997.
5. Zero DT, Fontana M, Lennon AM, Clinical applications and outcomes of using indicators of risk in caries management. *J Dent Educ* 65(10):1126-32, 2001.
6. Featherstone JD, The caries balance: contributing factors and early detection. *J Cal Dent Assoc* 31(2):129-33, February 2003.
7. Featherstone JDB. The caries balance: the basis for caries management by risk assessment. *Oral Health Prev Dent* 2(Suppl 1):259-64, 2004.
8. Featherstone JD, Gansky SA, et al, A randomized clinical trial of caries management by risk assessment. *Caries Res* 39(4):295, 2005.
9. Curnow MMT, Pine CM, et al, A randomized controlled trial of the efficacy of supervised toothbrushing in high-caries-risk children. *Caries Res* 36(4):294-300, July-August 2002.

TO REQUEST A PRINTED COPY OF THIS ARTICLE, PLEASE

CONTACT John D.B. Featherstone, MSc, PhD, University of California, San Francisco, Department of Preventive and Restorative Dental Sciences, 707 Parnassus Ave., Box 0758, San Francisco, Calif, 94143.

Dear (Patient Z),

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

- Complete a caries bacterial test with us today (as a base line before antibacterial therapy). We will know the results of this test in three days.
- Complete a saliva flow measurement to confirm your extreme dry mouth. This is a very simple test that we will complete today as part of the bacterial assessment.
- Review your dietary and oral hygiene habits with us and receive instructions about how to improve them both. The most important thing is to reduce the number of between-meal sweet snacks that contain carbohydrates, especially sugar. Substitution by snacks rich in protein, such as cheese, will also help as well as the xylitol gum or candies recommended below.
- Brush twice daily with a new strong toothpaste, either Control RX or Prevident Plus toothpaste (5,000 parts per million fluoride). We will provide you with some today. This is to be used twice daily in place of your regular toothpaste.
- Rinse for one minute, once a day with a special antibacterial mouthrinse that we will provide you with today. It is called Peridex or Periogard and has an active ingredient called chlorhexidine gluconate at 0.12 percent. You will use this once daily just before going to bed at night (10 ml for one minute), but only for one week each month. You must use this at least one hour after brushing with the 5,000 ppm fluoride toothpaste.
- Get a fluoride varnish treatment for all of your teeth every three months at your caries recall exams.
- Receive the necessary restorative work such as fillings and crowns, as needed, in a minimally invasive fashion.
- Suck or chew xylitol candies or gum four times daily. You can obtain supplies from us today or we can help you buy these elsewhere.
- Use a special paste that contains calcium and phosphate (e.g., MI paste). Apply it several times daily to your teeth. We will teach you how to do this properly.
- Obtain a thorough professional cleaning during your current visit.
- Get a sealant treatment on all of the biting surfaces of your back teeth to keep them from being reinfected with the bacteria that cause dental decay.
- Use a baking soda rinse (or similar neutralizing product) four to six times daily during the day. You can make this yourself by shaking up two teaspoons of baking soda in an eight-ounce bottle of water.
- Please return when called for a re-evaluation in about one month.
- Please return when requested for a caries recall exam in three months.
- Get new bitewing radiographs (X-rays) about every six months until no cavitated lesions are evident.
- Come in for another caries bacterial test at the three-month visit or sooner to compare results with your first visit to check whether the chlorhexidine is working satisfactorily.
- Receive a review of your use of chlorhexidine and Control RX/Prevident and oral hygiene at that visit.
- Come in for a thorough professional cleaning as needed for your periodontal health.
- Get another fluoride varnish treatment of all teeth again at three-month caries recall visit and another set of bitewing X-rays at six months.

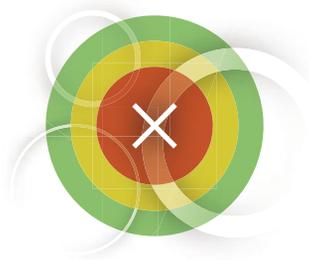
We will provide you with a timetable to help you to remember all of these procedures.

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

Practitioner signature _____ Date _____

Patient signature _____ Date _____

FIGURE 6. Extreme caries risk (high risk plus severe salivary gland hypofunction).



Clinical Protocols for Caries Management by Risk Assessment

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ABSTRACT This article seeks to provide a practical, everyday clinical guide for managing dental caries based upon risk group assessment. It is based upon the best evidence at this time and can be used in planning effective caries management for any patient. In addition to a comprehensive restorative treatment plan, each patient should have a comprehensive caries management treatment plan. Some sample treatment plans are included.

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Part 1: Caries Disease Management

YOU HAVE COMPLETED A CARIES RISK ASSESSMENT: NOW WHAT?

Performing a caries risk assessment as described in a previous article makes little sense if there is no difference in the way we plan treatment for individual patients. Indeed, if dental caries were pandemic, everyone has the disease, we would not need a risk assessment at all — every patient would be at high risk. One of the strongest predictors for future disease is a recent history of the disease. If every patient is at high risk, the management of every patient would be the same.

However, dental caries is not pandemic; many people simply do not have the disease, or at least detectable manifestations of it, and so we have to ask ourselves the questions: Should patients in different risk groups receive different treatment? And if so, what is the best way to manage patients at the different risk levels?

Recent research by Featherstone et al. clearly demonstrated that assigning risk assessment levels does make a difference in the effective management of patients for dental caries.¹ The use of antimicrobials, fluoride, sealants, the frequency of radiographs and periodic oral exams, as well as other risk factor management procedures will all be determined by the caries risk level of the patient and knowledge of the contributing risk factors for that patient. Subsequent to this research, protocols for the clinical management of caries by risk factor level, CAMBRA, have been determined and employed at a growing number of dental schools, including the five in California (see article by Young, Featherstone, and Roth). While complete consensus on these protocols continues to develop, there is strong agreement about treating patients for dental caries based on risk level.

This article seeks to provide a practical, everyday clinical guide for managing dental caries based upon risk group

assessment. It is based upon the best evidence at this time and can be used in planning effective caries management for any patient. We have also included some sample treatment plans to help practitioners visualize how CAMBRA may impact a patient's treatment. It is important to keep in mind research also shows that placing dental restorations does little or nothing to manage the caries disease process. In addition to a comprehensive restorative treatment plan, each patient should have a comprehensive caries management treatment plan.

CAMBRA TREATMENT RECOMMENDATIONS FOR PATIENTS AGE 6 AND OLDER

In this section, the authors present clinical guidelines for managing patients in each of the various caries risk assessment categories for age 6 through adult. Treatment for children age 5 and under is described in the article by Ramos-Gomez et al. in this issue. **TABLE 1** lists the four risk level groups (low, moderate, high, and extreme) and the recommendations for caries management procedures for each level. The authors first point out that a patient's caries risk level determines both diagnostic procedures and risk factor management procedures. The recommendations presented here were developed by consensus of the Western CAMBRA Coalition, a working group assembled from different aspects of the dental profession including unofficial representatives of education, research, industry, organized dentistry, governmental assistance agencies, the state licensing board, third-party payers, and private practice clinicians.

There are several things about this table of recommendations that should be noted. First, these recommendations are subject to clinical judgment based upon the caries risk assessment carried out by the individual dentist and are not intend-

ed to be the final word for any particular patient. Dentists should use this table as a guide in developing a comprehensive caries management program individually tailored for each patient's needs and wishes. Second, research in treatment modalities for managing caries is an ongoing process that most likely will result in modifications to these recommendations over the years. Third, these recommendations are based upon the available

PRACTICES THAT PRESCRIBE the same radiograph and periodic oral exam frequency for all patients are not exhibiting a reasonable protocol that will benefit the individual needs of their patients.

evidence at the time of writing and therefore constitute a basis for what counts as reasonable care for patients with dental caries. And finally, brand names of caries management products have not been used in **TABLE 1**. They are referred to by their generic composition. A full description and listing of available products is given in the paper by Spolsky et al. in this *Journal*. It is not our intention to endorse any one product or to exclude competitors.

1. Diagnostic procedures

Caries is a chronic disease process that must be monitored over time to be effectively managed. The frequency of periodic oral examinations, radiographs, and bacterial tests are all de-

termined by the caries risk level for a patient. For example, the national recommendations (www.kodak.com/go/dental) for radiographs for the recall patient depend upon a caries risk assessment. Recall patients who are at high risk for the disease are recommended to have posterior bitewing radiographs every six to 12 months, while patients in the low-risk category are recommended to have posterior bitewing radiographs no more frequently than every 24 to 36 months.

Of course, there may be other pathologies that require a higher frequency of radiographs, but as far as caries is concerned, one must know the caries risk level for a patient before prescribing radiographs. Similarly, patients in the high-risk group should be seen for clinical examination more frequently than the low- or moderate-risk groups. Practices that prescribe the same radiograph and periodic oral exam frequency for all patients are not exhibiting a reasonable protocol that will benefit the individual needs of their patients.

Patients who are at high risk for caries should have an initial base line bacterial test to determine the bacterial challenge of the organisms most closely related to the disease: mutans streptococci and lactobacilli.² The tests currently available on the market are described in the caries risk assessment article in this issue. Chemical antibacterial therapy to reduce the bacterial challenge and lower this risk factor must be monitored frequently to determine the effectiveness of the antimicrobial therapy and patient compliance.³ The recommended frequency of such tests is displayed in **TABLE 1**.

Risk Factor Management Procedures

TABLE 1 lists risk factor management protocols that have some substantiated clinical success. It assumes patients in all risk groups will receive education in

TABLE 1

Caries Management by Risk Assessment Clinical Guidelines for Patients Age 6 and Older

Risk Level ### ***	Frequency of Radiographs	Frequency of Caries Recall Exams	Saliva Test (Saliva Flow & Bacterial Culture)	Antibacterials Chlorhexidine Xylitol ****	Fluoride	pH Control	Calcium Phosphate Topical Supplements	Sealants (Resin-based or Glass Ionomer)
Low risk	Bitewing radio- graphs every 24- 36 months	Every 6-12 months to re- evaluate caries risk	May be done as a base line refer- ence for new patients	Per saliva test if done	OTC fluoride-containing toothpaste twice daily, after breakfast and at bedtime. Optional: NaF varnish if excessive root exposure or sensitivity	Not required	Not required Optional: for excessive root exposure or sen- sitivity	Optional or as per ICDAS seal- ant protocol (TABLE 2)
Moderate risk	Bitewing radio- graphs every 18- 24 months	Every 4-6 months to re- evaluate caries risk	May be done as a base line refer- ence for new patients or if there is suspicion of high bacterial challenge and to assess efficacy and patient coop- eration	Per saliva test if done Xylitol (6-10 grams/day) gum or candies. Two tabs of gum or two candies four times daily	OTC fluoride-containing toothpaste twice daily plus: 0.05% NaF rinse daily. Initially, 1-2 app of NaF varnish; 1 app at 4-6 month recall	Not required	Not required Optional: for excessive root exposure or sen- sitivity	As per ICDAS sealant protocol (TABLE 2)
High risk*	Bitewing radio- graphs every 6-18 months or until no cavitated lesions are evident	Every 3-4 months to re- evaluate caries risk and apply fluoride varnish	Saliva flow test and bacterial culture initially and at every car- ies recall appt. to assess efficacy and patient coop- eration	Chlorhexidine gluconate 0.12% 10 ml rinse for one min- ute daily for one week each month. Xylitol (6-10 grams/day) gum or can- dies. Two tabs of gum or two candies four times daily	1.1% NaF toothpaste twice daily instead of regular fluoride tooth- paste. Optional: 0.2% NaF rinse daily (1 bottle) then OTC 0.05% NaF rinse 2X daily. Initially, 1-3 app of NaF varnish; 1 app at 3-4 month recall	Not required	Optional: Apply calcium/ phosphate paste several times daily	As per ICDAS sealant protocol (TABLE 2)
Extreme risk** (High risk plus dry mouth or special needs)	Bitewing radio- graphs every 6 months or until no cavitated lesions are evident	Every 3 months to re-evaluate caries risk and apply fluoride varnish.	Saliva flow test and bacterial culture initially and at every car- ies recall appt. to assess efficacy and patient coop- eration	Chlorhexidine 0.12% (preferably CHX in water base rinse) 10 ml rinse for one minute daily for one week each month. Xylitol (6-10 grams/day) gum or candies. Two tabs of gum or two candies four times daily	1.1% NaF toothpaste twice daily instead of regular fluoride tooth- paste. OTC 0.05% NaF rinse when mouth feels dry, after snacking, breakfast, and lunch. Initially, 1-3 app. NaF varnish; 1 app at 3 month recall.	Acid-neutralizing rinses as needed if mouth feels dry, after snacking, bedtime and after breakfast. Baking soda gum as needed	Required Apply calcium/ phos- phate paste twice daily	As per ICDAS sealant protocol (TABLE 2)

* Patients with one (or more) cavitated lesion(s) are high-risk patients. *** Patients with one (or more) cavitated lesion(s) and severe hyposalivation are extreme-risk patients. **** All restorative work to be done with the minimally invasive philosophy in mind. Existing smooth surface lesions that do not penetrate the DEJ and are not cavitated should be treated chemically, not surgically. For extreme-risk patients, use holding care with glass ionomer materials until caries progression is controlled. Patients with appliances (RPDs, prosthodontics) require excellent oral hygiene together with intensive fluoride therapy e.g., high fluoride toothpaste and fluoride varnish every three months. Where indicated, antibacterial therapy to be done in conjunction with restorative work. ### For all risk levels: Patients must maintain good oral hygiene and a diet low in frequency of fermentable carbohydrates. **** Xylitol is not good for pets (especially dogs).

plaque removal and dietary counseling to control the amount and frequency of fermentable carbohydrate intake.

THE LOW-RISK PATIENT

Low-risk patients typically present with little history of carious lesions, extractions, or restorations.⁴ Whatever combination of oral bacteria, oral hygiene habits, diet, fluoride use, or salivary content and flow they may have, it has protected them from the disease of caries thus far and could very likely continue to protect them from the disease in the future. However, there is no guarantee of this. If the protective or pathogenic factors in their mouth changes significantly, they will become susceptible to the disease. For example, addition of medications with severe hyposalivatory side effects could markedly alter the saliva flow of the patient and place them in the high- or extreme-risk category. Conversely, the absence of teeth and the presence of multiple restorations do not preclude someone from being at low risk. It is possible for someone who has had a history of uncontrolled caries, lost teeth, and multiple restorations to become a low-risk patient by effectively controlling their risk factors for the disease. The management strategy for the low-risk patient is to maintain the balance of protective factors they currently have and to make them aware that their risk for caries can change over time. Should there be a change in oral hygiene, bacterial levels, diet, salivary flow, or fluoride use, the dentist should address these following a caries risk assessment at each periodic oral exam.

Low-risk patients generally need less professional supervision for caries (they may well need frequent professional visits due to periodontal disease or other conditions) so the frequency of periodic oral exams is less and, following the *Guide-*

lines for Prescribing Dental Radiographs in 2004, (www.kodak.com/go/dental) the frequency of radiographic examination is less in these groups, with bitewing radiograph every 24 to 36 months.

THE MODERATE-RISK PATIENT

Moderate-risk patients, by definition have more risk factors than the low-risk patients. However, these patients typically do not show the signs of continu-

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that someone who
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ing dental caries that would put them into the high-risk group.⁴ As mentioned before, risk level assignment is a judgment based upon the factors identified in the risk assessment procedure and getting consensus on moderate-risk patients is more difficult than with the high- and low-risk groups. A moderate-risk patient in general terms is one who has some risk factors identified and whose caries balance could likely be moved easily to high risk. In these patients additional fluoride therapy, for example, could be added to ensure that the balance is tipped toward arresting the progression of the disease.

Moderate-risk patients generally require more frequent radiographic evaluation for caries disease activity than do low-risk patients, with bitewing radiographs approximately every 18 to 24

months, dependent upon the risk factors present and the practitioner's judgment. Risk factor interventions, such as diet counseling, oral hygiene instruction, and use of fluoride rinses, may require more aggressive implementation and more frequent monitoring. Use of sealants as a preventive measure may be more desirable to recommend in this risk category.⁵

THE HIGH-RISK PATIENT

Patients who currently have dental caries, most often determined by cavitated lesions, are high-risk patients.⁴ The presence of observable carious lesions, for example, is a disease indicator, and is a very strong indicator that the disease, dental caries, will progress to produce more cavities, unless we intervene with chemical therapy to lower the bacterial challenge and increase remineralization (Featherstone et al., caries risk assessment, this issue). It is also possible that someone who does not have a cavitated lesion, but has two or more high-risk factors, could be placed in the high-risk group. These patients must be managed aggressively to eliminate or reduce the possibility of a new or recurrent caries lesion. Bacterial testing, antimicrobial treatments, 1.1 percent NaF toothpaste, 5 percent NaF fluoride varnish, and xylitol are standard regimens for all high-risk patients (details are given later and in **TABLE 1**).^{3,6-9} The frequency of periodic oral exams is increased and radiographic evaluation with new bitewing radiographs may be desirable every six to 12 months.

THE EXTREME-RISK PATIENT

The extreme-risk patient is a high-risk patient with special needs or who has the additional burden of being severely hyposalivatory. Patients in this risk group must be even more aggressively managed and seen more frequently than those in

the high-risk group. These patients lack both the buffering ability provided by saliva, and the calcium and phosphate needed to remineralize noncavitated lesions. Thus, additional therapies are indicated, including buffering rinses (e.g., baking soda and others, see Spolsky et al.) to replace the cleansing and buffering functions of normal saliva and calcium and phosphate pastes to replace the normal salivary components for remineralization of tooth structure following the acid production of food ingestion.^{10,11}

A Word About Antimicrobials

As important as antimicrobial therapy is in combating the infectious pathogens that cause dental caries, the fact remains there is still no single modality that eliminates cariogenic bacteria with one treatment. Research and industry has yet to provide the products to rapidly and permanently modify the complex human biofilm to a healthy state. Current products always require repetition at intervals customized for each patient. Patients and clinicians should be warned that biofilm modification will not happen overnight and, in reality, may take several months or even years. Chlorhexidine, the most studied of caries antimicrobials, has been clearly shown to reduce levels of MS and to reduce the recurrence of caries lesions.⁶ However, chlorhexidine has been shown to be less effective on lactobacilli in the mouth, which is another primary pathogen in dental caries.²

Although iodine has been reported in the literature to be effective in young children, when applied in the operating room environment, there is a lack of published research on its effectiveness in older children or adults and therefore has been excluded from the age 6 through adult protocol presented in **TABLE 1**.² With that said, the clinician must remember that efficacy

TABLE 2

Sample Treatment Plan for a Low-risk Patient

Patient No. 1

Low caries risk: 24-year-old female, no history of decayed, missing, or filled teeth, no carious lesions present, adequate saliva flow, good oral hygiene, last dental visit more than three years ago, chief complaint of chipped anterior tooth.

Phase 0:

Comprehensive oral exam
4 bitewing radiographs

Phase I

Adult prophylaxis
Recommend OTC toothpaste with fluoride

Phase II

Tooth No. 9 incisal composite

Phase III

No Phase III (prosthetic) care indicated

Phase IV

Periodic oral exam in 12-24 months
Bitewing radiographs in 24-36 months

of products are usually tested as the sole independent variable and not used with other products either concurrently or in succession. In practice, dentists commonly prescribe several modalities simultaneously and the efficacy of these combinations is poorly studied. It may well be that a combination of antimicrobials and other risk management products will lead to a beneficial change in the biofilm. In order to alter the caries imbalance that is present in high or extreme caries risk patients, aggressive antimicrobial therapy is needed as well as aggressive fluoride therapy.

A Word About Recommended Procedures and Optional Procedures

TABLE 1 contains recommendations based on the available science. Often, patients, and sometimes their health care professionals as well, want to feel they are doing all they can to promote oral health. When there is a lack of definitive

TABLE 3

Sample Treatment Plan for a Moderate-risk Patient

Patient No. 2

Moderate caries risk: 45-year-old male, history of several restorations and missing teeth, history of periodontal surgery, no new carious lesions, no lesions restored in the last three years, fair oral hygiene, uses salivary reducing medications, last dental visit six months ago with radiographs, chief complaint is broken lower molar.

Phase 0

Periodic oral exam

Phase I

Periodontal maintenance
Oral hygiene instructions
Recommend OTC toothpaste (1,000 or 1,100 ppm fluoride) with fluoride

Recommend OTC fluoride rinse (0.05 percent sodium fluoride) daily in addition to toothpaste

Recommend xylitol candies or gum daily

Phase II

Tooth No. 19 porcelain bonded to metal crown

Phase III

Partial denture reline to laboratory

Phase IV

Periodic oral exam in 12 months
Bitewing radiographs in 12 months
Periodontal maintenance every three months

scientific research demonstrating that such a treatment modality has clear benefits for a particular risk category (not all these studies have been done based on risk category), the decision to use additional or other preventive measures should be carefully considered and the risks and costs weighed against the benefits of those measures.

Antimicrobials, sealants, and high-strength fluoride could have some associated risks and costs that accompany any potential benefit. If the cost and any risks of a treatment modality are ac-

ceptable to the informed patient, then a treatment could be considered to be optional for patients who wish them.

Sample treatment plans are given in TABLES 2-5 for each of the low-, moderate-, high-, and extreme-risk situations.

Part II: Caries Lesion Management

The decision to manage an existing carious lesion by chemotherapeutic means (e.g., fluoride, antimicrobial, xylitol) or by surgical means (excision and restoration) may at times be influenced by the site or location, the depth or extent of lesion, and the activity status of the lesion (active or arrested). Although surgical repair of cavitated caries lesions may not alter the disease risk level of a patient, it does remove niches that harbor caries-causing bacteria and, of course, restores the function of the tooth.

SITE-SPECIFIC MANAGEMENT OF LESIONS AND PREVENTION

Evidence-based intervention strategies are chosen to bring the patient back into a healthy state. However, the CAMBRA treatment model does not stop at managing caries risk (prevention); it also includes early detection and minimally invasive strategies that treat carious lesions differently depending on site (occlusal, approximal, or root); extent of the lesion (cavitated or not); and caries activity.^{12,13} Although the chemistry of the caries process is the same at all sites, the differences in morphology, mineral content, and ability to detect early lesions lead to very different management strategies.¹⁴

1. Occlusal Pit and Fissure Lesions (Hardest to Detect)

Occlusal caries lesions are responsible for the majority of the restorations in children.¹⁵ A number of studies have concluded that the use of a dental explorer is

TABLE 4

Sample Treatment Plan for a High-risk Patient

Patient No. 3

High caries risk: 26-year-old male, history of restorations for carious lesions 18 months ago, no missing teeth, carious lesion to the dentin on tooth No. 4, poor oral hygiene, white spot lesion buccal No. 19, no symptoms, privately insured.

Phase 0

Comprehensive oral exam

Caries bacterial test (insurance code: D-0405)

Diet analysis

Bitewing radiographs

Phase I

Adult prophylaxis

Oral hygiene instruction

Prescribe high concentration 1.1 percent sodium fluoride (NaF) toothpaste used twice daily in place of OTC fluoride toothpaste

Prescribe chlorhexidine gluconate (0.12 percent) rinse to be used once daily at night for one week each month. Repeat monthly. Use separated by one hour from high concentration fluoride toothpaste.

Fluoride varnish of all teeth

Phase II

Tooth No. 4 DO amalgam

Sealants for all posterior teeth

Phase III

No Phase III treatment indicated

Phase IV

Periodic oral exam every six months

Caries bacterial test every six months to check for compliance and efficacy of the chlorhexidine rinse

Review compliance with chlorhexidine gluconate rinse and 1.1 percent NaF toothpaste and oral hygiene

Adult prophylaxis

Fluoride varnish of all teeth

not adequate for detecting early occlusal caries and because of false negatives, may lead to a significant number of lesions being undetected (the so-called “hidden occlusal lesions”).¹⁶⁻²⁰ Because of the large amount of surrounding sound enamel on the facial and lingual of the tooth, radiography cannot detect occlusal lesions until they are well advanced.²¹ Caries detecting dye applied to fissures does not improve

TABLE 5

Sample Treatment Plan for an Extreme-risk Patient

Patient No. 4

Extreme caries risk: 52-year-old female, extensive restorative history, missing teeth, generalized attachment loss, new carious lesions Nos. 4, 8, 9, 10, 18, and 31, taking medications resulting in salivary gland hypofunction, last dental visit two years ago.

Phase 0

Comprehensive oral exam

Full-mouth series of radiographs

Caries bacterial test

Medical consult on medications

Diet analysis

Phase I

4 quadrants of scaling and root planing

One-month re-evaluation

Oral hygiene instruction

Prescribe 1.1 percent NaF toothpaste used twice daily in place of OTC toothpaste (same as for high-risk patient, above)

Prescribe chlorhexidine rinse used once daily at night for one week each month. Use separated by one hour from high concentration F toothpaste (same as for high-risk patient above)

Prescribe baking soda rinses four to six times daily

Fluoride varnish of all teeth

Calcium/phosphate paste applied several times daily (trays can be helpful)

Phase II

Tooth No. 8 mesial composite

Tooth No. 9 mesial composite

Tooth No. 10 distal composite

Tooth No. 4 mod amalgam

Tooth No. 18 full veneer gold crown

Phase III

Hold on prosthetics until caries and periodontal processes are stabilized

Re-evaluate caries and periodontal status at four to six weeks from initial therapy/Phase I

Phase IV

Periodic oral exam every three months

Caries bacterial test at each caries recall exam

Fluoride varnish at each caries recall exam

Bitewing radiographs every six months

Periodontal maintenance every three months

the visual detection of dentinal caries and should not be used for that purpose.²² Fissure widening has been shown to improve sensitivity from 17 percent to 70 percent, but it still is difficult to determine whether the lesions extended into dentin.²² The use of a DIAGNOdent caries detector (KaVo America Corp, Lake Zurich, Ill.) may aid in the decision making process of an early occlusal lesion, but is by no means absolute.²³⁻²⁶

Until recently, there was no universal way for clinicians to categorize the visual characteristics of the occlusal surface of teeth. The International Caries Detection and Assessment System, ICDAS, was developed by international committee to facilitate caries epidemiology, research, and appropriate clinical management.²⁷ The system was designed to provide a terminology to describe what is seen visually rather than dictate treatment protocol.²⁷ However, given the correlation of visual findings to histologic findings, the system can reasonably be used to guide treatment decisions in managing occlusal lesions.

TABLE 6 shows the ICDAS definitions, histologic findings, and visual interpretation of the definitions. The recommended protocol is footnoted at the bottom of the **TABLE 6**.

In summary, pits and fissures identified as codes 0-2 = do not require sealants. Sealants are considered optional if no tooth structure is removed to complete the procedure. (DIAGNOdent readings may be helpful in classifying lesions using the ICDAS codes.²³⁻²⁶) Pits and fissures classified as codes 2-3 with DIAGNOdent readings in the 20-30 range should have a minimally invasive “caries biopsy” (conservative fissure widening) to determine whether a sealant and, quite possibly, a restoration is to be placed.²⁵ Pits and fissures classified as codes 4-6 require minimally invasive restoration. The definition of a “sealant” and “restoration” are defined

by the CDT-7 codes and summarized as follows: Sealant means it is still confined in enamel; it is not the dental material (e.g., resin versus glass ionomer). It is considered a restoration if any part of the preparation is in dentin; if the preparation “extends to” a second surface (whether or not the second surface is in dentin), then it is considered a two-surface restoration.

Note: In performing minimally invasive dentistry, especially when surgical

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procedures are involved, it is critical to have proper documentation. In this case, ICDAS codes, DIAGNOdent readings (if done), and preop, intraop, and postop clinical photographs is highly recommended. We have the professional obligation to eliminate the unethical misuse of MID (overtreatment) for financial gain.

Preventive care of the occlusal surface is problematic. Resin-based materials do not bond as well to aprismatic enamel (common on newly erupted teeth), nor do they allow for continued mineralization of a newly erupted tooth, and resin sealants may fail when isolation is not ideal. In order to get a good resin bond to enamel, pits and fissures should be deepened and widened; however, this is contradictory to a minimally invasive approach. Glass ionomer sealants that bond chemically

rather than micromechanically might be an alternative choice. Some studies show resin-based sealants have good retention, while other studies found 25 percent to 50 percent decay underneath previously placed sealants.²⁸⁻²⁹ Recently, new conventional glass ionomers have been proposed as a chemical treatment for caries, mainly for its ability to chemically bond to enamel (prismatic or aprismatic) and dentin, as well as its internal caries preventive effects at the tooth-glass ionomer interface.^{30,31}

Glass ionomer, since it is a chemical acid-base reaction, does not have the problem of the contraction gap formation common when resin is polymerized. It, by nature of its fluoride release, is caries protective.³² One study showed better penetration and retention of the unprepared fissures using a glass ionomer sealant in the presence of saliva.³³ In addition, some have speculated that placing resin on a newly erupted tooth could inhibit future mineral maturation, and perhaps glass ionomer may prove advantageous for continued permeation of certain molecules and minerals into the tooth.^{30,34}

In summary, as of yet, there is no perfect way to detect the early occlusal lesion. ICDAS occlusal codes and protocol could help clinicians make the decision to treat a pit or fissure with chemotherapeutic agents, sealants, or restorations. Glass ionomer could be a possible treatment alternative to resin-based sealants, especially in immature enamel, when no fissure preparation is performed, or when proper isolation is not achievable.³³ Aggressive prevention and early minimal intervention is indicated for those at higher risk.

2. Approximal Lesions (Smooth Surface Lesions)

If the surface of a smooth surface lesion is not cavitated, then chemical repair is the recommended treatment.

TABLE 6

Occlusal Protocol***

ICDAS code	0	1	2	3	4	5	6
Definitions	Sound tooth surface; no caries change after air drying (5 sec); or hypoplasia, wear, erosion, and other noncaries phenomena	First visual change in enamel: seen only after air drying, or colored change "thin" limited to the confines of the pit and fissure area	Distinct visual change in enamel; seen when wet, white or colored, "wider" than the fissure/fossa	Localized enamel breakdown with no visible dentin or underlying shadow; discontinuity of surface enamel, widening of fissure	Underlying dark shadow from dentin, with or without localized enamel breakdown	Distinct cavity with visible dentin; frank cavitation involving less than half of a tooth surface	Extensive distinct cavity with dentin; cavity is deep and wide involving more than half of the tooth
Histologic depth		Lesion depth in P/F was 90% in the outer enamel with only 10% into dentin	Lesion depth in P/F was 50% inner enamel and 50% into the outer 1/3 dentin)	Lesion depth in P/F with 77% in dentin	Lesion depth in P/F with 88% into dentin	Lesion depth in P/F with 100% in dentin	Lesion depth in P/F 100% reaching inner 1/3 dentin
Sealant/restoration Recommendation for low risk	Sealant optional DIAGNOdent may be helpful	Sealant optional DIAGNOdent may be helpful	Sealant optional or caries biopsy if DIAGNOdent is 20-30	Sealant or minimally invasive restoration needed	Minimally invasive restoration	Minimally invasive restoration	Minimally invasive restoration
Sealant/restoration Recommendation for moderate risk	Sealant optional DIAGNOdent may be helpful	Sealant recommended DIAGNOdent may be helpful	Sealant recommended or caries biopsy if DIAGNOdent is 20-30	Sealant or minimally invasive restoration needed	Minimally invasive restoration	Minimally invasive restoration	Minimally invasive restoration
Sealant/restoration Recommendation for high risk *	Sealant recommended DIAGNOdent may be helpful	Sealant recommended DIAGNOdent may be helpful	Sealant recommended or caries biopsy if DIAGNOdent is 20-30	Sealant or minimally invasive restoration needed	Minimally invasive restoration	Minimally invasive restoration	Minimally invasive restoration
Sealant/restoration Recommendation for extreme risk **	Sealant recommended DIAGNOdent may be helpful	Sealant recommended DIAGNOdent may be helpful	Sealant recommended or caries biopsy if DIAGNOdent is 20-30	Sealant or minimally invasive restoration needed	Minimally invasive restoration	Minimally invasive restoration	Minimally invasive restoration

* Patients with one (or more) cavitated lesion(s) are high-risk patients. ** Patients with one (or more) cavitated lesion(s) and xerostomia are extreme-risk patients.

*** All sealants and restorations to be done with a minimally invasive philosophy in mind. Sealants are defined as confined to enamel. Restoration is defined as in dentin. A two-surface restoration is defined as a preparation that has one part of the preparation in dentin and the preparation extends to a second surface (note: the second surface does not have to be in dentin). A sealant can be either resin-based or glass ionomer. Resin-based sealants should have the most conservatively prepared fissures for proper bonding. Glass ionomer should be considered where the enamel is immature, or where fissure preparation is not desired, or where rubber dam isolation is not possible. Patients should be given a choice in material selection.

Early approximal lesions are ideal to remineralize simply because topical fluoride works well on smooth surfaces and there is a reliable way to monitor its progress (bitewing radiographs). In 1992, Pitts and Rimmer correlated radiographic depth to cavitation. In this study, none of the samples were cavitated that presented with a radiolucency in the outer half of enamel. If the radiolucency appeared in the inner half of enamel on the radiograph, then the percent cavitation was about 10 percent. This increased to 41 percent if the radiolucency extended to the outer half of dentin, and 100 percent cavitation if the radiolucency extended to the inner half of the dentine.³⁵ Other studies correlating radiographic depth to histology are not as helpful since it does not determine the presence of cavitation. Thus, many resort to surgical repair only if the radiograph shows a clear enamel cone with a dentinal penetration and use chemical remineralization strategies to repair lesions showing lesser radiographic penetration.

The exception to this guideline is the case of vertical marginal ridge fracture where bacteria could be penetrating dentin showing a dentinal radiolucency without radiographic radiolucency in enamel.³⁶ In this case, restoration is indicated after clinically confirming the vertical marginal ridge fracture. Those showing slight vertical fracture of the marginal ridge without radiographic dentinal radiolucency may not require restoration. It is also reassuring to note the conservative approach is especially applicable to the approximal lesion because most early lesions, even if chemical repair was attempted and failed, could be easily observed on a subsequent radiograph and restored without making the preparation design much bigger, if at all.

3. Root Lesions (Hardest to Restore)

Cementum and dentin is much more porous than enamel, being about 50 percent by volume mineral and about 50 percent by volume diffusion space (water, protein, and lipids). Bonding composite materials to dentin and cementum is a clinical challenge if for nothing more than its location, often subgingival, difficult to isolate (keep dry), and difficult to light cure (deep box forms). In this case, chemical seal is perhaps more important than retentive bond strength.³⁰ Glass ionomer restorative materials are, reasonably, the material of choice on dentin and cementum because of their chemically fused seal (rather than micromechanical bond), less shrinkage, fluoride release, biocompatibility, and perhaps the nicest feature, the need for a moist surface to interact with.^{31,32} Composite can also be layered on top of glass ionomer products using the correct techniques and materials.³⁷ This so-called “sandwich” technique allows the stress of the resin polymerization process to be dissipated in the setting glass ionomer (glass ionomer takes days to set and has been shown to increase in strength for two to three years).³⁸

Conclusions

Caries risk assessment is the basis for subsequent treatment planning to manage the disease of caries. Caries risk assessment should be routinely built into comprehensive oral examinations and periodic oral examinations. Patient treatment plans should reflect both caries management strategies as well as restorative plans for the destruction created by the disease. Caries management strategies may include chemical therapy to reduce bacterial challenge as well as fluoride and other therapies to enhance remineralization of lesions that are not cavitated. If surgical treatment is needed for cavitated lesions, the principles of minimally

invasive dentistry should apply. The guidelines presented in this article are based in the best available scientific literature and are intended to be a helpful guide for dental practitioners managing dental caries. ■■■■

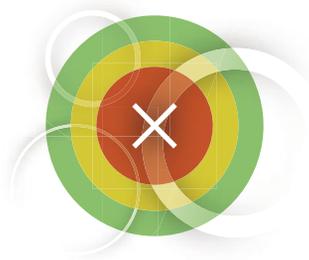
REFERENCES:

1. Featherstone JDB, Gansky SA, et al, A randomized clinical trial of caries management by risk assessment. *Caries Res* 39:295 (abstract #25), 2005.
2. Berkowitz RJ, Acquisition and transmission of mutans streptococci. *J Calif Dent Assoc* 31(2):135-8, 2003.
3. Featherstone JD, The caries balance: contributing factors and early detection. *J Calif Dent Assoc* 31(2):129-33, 2003.
4. Featherstone JDB, et al, Caries management by risk assessment: consensus statement. *J Calif Dent Assoc* 2003;31(3):257-69, April 2002.
5. Adair SM, The role of sealants in caries prevention programs. *J Calif Dent Assoc* 31(3):221-7, 2003.
6. Anderson MH, A review of the efficacy of chlorhexidine on dental caries and the caries infection. *J Calif Dent Assoc* 31(3):211-4, 2003.
7. Donly KJ, Fluoride varnishes. *J Calif Dent Assoc* 31(3):217-9, 2003.
8. Weintraub JA, Ramos-Gomez F, et al, Fluoride varnish efficacy in preventing early childhood caries. *J Dent Res* 85(2):172-6, 2006.
9. Lynch H, Milgrom P, Xylitol and dental caries: an overview for clinicians. *J Calif Dent Assoc* 31(3):205-9, 2003.
10. Reynolds EC, Remineralization of enamel subsurface lesions by casein phosphopeptide-stabilized calcium phosphate solutions. *J Dent Res* 76(9):1587-95, 1997.
11. Reynolds EC, Cai F, et al, Retention in plaque and remineralization of enamel lesions by various forms of calcium in a mouthrinse or sugar-free chewing gum. *J Dent Res* 82(3):206-11, 2003.
12. Mount GJ, Hume WR, Preservation and restoration of tooth structure, first ed., Mosby, 1998.
13. Mount GJ, Hume WR, A new cavity classification. *Australian Dent J* 43(3):153-9, 1998.
14. Young DA, New caries detection technologies and modern caries management: merging the strategies. *Gen Dent* 50(4):320-31, 2002.
15. Ekstrand KR, Ricketts DN, Kidd EA, Occlusal caries: pathology, diagnosis and logical management. *Dent Update* 28(8):380-7, 2001.
16. Lussi A, Validity of diagnostic and treatment decisions of fissure caries. *Caries Res* 25(4):296-303, 1991.
17. Verdonchot EH, Bronkhorst EM, et al, Performance of some diagnostic systems in examinations for small occlusal carious lesions. *Caries Res* 26(1):59-64, 1992.
18. Penning C, van Amerongen JP, et al, Validity of probing for fissure caries diagnosis. *Caries Res* 26(6):445-9, 1992.
19. Lussi A, Comparison of different methods for the diagnosis of fissure caries without cavitation. *Caries Res* 27(5):409-16, 1993.
20. Ricketts D, Kidd E, et al, Hidden caries: what is it? Does it exist? Does it matter? *Int Dent J* 47(5):259-65, 1997.

21. Rock WP, Kidd EA, The electronic detection of demineralisation in occlusal fissures. *Br Dent J* 164(8):243-7, 1988.
22. Pereira AC, Verdonschot EH, Huysmans MC, Caries detection methods: can they aid decision making for invasive sealant treatment? *Caries Res* 35(2):83-9, 2001.
23. Lussi A, et al. Clinical performance of the laser fluorescence system DIAGNOdent for detection of occlusal caries. *Caries Res* 33(1):299, 1999.
24. Hibst R, Paulus R, Caries detection by red excited fluorescence: Investigations on fluorophores. Paper presented at 46th ORCA Congress, 1999.
25. Heinrich-Weltzien R, Weerheijm KL, et al, Clinical evaluation of visual, radiographic, and laser fluorescence methods for detection of occlusal caries. *ASDC J Dent Child* 69(2):127-32, 2002.
26. Shi XQ, Welander U, Angmar-Mansson B, Occlusal caries detection with KaVo DIAGNOdent and radiography: an in vitro comparison. *Caries Res* 34(2):151-8, 2000.
27. Pitts N, ICDAS, an international system for caries detection and assessment being developed to facilitate caries epidemiology, research and appropriate clinical management. *Community Dent Health* 21(3):193-8, September 2004.
28. Simonsen RJ, Retention and effectiveness of dental sealant after 15 years. *J Am Dent Assoc* 122(11):34-42, 1991.
29. Poorterman JH, Weerheijm KL, et al, Clinical and radiographic judgment of occlusal caries in adolescents. *Eur J Oral Sci* 108(2):93-8, 2000.
30. Young DA, The use of glass ionomers as a chemical treatment for caries. *Pract Proced Aesthet Dent* 18(4):248-50, 2006.
31. Ngo H, Mount GJ, A study of glass ionomer cement and its interface with enamel and dentin using a low-temperature, high-resolution scanning electron microscopic technique *Quintessence Int* 28(1):63-9, 1997.
32. Gorton J, Featherstone JD, In vivo inhibition of demineralization around orthodontic brackets. *Am J Orthod Dentofacial Orthop* 123(1):10-4, 2003.
33. Antonson SA, Wanuck J, et al, Surface protection for newly erupting first molars. *Compend Contin Educ Dent* 27(1):46-52, 2006.
34. Yiu CK, Tay FR, et al, Interaction of resin-modified glass-ionomer cements with moist dentine. *J Dent* 32(7):521-30, 2004.
35. Pitts NB, Rimmer PA, An in vivo comparison of radiographic and directly assessed clinical caries status of posterior approximal surfaces in primary and permanent teeth. *Caries Res* 6(2):146-52, 1992.
36. Milicich G, Rainey JT, Clinical presentations of stress distribution in teeth and the significance in operative dentistry. *Pract Periodontics Aesthet Dent* 12(7):695-700; quiz 02, 2000.
37. Mount GJ, Papageorgiou A, Makinson OF, Microleakage in the sandwich technique. *Am J Dent* 5(4):195-8, 1992.
38. Van Duinen RN, Davidson CL, et al, In situ transformation of glass ionomer into an enamel-like material. *Am J Dent* 17(4):223-7, 2004.

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Products — Old, New, and Emerging

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ABSTRACT The paradigm shift in understanding the etiology, prevention, and treatment of dental caries requires an understanding of the dental products that are currently available to assist the clinician in prudent recommendations for patient interventions. The purpose of this review is to present the evidence base for current products and those that have recently appeared on the market.

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DISCLAIMER

The products discussed in this issue are intended to be examples of currently available products for clinicians to use in caries management by risk assessment. The authors do not endorse any of these products and appreciate that there are many other products that were omitted only because of limitations of space.

Managing dental caries by risk assessment requires an understanding of the pathologic and protective factors that exist in the “caries balance” (refer to Featherstone et al. this issue). The pathologic factors include the transmissible and infective organisms, mutans streptococci (MS, and lactobacilli, LB); reduced salivary flow; and the frequent ingestion of fermentable carbohydrates, not just sucrose. Recognizing caries etiology is imperative before rational interventions can be developed.¹

The protective factors include adequate amounts of healthy saliva that include acid buffers, the presence of calcium, phosphate, and fluoride for remineralization, proteins and lipids that form the protective pellicle, immunoglobulins, and a salivary flow rate adequate to clear the oral cavity. Although intrinsic antibacterial factors are present in the saliva, extrinsic antibacterial agents are an important consideration in the “extreme-risk” and “high caries risk” patient because salivary antimicrobials may be insufficient to overcome the challenge of high MS and LB counts.

The remainder of this review will discuss practical dental products to use in

patient interventions covering the broad range of extreme and high caries risk, to patients with moderate and even low risk. Although low caries risk patients might not be considered at risk for caries, primary prevention, by definition, is intended to prevent disease from occurring before any pathology is present.

Clinicians spend the majority of their careers dealing with secondary prevention, i.e., removing the result of dental caries and restoring the cavitation and/or defects in tooth structure with dental materials that are biologically compatible with the teeth and supporting tissues. Some of the products, such as chlorhexidine (CHX) and fluorides, have an extensive evidence base to support efficacy but may not have as strong an evidence base as a caries treatment intervention. Comments will be made concerning the strength of evidence within the context of risk assessment and “caries balance.” Lastly, the use of any of the products discussed in this paper is predicated on assisting patients to thoroughly clean their teeth, including approximals, on a daily basis.

Product Categories with Examples

The products reviewed here are for use in the clinical management of dental

caries, as described in detail in this issue by Ramos-Gomez et al. and Jenson et al. in other papers in this *Journal*. In those papers, generic descriptions are used in the treatment tables and procedural descriptions. This paper provides examples of these products including product descriptions, brand names, and sources. It is not intended to be inclusive nor is any endorsement to a particular product or company implied. Many products were omitted only because of limitations of space.

Antibacterials

CHLORHEXIDINE (CHLORHEXIDINE GLUCONATE 0.12 PERCENT, 11.6 PERCENT ALCOHOL, PERIOGARD, PERIDEX, PERIORX AND G-U-M CHLORHEXIDINE GLUCONATE ORAL RINSE USP)

There is a large body of data including controlled clinical trials to support the efficacy of chlorhexidine (CHX) as an antiplaque agent. The mechanism of action is time-dependent and requires a two-step process. First, the strongly cationic CHX molecule must attach to the anionic tooth surface and then it is released over a period of four to 12 hours. The cationic molecule attaches to the anionic surface of the bacterial cell. Prolonged contact with the bacteria eventually weakens the cell wall and disrupts its contents.² Chlorhexidine is effective against a broad spectrum of microorganisms in dental plaque, including MS (not necessarily LB).

An excellent and concise review of the efficacy of chlorhexidine is presented by Anderson.³ He concluded that the literature is mixed on the effects of CHX against dental caries, but is favorable with respect to controlling MS. More specifically CHX has been demonstrated to be effective in caries control among patients with special needs.^{3,5} Schaecken et al. compared chlorhexidine

and iodine in young adults and found that both were effective in suppressing *S. mutans*.⁶ However, it is significant that with CHX, *S. mutans* remained suppressed 21 days after application.

In a randomly controlled clinical trial that extended more than two years, Wyatt and MacEntee compared daily rinsing with either CHX or 0.2 percent neutral sodium fluoride.⁷ They concluded that the 0.2 percent fluoride rinse significantly

ALTHOUGH LOW caries risk patients might not be considered at risk for caries, primary prevention, by definition, is intended to prevent disease from occurring before any pathology is present.

reduced the incidence of caries among elders in a long-term care residence compared to the CHX group. This is not surprising, because the CHX can only reduce the MS⁸, whereas the 0.2 percent fluoride rinse contributes to the remineralization of the tooth surface. In that study, the daily use of 0.2 percent neutral sodium fluoride decreased the incidence of caries in institutionalized elders, demonstrating the necessity of enhancing remineralization during the treatment of individuals at risk of caries progression. Antibacterial treatment will generally need fluoride treatment in conjunction.

Conclusion

Despite the great need for the development of new and better antimicrobials for

clinical use, there is a strong body of evidence supporting the efficacy of 0.12 percent chlorhexidine that justifies its designation as one of the most effective caries antimicrobial agents currently available.

Application

In extreme-risk and high-risk caries adults, 10 milliliters of 0.12 percent CHX solution should be used for rinsing once or twice daily for one minute, after breakfast and at bedtime (after brushing the teeth), for seven days or one week per month. More detail about how this fits into the therapy for individuals following caries risk assessment is given in the paper by Jenson et al. this issue. In the high caries risk adult, this should be followed by three weeks of rinsing with either the 0.2 percent NaF Rinse (Prevident or Oral-B) or OTC 0.05 percent NaF rinse. Use of the 0.2 percent NaF rinse is optional, and, if selected, should be used daily, after lunch so as not to interfere with the 1.1 percent NaF toothpaste. If this option is not selected, the patient should use the OTC 0.05 percent NaF rinse, twice daily, after breakfast and after lunch. It is useful to note that cationic products (e.g., CHX) will bind to some extent with anionic products (e.g., fluoride or iodine) and the contents should not be mixed together or used immediately after one another. It is possible to use fluoride therapy and CHX on the same day for one week a month, provided they are used about one hour or more apart to allow for either to interact with the teeth and the plaque. In this case, a once-a-day rinse with the CHX and a once-a-day rinse with fluoride at another time of day is recommended. This regimen is likely to achieve better compliance as it is less confusing for the patient.

At this time, a postintervention saliva/bacterial test should be administered to monitor the treatment process and motivate the patient to continue. The

patient then returns to using the CHX daily for seven days to keep the bacterial levels suppressed. After this second round of CHX use, the patient should rinse twice daily with 0.05 percent NaF rinse (Act, Fluorigard, CariFree Maintenance). This latter protocol (i.e., CHX and 0.05 percent NaF rinse) should be repeated monthly until bacterial levels are consistently low or until no new carious lesions are detected for up to at least one year. Periodic saliva/bacterial testing should be done to determine whether the patient is cooperating with the CHX regimen and whether it is working.

This same regimen should also be considered in the high caries risk child over the age of 6.

CHLORHEXIDINE (CHLORHEXIDINE GLUCONATE 0.12 PERCENT, AQUEOUS SOLUTION, G-U-M CHLORHEXIDINE GLUNCONATE ORAL RINSE USP)

One of the more recent developments in the United States has been the introduction of a water-based chlorhexidine mouthrinse. This has widespread appeal not only for safety reasons, but also for patients who should avoid alcohol-containing mouthrinses. In addition, patients who are immunocompromised, or who have decreased salivary flow due to radiation therapy, medications or systemic conditions and cannot tolerate alcohol-containing mouthrinses.

There is some limited evidence that the water-based CHX is as effective as the alcohol-based CHX. Eldridge et al. in 1998 conducted a double-blind randomly controlled clinical trial comparing three groups: CHX with alcohol, CHX alcohol-free, and Listerine. All subjects refrained from all oral hygiene practices for 21 days while using 15 ml of the assigned mouthrinse for one minute daily.⁹ In that study the authors concluded that the

alcohol-free CHX was as effective as the alcohol-based CHX in reducing *Streptococcus mutans* levels. Although the authors found statistically significant differences between both CHX groups and the Listerine, the total sample size of the study (N=32) lacked the power to show true differences. In another controlled clinical trial conducted by Borrajo et al. in 2002, 10 concluded that the water-based CHX was equally as effective as the alcohol-

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containing CHX product in controlling plaque and reducing gingival inflammation after 28 days. This study had sufficient sample size, but it was not directed at measuring decreases in *S. mutans* levels.

Conclusion

At this time there is limited evidence to recommend the use of the alcohol-free CHX as substitute for CHX in alcohol. Even though additional research is needed to document its efficacy, it should be considered and recommended to patients who are intolerant of alcohol.

Application

Use of the water-based CHX should be considered for those at extreme risk for caries, or any patient who is intolerant of alcohol. The protocol for using the alcohol-free CHX is the same as that described above for the alcohol-based CHX.

1 PERCENT IODINE (10 PERCENT Povidone-Iodine, Betadine)

The microbicidal effect of povidone-iodine has been used for many years in the cleaning of surgical instruments, as a handrinse and body scrub before surgery. It is microbicidal for gram-positive and gram-negative bacteria, fungi, mycobacteria, viruses, and protozoans.¹¹ Unlike chlorhexidine, povidone-iodine exerts its lethal effects by direct contact with the microbial cell wall. Ten percent povidone-iodine yields 1 percent active iodine. One additional attribute of povidone iodine is that it appears to be effective against both MS and LB in children.

Most of the studies that have examined topically applied iodine have been conducted in young children. A review of these studies is presented by DenBesten and Berkowitz in 2003¹²; refer to http://www.cdafoundation.org/news_journals.htm. For our purposes, a concise summary will be presented. In one study, a one-time two-minute topical application of 2 percent iodine or potassium iodine lowered bacterial levels for up to 13 weeks.¹³ In another, following a prophylaxis, three applications of potassium iodine reduced MS for up to six months.¹⁴ In a randomly controlled clinical trial, 10 percent povidone iodine was applied every two months (up to seven months) in infants 12 to 19 months of age. None of the infants in the treatment group developed white spot lesions, whereas 31 percent of the infants in the control group developed white spots.¹⁵ This needs to be interpreted with caution because of the small sample size (N=31).

In a pilot study of children with extensive dental caries requiring general anesthesia for treatment, 25 children ranging in age from 2 to 7 were randomly separated into a treatment and control group.¹⁶ The treatment group received

topical application of 10 percent povidone-iodine three times at two-month intervals, and the control group did not receive iodine. Six months following extensive one-time restorative dental treatment, both groups had a statistically significant decrease in *S. mutans* counts, but there was no difference between the two groups. One year following initial treatment, 63 percent of the children in the control group had new cavities compared to 18 percent in the treatment group.

In a similar study of children with extensive early childhood caries (22 children, age 2 to 6), the treatment group received a one-time application of 10 percent povidone-iodine and the control group a phosphate buffered saline.¹⁷ Prior to restorative treatment, all children received a prophylaxis, a two-minute 1.23 percent acidulated phosphate fluoride gel application, followed with either the iodine or saline treatment.

Mutans streptococci and lactobacilli were significantly reduced at one hour, three weeks, and three months in the povidone-iodine group. Following one year, more than 60 percent of the children had new cavities, but there was no significant difference in caries increment between the two groups. The results suggest that periodic reapplication of the povidone-iodine is needed in a high-risk group with early childhood caries.

In 2005, El-Housseiny and Farsi conducted a controlled clinical trial in children age 4 to 6.¹⁸ The treatment group (10 percent povidone-iodine) and the control group (APF gel) each received a prophylaxis and APF before starting the study. Thereafter, the treatment group received topical applications of povidone-iodine weekly for the first month, and then at three, six, and 12 months. The control group followed the same application regi-

men using only the APF gel. The differences in salivary MS and LB between the treatment and control groups were not statistically significant.

Conclusion

The positive results of povidone-iodine as an antimicrobial to decrease MS and LB in young children have been well documented. There is little evidence, however, that it is effective in adults

or older children. Additional studies are needed to determine its efficacy in reducing MS and LB in adults or older children. Until such studies are done, the use of iodine in adults cannot be recommended as being proven to be beneficial.

Application in Children

When using topical iodine all patients/caregivers should be screened for potential iodine allergies. In high and moderate caries risk young children, 10 percent povidone-iodine can be applied with a cotton swab saturated with the iodine. Several studies reported better results if the biofilm was disturbed or removed with a prophylaxis polish. In children younger than age 6, or in special needs patients, the teeth should be isolated with cotton rolls and gently dried with gauze or cotton rolls with excess iodine being aspirated with suction. One to two milliliters may

be applied for up to two minutes, followed by wiping with gauze or rinsing with a water syringe. After age 6, or when a child has developed a coordinated swallowing reflex, they may rinse with 10 ml of povidone-iodine for one minute and expectorate. This routine should be repeated at all recall examinations and restorative appointments until no new carious lesions are detected. Use in adults is not required.

Topical Fluoride Modalities

In the extreme-risk and high-risk caries patient, the first step is to deal with the infectious disease of dental caries. After MS and LB have been challenged with antibacterials, other protective agents such as topical fluorides and xylitol need to be employed to help tip the caries balance in favor of a healthy oral environment. There is a substantial body of good evidence to support topical fluoride agents.¹⁹ The first studies on professionally applied fluorides included high concentration sodium fluoride (NaF), stannous fluoride (SnF₂) and acidulated phosphate fluoride (APF) aqueous solutions. When used repeatedly (i.e., two times per year), all of these agents were equally effective in reducing dental caries. Eventually they evolved into gels, foams, and varnishes. Fluoridated dentifrices and rinses were developed concurrently with professionally applied fluorides. The objective of fluoride intervention is to inhibit plaque bacteria, inhibit demineralization, enhance remineralization, and form a fluoroapatite-like coating at the partially demineralized mineral crystals in the tooth subsurface carious lesions.

FLUORIDATED DENTIFRICES

Irrespective of caries risk, all age groups should use commercially available fluoridated toothpaste at least twice per day. Children younger than 2 should limit

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the amount of paste to a pea-size amount, applied on a soft toothbrush by the caregiver, to minimize the risk of fluorosis.²⁰ Studies on the efficacy of fluoridated dentifrices in children of two to three years' duration have reported reductions in caries experience of 15 percent to 50 percent. In the United States, the concentration of fluoride in fluoride toothpastes is usually 1,000 to 1,100 ppm F.¹⁹

In recent years, 1.1 percent NaF toothpaste and gel (5,000 ppm F) (Prevident 5000, Control RX, Fluoridex Daily Defense) have become available for treating root sensitivity and have been approved for safety and efficacy by the Food and Drug Administration. Its use as an "off-label" anticaries agent is based on the likelihood of it being more beneficial in treating rampant caries, root caries and patients with decreased salivation or decreased cooperation in applying other forms of fluoride. In a clinical study that followed root caries progression, the use of a 5,000 ppm F toothpaste produced statistically significantly less caries than the control 1,000 ppm F product.²¹

Conclusion

It is reasonable to assume that the anticaries effect of high fluoride concentration toothpastes is an extension of the evidence base for the routinely used toothpastes with lower amounts of fluoride and may prove helpful with patients who will not cooperate with other recommended sources of topical fluoride such as OTC fluoride rinses. These high fluoride toothpastes require a prescription and many clinicians have experienced dramatic increases in success by dispensing all Caries Management by Risk Assessment (CAMBRA) products directly to patients, while at the same time providing a beneficial service for patients. More detail is provided in the paper by Jenson et al. in this issue.

Application

In the extreme-risk and high caries risk adult (i.e., rampant caries, root caries, or excessive gingival recession, or decreased salivation) it is reasonable to recommend the use of 1.1 percent NaF toothpaste twice per day (refer to Jenson et al., this issue, for recommended treatment protocols for the various risk levels and to Featherstone et al., this issue, for caries risk determination procedures). It

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patients should
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can be used after breakfast, lunch, dinner, or at bedtime, as long as it does not interfere with any other fluoride modality that is recommended. If it is used only once per day, it is preferable to use at bedtime. Ideally, patients should be instructed to expectorate, but not rinse with water following brushing. When the tongue and lips are cleared of foam, the mild flavor of the paste is pleasantly tolerable. If patients prefer to rinse with water to eliminate food or other debris, they should try to rinse with just one mouthful of water holding it in the mouth for at least one minute, or alternatively reapplying a small amount of the toothpaste after rinsing.

The utility of 1.1 percent NaF toothpaste is that it is a single product. It does not require brushing first and then applying a high concentration fluoride gel, which may discourage some patients. One optional procedure in the extreme-

risk patient with low salivary flow is the construction of custom trays and the use of the 1.1 percent NaF gel (10 minutes per night). This is justifiable even though it is more costly. Use of the high concentration fluoride toothpastes should be continued until the caries status of the patient has changed and remains controlled. One cautionary note: Avoid using the 5,000 ppm fluoride toothpaste or gel directly after the use of chlorhexidine. Separating their use by an hour or more will help prevent the cationic charge of CHX from binding with the anionic charge of the fluoride, and allow either product to interact independently with the bacteria on the plaque and with the tooth.

FLUORIDE MOUTHRINSES (0.05 PERCENT NAF, ACT, FLUORIGARD, CARIFREE MAINTENANCE RINSE AND 0.2 PERCENT NAF, PREVIDENT AND ORAL-B FLUORINSE)

Mouthrinses containing fluoride were developed for daily (0.05 percent NaF) or weekly (0.2 percent NaF) use for children over the age of 6. The 0.05 percent NaF rinse is an over-the-counter item, whereas the 0.2 percent NaF rinse requires a prescription, or must be dispensed by the dental office. The evidence base for supporting their efficacy dates back to early 1970s when the prevalence of dental caries was higher than today. The average reduction in caries experience was 30 percent. Even though the early randomized clinical trials used historical controls rather than concurrent controls, the quality of the evidence to support mouthrinses is high.¹⁹ Their convenience and cultural acceptance makes them appealing.

Conclusion

There is a good quality evidence base to support the used of fluoride rinses in the demineralization/remineralization cycle. They are especially valuable

in treating the moderate-risk, high-risk and extreme caries risk patient.

Application

In the high caries risk patient, daily rinsing with 10 ml of 0.05 percent NaF rinse for 30 to 60 seconds should be done twice daily. If it is used after breakfast and after lunch, 1.1 percent NaF toothpaste could be used before retiring. This same schedule may also be used for patients with decreased salivation (extreme risk), because the fluoride will not be cleared rapidly from the oral cavity. One other option for the high caries risk or extreme risk patient is to use 10 ml of the 0.2 percent NaF rinse once per day, between the times that chlorhexidine is being used. After completion of one bottle of the 0.2 percent NaF rinse, the patient can start to use the 0.05 percent NaF rinse.

In the moderate caries risk patient, daily rinsing with 10 ml of 0.05 percent NaF rinse for 30 seconds should be done in the morning and before retiring. The young adolescent with orthodontic appliances also meets the profile of a moderate caries risk patient. Even the low caries risk patient with numerous crowns or restorations should rinse once daily with 10 ml of the NaF rinse to have additional protection beyond fluoridated toothpaste. All of these regimens should be continued until the caries risk changes or as long as the patient desires to continue.

FLUORIDE VARNISHES (5 PERCENT NaF VARNISH: DURAPHAT, DURAFLOR, CAVITY SHIELD, FLUOR PROTECTOR, VANISH)

The advantage of fluoride varnish is that because it adheres extremely well to the tooth surface it maximizes the long-term delivery of fluoride. In addition, high concentrations of fluoride can be applied in small quantities. A completely dried tooth surface is not required and the

varnish can be applied more quickly than a four-minute fluoride gel or form tray application. A systematic review found that fluoride varnishes have a substantial caries preventive effect, but no concurrent controls were employed in these studies.²² In a two-year randomized controlled clinical trial on low-income children younger than age 2 Weintraub et al. found that once per year and twice per year application of 5 percent sodium fluoride varnish

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significantly reduced the incidence of early childhood caries with twice per year significantly more effective than once.²³

This product is also suitable for adults as a caries control agent that does not require personal compliance, although controlled clinical trials have not been reported. The House of Delegates of the American Dental Association approved a resolution that “supports the use of fluoride varnishes as safe and efficacious within a caries prevention program ...” (Resolution 37H, November 2004). It is recommended by the ADA Council on Scientific Affairs for biannual application in children and adolescents for preventing caries; in high-risk patients, two or more applications are recommended in preventing caries.²⁴

Conclusion

The evidence base for 5 percent NaF varnish is of a high quality. Additional re-

search to establish an optimal interval of frequency of applications is still needed. At least one randomized controlled trial has been reviewed systematically supporting its use in adolescents up to age 14.²² Evidence for its use in adults has been extrapolated from these studies.

Application

In the high caries risk child (e.g., ECC or adolescent with rampant caries) the tooth should be swabbed with either cotton rolls or 2-by-2 gauze sponges to remove the plaque and excessive moisture. The fluoride varnish, whether it comes in the 10 ml tubes or 1 ml individual applicators, should be mixed with the applicator brush to mix the fluoride and resin carrier, and then painted on all of the tooth surfaces, working the varnish into the embrasures as much as possible. It can also be flossed into the interproximal spaces. The varnish has a yellowish-brown appearance, except for Vanish, which is white. The patient or caregiver should be instructed to have the child refrain from drinking or eating for 30 minutes after the application. Although it may feel somewhat “gritty” or “pasty,” they may eat or drink with the varnish on their teeth. It will be removed the next time they brush. The longer it is on the teeth, the more benefit the patient receives. Although some practitioners suggest that the child not brush until the following morning, this recommendation is made at the discretion of the practitioner. Even if it is on the teeth for only three to four hours, it will provide at least as much benefit as a four-minute professionally applied tray application.

In the extreme-risk or high caries risk adult (e.g., excessive or rampant caries, gingival recession, dry mouth), the teeth are lightly dried to remove excessive moisture with a 2-by-2 gauze and varnish

is painted on the root surface, on the margins of restorations, and decalcified areas. Up to three applications are planned in the patient's sequence of restorative treatment. For example, varnish can be applied after the initial prophylaxis or after completing scaling and root planing, to diminish dentinal sensitivity. The other applications are made after all of the active decay is removed or temporized. The number of applications is governed by the number of restorative appointments needed and at the discretion of the practitioner. The patient is instructed to refrain from drinking or eating for 30 minutes, and reassured that the varnish will be removed at the next brushing. One application is also made at the patient's recall visits. For the extreme caries risk patient, a three-month recall is recommended, and for the high caries risk, three to four months. The same protocol is followed for the moderate-risk adult (one to two applications) with a recall at four to six months. Even an apparently low caries risk patient may benefit from an application of varnish if they present with excessive gingival recession or root sensitivity.

Applying varnish at the recall examinations would continue until the risk of caries has diminished for the patient. Finally, those white spot decalcified areas, stained fissures and areas noted as "watches" are all candidates for varnish application, no matter what the caries risk. One of the desirable features of using the 5 percent NaF varnish is that it is not subject to the compliance of the patient, but is under the control of the dentist. In general, adults may prefer the white varnish to the yellowish-brown varnishes.

XYLITOL

Xylitol is a naturally occurring, diabetic-safe, low-calorie sugar that is

not metabolized by MS. An overview of xylitol and dental caries was presented by Lynch and Milgrom.²⁵ Since it is not broken down by cariogenic microorganisms, xylitol starves the MS in a manner similar to removing sucrose from the diet completely. Including xylitol into the diet will also inhibit MS attachment to the teeth making it a good product for decreasing the bacterial load of primary care givers and interrupting

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the vertical transmission of MS to the child.^{26,27} Since there is no metabolism and no drop in the salivary pH, the environment favors nonacidogenic bacteria.²⁶ Makinen et al. found that the systematic use of xylitol chewing gum significantly reduced the relative risk of caries compared to gums containing sorbitol/xylitol and sucrose.²⁸ Using the same population, he and his coworkers found that the use of a xylitol gum was more frequently associated with the arrest of dentinal caries than the other combinations of chewing gum.²⁹

In summary, the use of xylitol-containing products, such as chewing gum, mints, candy, and cookies has resulted in decreasing the incidence of dental caries, arresting carious lesions and decreasing the transmission of MS from mothers and caregivers to children. The only side effect of too much xylitol ingestion is

that it may have a mild laxative effect. The benefit of using xylitol-containing products is complemented by increasing the salivary flow, which draws the buffering capacity of saliva into action as well as the electrolytes that contribute to remineralization. Therefore, the benefit of using xylitol is not confined to children, it is extended to many adults who experience dry mouth. The amount of xylitol needed for benefits against caries is slowly being refined. In 2006, Makinen narrowed the daily dose to between 6-10 grams per day.^{28,29} To determine the exact amount of xylitol in a product, the manufacturer should be consulted or alternatively, patients can be advised to choose products with xylitol listed on the label as the first ingredient.

Conclusion

The evidence base for recommending products manufactured with xylitol is strongly supported by controlled clinical trials.

Application

More products containing xylitol are becoming available in the United States. Products and Web sites for purchasing the confections appear in **TABLE 1**. For moderate, high, and extreme caries risk patients, two pieces of xylitol gum or two pieces of xylitol hard candy/mints should be used for five minutes following meals or snacks four times daily. The target dose of xylitol is 6 to 10 grams spread throughout the day. Excessive or prolonged gum chewing is not advised. Most xylitol-sweetened products contain flavor that only lasts a short time to discourage excessive chewing. Adults with dry mouths or senior citizens, who may not like to chew gum because of occlusion problems, have the option of using xylitol in mints, candies, mouthwash, toothpaste, or mouth sprays.

Dry Mouth Considerations

The healthy patient has an adequate supply of calcium and phosphate in the saliva to remineralize teeth after acid attacks from cariogenic bacteria. In addition, the antimicrobial properties of the saliva, along with its strong buffering system are more than adequate to maintain an environment that is optimal for a healthy caries balance. When the salivary flow is decreased, for whatever reason, the caries balance is shifted and pathologic factors can have a devastating effect on the teeth in a very short period. Therefore, patients who experience a decreased salivary flow are willing to grasp any product that may provide them relief. The products that are currently available do not have a strong evidence base but they may be able to provide palliative relief to patients.

The pH of the saliva is highest in the morning and decreases after eating when starches and sugars are metabolized to acid by cariogenic bacteria. Proteins and lipids have little effect on the salivary pH.³⁰ Stimulation of the saliva brings the protective functions of saliva into play. The most important protective functions of saliva are lubrication, chemical buffering, and antimicrobial activity.³¹ The bicarbonate system is the major buffering system followed to a lesser extent by phosphate and protein. The bicarbonate system can quickly elevate the depressed pH caused by acidogenic bacteria to safe levels. When medications, systemic diseases, or irradiation diminishes the flow of saliva, the protective effects of saliva leave the teeth vulnerable to demineralization, and oral soft tissues may become dehydrated to the point of cracking and open to microbial infection. Hence, any product that simulates even some of the functions of saliva could have a profound effect on improving the quality of life for patients with hyposalivary symptoms.

BUFFERING PRODUCTS (ARM & HAMMER TOOTHPASTES, GUM, AND BAKING SODA; ORBIT WHITE, CARIFREE, PROCLUDE, AND DENCLUDE)

With the exception of two toothpastes (Arm & Hammer P.M., Fresh Mint and Enamel Care), all of the toothpastes manufactured by Arm & Hammer contain sodium bicarbonate as the primary abrasive ingredient.³² Its safety, low abrasivity, compatibility with fluoride and low cost

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make it an ideal dentifrice ingredient.³³ Sodium bicarbonate dentifrice has the ability to rapidly neutralize (in vitro) pHs as low as 4.5.³⁴ This is also the rationale for making a solution of water with baking soda (two teaspoons in a 12- or 16-ounce bottle of water) for hyposalivary patients to rinse and expectorate as needed throughout the day to neutralize the detrimental effects of acidity from gastric reflux (GERD), bulimia, or the dryness that occurs when the saliva is drastically decreased. Because of its ability to increase the pH, it has shown a decrease (in vitro) in mineral loss of enamel.³⁵ It has also demonstrated strong inhibitory activity (in vitro) against *S. mutans*. Several small clinical studies suggest that it can be effective in reducing dental staining. Its low abrasivity is highly desirable because it will not abrade tooth structure like the high abrasive

dentifrices.³⁶ Removing tooth stains is the advertising basis for Orbit White chewing gum, which contains baking soda.

ProClude is a desensitizing prophylaxis paste and DenClude is a desensitizing toothpaste. Both products contain SensiStat which contains arginine, an amino acid which stimulates the acid-neutralizing properties of certain plaque bacteria. It also contains calcium carbonate and bicarbonate. CaviStat in a toothpaste has been shown, in a large study in Venezuela with more than 700 participants, to decrease decay in schoolchildren better than the fluoride control.³⁷

Conclusion

There is a considerable evidence base to support the many properties of baking soda or other buffering agents. Even though additional research is needed to clinically demonstrate the ability of buffering agents to decrease dental caries, extrapolating the use of baking soda, or other buffering agents to patients is reasonable in order to relieve the problems of acidity and decreased salivation.

Application

In the extreme-risk patient, neutralizing the acidity that exists due to the lack of the saliva's protective properties can be offset by rinsing with a baking soda solution when the mouth feels dry. Additional recommendations include rinsing after every snack or meal and at bedtime, as well as using a baking soda chewing gum. These recommendations also apply to the patient with gastric reflux and bulimia.

ARTIFICIAL SALIVA (SALIVART, OPTIMOIST)

Artificial saliva is intended to imitate natural saliva both chemically and physically. Its properties include viscosity, mineral content, preservatives and

TABLE 1

Products for Caries Intervention

	Product	Where to Find Product
Chlorhexidine (chlorhexidine gluconate 0.12%, 11.6 % alcohol)	Periogard Peridex	Colgate www.colgateprofessional.com OMNI Preventive Care, a 3M ESPE Company www.omnipreventivecare.com
Chlorhexidine (chlorhexidine gluconate 0.12%, aqueous solution)	G-U-M Chlorexidine Gluconate Oral Rinse USP	Sunstar Americas, Inc./Butler www.jbutler.com
Iodine (10% povidone-iodine)	Betadine	Medical suppliers
Other antimicrobials	CariFree Treatment Rinse	OralBioTech www.carifree.com
Fluoridated dentifrices [1.1% NaF toothpaste and gel (5,000 ppm)]	Preident 5000 Control RX Fluoridex Daily Defense	Colgate Omnii Discus Dental www.discusdental.com
Fluoride mouthrinses (0.05 % NaF)	Act Fluorigard CariFree Maintenance Rinse	Johnson and Johnson Colgate OralBioTech www.carifree.com
Fluoride mouthrinses (0.2% NaF)	Preident Oral-B Fluorinse	Colgate Procter & Gamble www.dentalcare.com
Fluoride varnishes (5% NaF varnish)	Duraphat Duraflor Cavity Shield Fluor Protector Vanish	Colgate Medicom OMNI Preventive Care Ivoclar OMNI Preventive Care
Xylitol	Epic Spry Squigle toothpaste Omni Theragum Ice Breakers Cubes Starbucks After-coffee gum Altoids gum	www.epicdental.com www.sprydental.com www.squigle.com OMNI Preventive Care Retail stores
Baking soda products	Arm & Hammer toothpastes and baking soda Orbit White	Retail stores Wrigley www.wrigley.com/wrigley
Other acid-buffering products	CariFree Maintenance rinse CariFree Boost Breath spray DenClude ProClude	OralBioTech, www.carifree.com Ortek Therapeutics, Inc. www.ortekinc.com

TABLE 1

Products for Caries Intervention **CONTINUED**

	Product	Where to Find Product
Palliative products for xerostomia	Optimoist	Colgate
	Salivart	Gebauer Company www.gebauer.com
	Oasis	GlaxoSmithKline www.gsk.com
	Stoppers 4 Dry Mouth Spray	Retail stores
	Spry Oral Rinse	Xlear, Inc. www.xlear.com/spry/dds
	Oralbalance gel and toothpaste	Laclede Professional Products www.biotene.com
	Biotene mouthwash	
	Biotene alcohol-free mouthwash	
	Biotene Antibacterial Dry Mouth toothpaste	
New Products Currently Available		
Recaldent products CPP-ACP	PROSPEC MI Paste (GC America, Inc.)	GC America, Inc. www.gcamerica.com.
	Trident White chewing gum	Retail stores
	Prospec MI Paste Plus	
NovaMin	SootheRx tooth sensitivity	OMNI Preventive Care www.denshield.com
	DenShield tooth sensitivity	Butler www.jbutler.com
	NuCare Root Conditioner with Novamin	Butler
	NuCare Prophylaxis Paste with NovaMin	Butler
ACP Products	Ageis products	Bosworth www.bosworth.com
	Sealants	Premier Dental www.premusa.com
	Bracket cmt	
	Crown and Bridge cmt	
	Enamel Pro – prophylaxis paste	
	Enamel Pro varnish	
Diagnostics	Saliva Check	GC America
CariFree System	CariScreen and CariCult	OralBioTech www.carifree.com

palatability. Hydroxyethylcellulose or carboxymethylcellulose provides the attributes of viscosity. Phosphates and calcium contribute to the mineral content. Methyl or propylparaben are frequently used as preservatives. Flavorings and sweeteners, such as sorbitol or xylitol, provide the qualities of palatability.³⁸ In addition to the previously mentioned ingredients, Salivart contains sorbitol, is preservative-free and is packaged as a sterile propellant aerosol. Optimoist has similar ingredients, but also contains sodium monofluorophosphate and is packaged as a spray.³⁹

Conclusion

With both products lacking an evidence base, they can at best be offered as palliative relief to patients with xerostomia on an as-needed basis. These products lack the most important functions of saliva, the buffering and antimicrobial properties.

MOUTHWASH FOR THOSE WITH XEROSTOMIA (OASIS, STOPPERS 4 DRY MOUTH SPRAY, SPRY ORAL RINSE)

Oasis is an alcohol-free formulation intended to provide the moisturizing benefits of a mouthwash without drying the mucosa.

It contains a combination of carboxymethyl cellulose and a polyvinylpyrrolidone backbone polymer and xanthan gum.⁴⁰ One study, using subjective questions, showed that in a population of subjects experiencing dry mouth, found it beneficial in managing dry mouth and preferred it over the control rinse.⁴¹ It is advertised as a mouth moisturizer and not as a saliva substitute. Stoppers 4 Dry Mouth Spray and Spry Oral Rinse both have an abundance of xylitol.

Conclusion

Lacking an evidence base, these products can at best be offered as pallia-

tive relief to patients with salivary gland hypofunction on an as-needed basis.

BIOTENE PRODUCTS

Oralbalance gel and toothpaste products contain the enzymes lactoferrin, glucose oxidase, and lactoperoxidase. When these enzymes combine with potassium thiocyanate, which is present in saliva, they form the hypothiocyanate ion, which mildly inhibits the growth of acid-producing microorganisms.⁴² Biotene mouthwash contains lysozyme, glucose oxidase, and lactoferrin. In addition to these ingredients, Biotene alcohol-free mouthwash contains lactoperoxidase.

Biotene Antibacterial Dry Mouth Toothpaste contains lysozyme, glucose oxidase, and lactoperoxidase.³² The studies that have been conducted on Biotene are difficult to interpret because some used different combinations of the Biotene mouthwash, toothpaste, chewing gum and Oralbalance gel or only one of the products separately. Out of the seven studies reviewed, five gave favorable results based on subjective measures and two did not have any effect based on physical measurements. The five studies with positive results were conducted in postradiation patients or severely hyposalivary patients.

Conclusion

Most of the evidence base comes from small studies and subjective measurements in which different combinations of the products were used. The Biotene products are intended to mimic the natural enzymes of the saliva. They have no buffering capability or anticaries effects and thus do not substitute for saliva. These products can at best be offered as palliative relief to patients with salivary gland hypofunction on an as-needed basis.

Application

They may be offered as palliative products to patients with dry mouth to see if they obtain any relief.

New Products Currently Available

PROSPEC MI PASTE (GC AMERICA, INC.)

MI Paste by GC America, Inc. is a water-based paste FDA-approved for sensitivity that uses Recaldent (CPP-ACP) technology

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to deliver calcium and phosphate ions to enamel surfaces. Recaldent is derived from the milk protein, casein. Casein benefits teeth by bringing calcium phosphates to demineralized enamel.⁴³ Casein phosphopeptide, CPP, creates a stable delivery vehicle for amorphous calcium phosphate, ACP, and can promote remineralization of subsurface enamel lesions.⁴⁴ At neutral pH or with a high concentration of calcium and phosphate ions, the concentration gradient favors the diffusion of ions back into the tooth causing remineralization.⁴⁵ Because it may provide some buffering along with amorphous calcium and phosphate, this product attempts to mimic healthy saliva. Anecdotally, MI Paste may provide comfort for patients with xerostomia and hyposalivary function. MI Paste Plus, launched in the United States in spring 2007, also contains fluoride. More studies are needed to study the effects of adding the fluoride.

Conclusion

There is substantial evidence for this technology. Currently there is more in vitro evidence than in vivo to support the benefits of MI Paste. The majority of studies have supported its ability to bring about remineralization by coating the tooth surface with the calcium and phosphate needed to repair demineralized enamel. One study has evaluated its effectiveness in reducing sensitivity associated with tray bleaching. An extension of this would be in treating sensitivity following scaling and root planing, and root surfaces exposed because of gingival recession and/or erosion.

Application

MI Paste is recommended for professional dispensing, and can be used by the patient with instruction from the dental staff. Because it contains a milk protein it should not be used on patients with milk protein allergies. It is recommended for patients with dentinal sensitivity, enamel erosions, and salivary gland hypofunction. MI Paste can be applied using a prophylaxis cup, custom tray, or fingertip. In the extreme-risk patient, multiple applications throughout the day is strongly recommended, and could be an option for the high caries risk patient as well. It may also be used in the low- and moderate-risk patient, when excessive root exposure or sensitivity is present.

NOVAMIN (E.G., SOOTHERX)

NovaMin is an amorphous, calcium sodium-phosphosilicate that was developed as a fine particulate to physically occlude dentin tubules and reduce dentin hypersensitivity.^{46,47} The reaction of NovaMin particles begins when the material is subjected to an aqueous environment and calcium, sodium, and phosphate ions are released. This initial series of reactions

occurs within seconds of exposure, and the release of the calcium and phosphate ions continues so long as the particles are exposed to the aqueous environment.^{48,49} The combination of the residual NovaMin particles and a newly formed calcium phosphate layer results in the physical occlusion of dentinal tubules, which will relieve hypersensitivity.^{46,47} In one experimental gingivitis study, it was proposed that the material also possesses some local anti-inflammatory action as determined by a reduction in gingival inflammation.⁵⁰ Although it has been shown that NovaMin can form apatite-like calcium phosphate, and it is therefore very likely that this product will enhance remineralization in the mouth, but there is no published clinical evidence of this at the time of writing.

NovaMin is available in the form of a toothpaste called SootheRx or Oravive™, currently marketed for dentin sensitivity control.

Conclusion

There is a considerable research base for this bioactive glass product. It has been shown to reduce sensitivity and is likely to enhance remineralization clinically.

Application

The manufacturer suggests that initially it be used daily and eventually only once per week.

CARIFREE SYSTEM

The CariFree System is an early caries detection and treatment approach based on the infectious disease nature of dental caries. The system consists of a screening caries susceptibility test, a rapid bacterial test, a caries risk assessment form, and a unique antimicrobial home care product line to reduce the caries risk.

The home care products use two distinctive but simple strategies: 1) create a pH environment that both favors healthy normal flora rather than caries pathogens and establishes a physiologic pH in hyposalivary patients, and 2) combine synergistic products with already proven efficacy into two simple rinse protocols to increase patient acceptance.

Mutans streptococci has the ability to survive in low pH environments requiring

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the high production and uses of energy (adenosine triphosphate, ATP) to survive. Numerous studies have documented a significant relationship between ATP levels and colony forming units (CFUs) of many species of bacteria, and fungi in the mouth.⁵¹⁻⁵³ The CariScreen caries susceptibility screening test is a one-minute, real-time chairside screening test based on ATP bioluminescence that has shown to have a strong correlation between the ATP levels of the dental biofilm and the patient's CFUs of mutans streptococci.

The CariFree Caricult is a rapid culture for MS, from plaque that is incubated and read after only 12 to 24 hours. Based on the combined results of the screening tests, caries risk assessment form, and bacterial cultures, a diagnosis is made for the patient's caries risk level.

The CariFree product line also includes an oral breath spray with a pH of 9

(CariFree Boost) for patients with reduced salivary flow. The spray contains xylitol, moisturizing agents, calcium hydroxide, anthocyanins, polyphenol, flavoring, and buffering agents. It can be conveniently used throughout the day to relieve dryness and neutralize acid attacks as needed.

The CariFree oral care products are targeted specifically at the known traits of the cariogenic biofilm, the primary one being the pH drop from the acidic by-products of the sugar metabolism by the biofilm.⁵⁴ The CariFree products were designed to reverse the low pH and drive the selection pressure equation back toward health. The CariFree Treatment Rinse is a two-component short-term (two weeks) rinse involving a one-minute/one-time-per-day protocol for easy patient compliance. The active ingredient is 0.05 percent sodium fluoride at a pH of 11. (Decalcification occurs at approximately pH 5.5.) Other ingredients include calcium hydroxide, sodium hypochlorite, anthocyanins, polyphenol, flavoring, and buffering agents.

Once the patient has completed the CariFree Treatment Rinse cycle, they are placed on the CariFree Maintenance Rinse for long-term strategies. The Maintenance Rinse is a 0.05 percent sodium fluoride rinse with an elevated pH of 8. This rinse also contains xylitol, calcium hydroxide, anthocyanins, polyphenols, flavoring, and buffering agents. The patients can use the CariFree Maintenance Rinse on an ongoing basis as part of their remineralization and anticaries strategies. They are routinely tested at the end of one month of the rinse therapies for their caries susceptibility with the CariScreen test.

Conclusion

Although all of the above ingredients have been studied individually, they have not been studied collectively as the CariFree system. The culturing

methods and bioluminescence need to be validated. Therefore, more research is warranted on this promising approach.

Application

The CariFree Treatment Rinse (0.05 percent NaF rinse, pH 11) and Maintenance Rinse (0.05 percent NaF rinse, pH 8) could be used as substitutes for the 0.05 percent NaF rinses recommended for the moderate-, high- and extreme-risk patient. The CariFree Boost (0.05 percent NaF spray, pH 9) was developed for the extreme-risk patient.

Products of the Future

CARIES VACCINE

The quest to find a caries vaccine has been going on for more than three decades, but the fruits of this endeavor have been unmeritorious. Within the humoral system, antibodies produced in response to a vaccine have a pathway to travel to the site of the invading pathogen. The problem in the oral cavity is that antibodies in the blood system cannot transverse the oral mucosa to get to the mutans streptococci on the teeth. The one glimmer of hope with this approach is to immunize a child around one year of age, before *S. mutans* is transmitted from the child's mother or caregiver. Pediatric clinical trials are needed to validate this approach.⁵⁵

Mucosal immunization with an antigen made from an enzyme that allows *S. mutans* to attach to the tooth surface is another approach. Mucosal immunization is administered by a tonsillar or nasal topical spray.^{56,57} A clinical trial is currently being planned to test this modality.

Lastly, passive administration of antibody to epitopes (three-dimensional chemical groups on the surface of an antigen) of *S. mutans* has provided some degree of protection in small-scale hu-

man investigation.⁵⁵ In summary, the reality of some form of a caries vaccine faces significant scientific challenges and political hurdles that may take several decades before becoming a reality.⁵⁸

PROBIOTICS (REPLACEMENT THERAPY)

Probiotics is a new approach being developed to manage dental caries by selectively removing only the (odonto) pathogen while leaving the remainder of the

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oral ecosystem intact.⁵⁹ One of the better examples of this approach is a genetic manipulation being devised by Hillman and coworkers.⁶⁰ His group has genetically modified a *S. mutans* organism that no longer is capable of producing lactic acid, but can still survive in its ecological niche with the other wild-type *S. mutans*. In theory, when this modified organism is introduced into a host, it will completely displace the disease-causing *S. mutans* wild-type and prevent it from re-emerging as a pathogenic organism. Unfortunately this engineered strain still produces acetic acid and, in combination with lactic acid from other species such as the lactobacilli, may limit its success. Some human trials are currently underway with no results known at time of writing.

Another approach to reduce pathogen content is called "targeted antimicrobials" or specifically (or selectively) tar-

geted antimicrobial peptides (STAMPs).⁶¹ The basic idea is to develop a targeting molecule that will attach specifically to *S. mutans*. Then a killer molecule is chained to the targeting molecule and introduced into the oral cavity where it selectively eliminates the disease-causing *S. mutans*. Time will tell how successful this approach might be.

CHINESE MEDICINAL HERBS

As new pathogens emerge and old pathogens become resistant to current antibiotics, the search for new antibacterial compounds is accelerating and many old sources are being reconsidered. One logical source is Chinese medicinal herbs because of their proven ability to treat microbial infections. One specific group of herbs that may have therapeutic application in dentistry has been reported in studies by Qing Re Jie Du et al.⁶² He et al. conducted a systematic screening of this group of herbs and found that *Glycyrrhiza uralensis* (Chinese name "Gancao" or Chinese licorice) exhibited a strong antimicrobial activity against *S. mutans*.⁶³ This extract has been formulated into a lollipop and has been clinically tested in a limited human study with promising results. ■■■■

Conclusions

As the evidence base for the products described above evolves, so will our understanding of how and when they should be used. With time, new technologies will direct us into different approaches and interventions.

REFERENCES

1. Featherstone JDB, Adair SM, et al, Caries management by risk assessment: consensus statement, April 2002. *J Calif Dent Assoc* 31(3):257-69, March 2003.
2. Greenstein G, Berman C, Jaffin R, Chlorhexidine. An adjunct to periodontal therapy. *J Periodontol* 57(6):370-7, 1986.
3. Anderson MH, A review of the efficacy of chlorhexidine on dental caries and the caries infection. *J Calif Dent Assoc* 31(3):211-4, March 2003.

4. Zickert I, Emilson CG, Krasse B, Effect of caries preventive measures in children highly infected with the bacterium *Streptococcus mutans*. *Arch Oral Biol* 27(10):861-8, 1982.
5. Zickert I, Emilson CG, Krasse B, Microbial conditions and caries increment two years after discontinuation of controlled antimicrobial measures in Swedish teenagers. *Community Dent Oral Epidemiol* 15:241-4, 1987.
6. Schaeken MJ, de Jong MH, et al, Effect of chlorhexidine and iodine on the composition of the human dental plaque flora. *Caries Res* 18:401-7, 1984.
7. Wyatt CCL, MacEntee MI, Caries management for institutionalized elders using fluoride and chlorhexidine mouthrinses. *Community Dent Oral Epidemiol* 32:322-8, 2004.
8. Persson RE, Truelove EL, et al, Therapeutic effects of daily or weekly chlorhexidine rinsing on oral health of a geriatric populations. *Oral Surg Oral Med Oral Pathol* 72(2):184-91, 1991.
9. Eldridge KR, Finnie SF, et al, Efficacy of an alcohol-free chlorhexidine mouthrinse as an antimicrobial agent. *J Prosthet Dent* 80:685-90, 1998.
10. Borrajo JLL, Varela LG, et al, Efficacy of chlorhexidine mouthrinses with and without alcohol: a clinical study. *J Periodontol* 73:317-21, 2002.
11. Quirynen M, Teughels W, De Soete M, van Steenberghe D, Topical antiseptics and antibiotics in the initial therapy of chronic adult periodontitis: microbiological aspects. *Periodontol* 2000 28:72-90, 2002.
12. DenBesten P, Berkowitz R, Early childhood caries: an overview with reference to our experience in California. *J Calif Dent Assoc* 31(2):139-43, February 2003.
13. Gibbons RJ, DePaola PF, et al, Interdental localization of *Streptococcus mutans* as related to dental caries experience. *Infect Immun* 9:481-8, 1974.
14. Caufield PW, Gibbons RJ, Suppression of *Streptococcus mutans* in the mouth of humans by a dental prophylaxis and topically applied iodine. *J Dent Res* 58(4):1317-26, 1979.
15. Lopez L, Berkowitz R, et al, Topical antimicrobial therapy in the prevention of early childhood caries. *Pediatr Dent* 21(1):9-11, 1999.
16. Amin MS, Harrison RL, et al, Effect of povidone-iodine on *Streptococcus mutans* in children with extensive dental caries. *Pediatr Dent* 26(1):5-10, 2004.
17. Zhan L, Featherstone JDB, et al, Antibacterial treatment needed for severe early childhood caries. *J Public Health Dent* 66(3):174-79, 2006.
18. El-Housseiny A, Farsi N, The effectiveness of two antibacterial regimens on salivary mutans streptococci and lactobacilli in children. *J Clin Pediatr Dent* 30(2):145-52, 2005.
19. Centers for Disease Control and Prevention. Recommendations for using fluoride to prevent and control dental caries in the United States. 50(No. RR-14):13-28, *MMWR* 2001.
20. Pendrys DG, Risk of fluorosis in a fluoridated population. Implications for the dentist and hygienist. *J Am Dent Assoc* 126(12):1617-24, December 1995.
21. Baysan A, Lynch E, et al, Reversal of primary root caries using dentifrices containing 5,000 and 1,100 ppm fluoride. *Caries Res* 35(1):41-6, 2001.
22. Petersson LG, Twetman S, et al, Professional fluoride varnish treatment for caries control: a systematic review of clinical trials. *Acta Odontol Scand* 62(3):170-6, 2004.
23. Weintraub JA, Ramos-Gomez F, et al, Fluoride varnish efficacy in preventing early childhood caries. *J Dent Res* 85(2):172-6, 2006.
24. ADA Council on Scientific Affairs. Professionally applied topical fluoride. Executive summary of evidence-based clinical recommendations. American Dental Association, May 2006. www.ada.org/goto/ebd
25. Lynch H, Milgrom P, Xylitol and dental caries: an overview for clinicians. *J Calif Dent Assoc* 31(3):205-8, March 2003.
26. Toors FA, Chewing gum and dental health. Literature review. *Rev Belge Med Dent* 47(3):67-2, 1992.
27. Soderling E, Isokangas P, et al, Long-term xylitol consumption and mutans streptococci in plaque and saliva. *Caries Res* 25:153-7, 1991.
28. Makinen KK, Bennett CA, et al, Xylitol chewing gums and caries rates: a 40-month cohort study. *J Dent Res* 74(12):1904-13, 1995.
29. Makinen KK, Makinen PL, et al, Stabilisation of rampant caries: polyol gums and arrest of dentine caries in two long-term cohort studies in young subjects. *Int Dent J* 45(1 Suppl 1):93-107, 1995.
30. Kleinberg I, Salivary control of the composition and metabolism of dental plaque. Chapter 10 (page 212) IN Sreebny LM (ed.) *The Salivary System*. CRC Press, Inc.: Boca Raton, Fla., 1987.
31. S-Gavvenmade EJ, Panders AK, Clinical applications of saliva substitutes. *Front Oral Physiol* 3:154-62, 1981.
32. Wynn RL, Meiller TF, Crossley HL, *Drug Information Handbook for Dentistry*, 12th ed., Lexi-Comp, Ohio, pp 1816-7, 2006.
33. Newbrun E, The use of sodium bicarbonate in oral hygiene products and practice. *Compend Contin Educ Dent Suppl* 17(19):S2-7, 1996.
34. Dawes C, Effect of a bicarbonate-containing dentifrice on pH changes in a gel-stabilized plaque after exposure to sucrose. *Compend Contin Educ Dent Suppl* 17(19):S8-10, 1996.
35. Kashket S, Yaskell T, Effects of a high-bicarbonate dentifrice on intraoral demineralization. *Compend Contin Educ Dent Suppl* 17(19):S11-6, 1996.
36. Koertge TE, Management of dental staining: can low-abrasive dentifrices play a role? *Compend Contin Educ Dent Suppl* 17(19):S33-8, 1996.
37. Acevedo AM, Machado C, et al, The inhibitory effect of an arginine bicarbonate/calcium carbonate CaviStat-containing dentifrice on the development of dental caries in Venezuelan school children. *J Clin Dent* 16(3):63-70, 2005.
38. Sims KM, Oral pain and discomfort. In, Berardi RR, DeSimone EM, et al, eds. *Handbook of Nonprescription Drugs*. Washington, D.C., American Pharmaceutical Association, pp 647-76, 2002.
39. Yagiela J, Agents affecting salivation. In, *ADA/PDR Guide to Dental Therapeutics*. Chicago, ADA, pp 251-62, 2006.
40. Corcoran RA, Stovell AG, et al, Evaluation of a combined polymer system for use in relieving the symptoms of xerostomia. *J Clin Dent* 17(spec issue): 34-8, 2006.
41. Shirodaria S, Kilbourn T, et al, Subjective assessment of a new moisturizing mouthwash for the symptomatic management of dry mouth. *J Clin Dent* 17(2):39-44, 2006.
42. Kroll B, Dry mouth. The pharmacist's role in managing radiation-induced xerostomia. *Pharma Pract* 14:72-82, 1998.
43. Merritt J, Qi F, Shi W, Milk helps build strong teeth and promotes oral health. *J Calif Dent Assoc* 34(5):361-6, May 2006.
44. Reynolds EC, Remineralization of enamel subsurface lesions by casein phosphopeptide-stabilized calcium phosphate solutions. *J Dent Res* 76:1587-95, 1997.
45. Young DA, Managing caries in the 21st century: today's terminology to treat yesterday's disease. *J Calif Dent Assoc* 34(5):367-70, May 2006.
46. Jennings DT, McKenzie KM, et al, Quantitative analysis of tubule occlusion using NovaMin (sodium calcium phosphosilicate). *J Dent Res* 83(spec issue A):2416, 2004.
47. Du MQ, Tai BJ, et al, Efficacy of dentifrice containing bioactive glass (NovaMin) on dentine hypersensitivity. *J Dent Res* 83(spec issue A):1546, 2004.
48. Andersson OH, Kangasniemi I, Calcium phosphate formation at the surface of bioactive glass in vitro. *J Biomed Mater Res* 25:1019-30, 1991.
49. Zhong JP, Feng JW, Greenspan DC, A microstructural examination of apatite induced by Bioglass in vitro. *J Mater Sci: Mater in Med* 13:321-6, 2002.
50. Eberhard J, Reimers N, et al, The effect of the topical administration of bioactive glass on inflammatory markers of human experimental gingivitis. *Biomaterials* 26:1545-51, 2004.
51. Nikawa H, Hamada T, et al, The effect of saliva or serum on *Streptococcus mutans* and *Candida albicans* colonization of hydroxylapatite beads. *J Dent* 26(1):31-7, 1998.
52. Ramji N, Donovan-Brand R, et al, ATP bioluminescence: a tool to measure clinical efficacy of topical oral antimicrobials. *J Dent Res* 81(spec issue A): abstr no. 4042, 2002 (www.dentalresearch.org).
53. Jin Y, Samaranyake Y, Yip HK, Biofilm formation of *Candida albicans* is variably affected by saliva and dietary sugars. *Arch Oral Biol* 49(10):789-98, October 2004.
54. Marsh PD, Dental plaque as a biofilm and microbial community - implications for health and disease. *BMC Oral Health* 6 Suppl:S14, 2006.
55. Smith J, Caries vaccines for the 21st century. *J Dent Educ* 67(10):1130-39, 2003.
56. Childers NK, Tong G, et al, Humans immunized with *Streptococcus mutans* antigens by mucosal routes. *J Dent Res* 81(1):48-52, 2002.
57. Russell MW, Childers NK, et al, A caries vaccine? The state of the science of immunization against dental caries. *Caries Res* 38(3):230-5, 2004.
58. Anusavice KJ, Present and future approaches for the control of caries. *J Dent Educ* 69(5):538-54, 2005.
59. Anderson MH, Shi W, A probiotic approach to caries management. *Pediatr Dent* 28(2):151-3; discussion 192-8, 2006.
60. Hillman JD, Genetically modified *Streptococcus mutans* for the prevention of dental caries. *Antonie Van Leeuwenhoek* 82(1-4):361-6, 2002.
61. Eckert R, He J, et al, Targeted killing of *Streptococcus mutans* by a pheromone-guided "smart" antimicrobial peptide. *Antimicrob Agents Chemother* 50(11):3651-7, 2006.
62. Chen L, Cheng X, et al, Letters to the Editor. Inhibition of growth of *Streptococcus mutans*, methicillin-resistant *Staphylococcus aureus*, and vancomycin-resistant enterococci by kurarinone, a bioactive flavonoid isolated from *Sophora flavescens*. *J Clin Microbiol* 43(7):3574-5, 2005.
63. He J, Chen L, et al, Antibacterial compounds from glycyrrhiza uralensis. *J Nat Prod* 69(1):121-4, 2006.

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Dental Spa-ahhhhh



The anti-aging facial alone at \$125 might not be a covered benefit, but, as L'Oréal says, "You're worth it."

→ Robert E. Horseman, DDS

ILLUSTRATION
BY CHARLIE O.
HAYWARD

Back in May of 2002 when we first reported the existence of a new dental phenomenon called "The Dental Spa," it was with a soupçon of disbelief. No, more than that — like forehead-smiting with overtones of guffaws and confident predictions of dental spas going the way of drive-in churches within six months.

This was based on our conviction that the average dental patient's overriding concern with his or her visit was that it be swift and painless with the earliest exit possible. That they didn't want to be there was a given and, in fact, we freely acknowledged there were days when we didn't want to be there ourselves. Whether due to ingestion of current anti-anxiety medications or the less-efficient application — from the operator's standpoint — of a stiff upper lip, we and our patients still managed to muddle through the

day with those hovering on the brink of syncope soldiering on manfully.

In our little corner of the dental world, the dentists that we know surveyed their premises they had painstakingly updated with every new gadget they could afford and several they couldn't. Most of us came to the conclusion the dental spa was a crackpot idea we could conscientiously avoid along with a tanning bed and an auxiliary hairstylist and shoeshine boy.

Apparently we were wrong. The dental spa concept has not slunk off into the sunset accompanied by howls of derision. At least, that's the word coming out of Hilton Head, S.C., as reported by Peter Frost of McClatchy Newspapers. Frost relays the news that Dr. James Canham, owner of Southern Smiles on Hilton Head Island, installed a full-service spa last

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February. Canham is quoted as saying his hygienist, Elizabeth Kirby, got the idea while attending esthetician school last fall. Before you send your hygienist off to esthetician school, assuming you can find one, listen to Stacy Dragulescu, Southern Smiles chief financial officer, "We're really trying to take the tension away from patients so they don't feel like they're going to the dentist."

Ah! Therein lies the rub, Stacy; they **are** going to the dentist and they know it. They can see right through those cucumber slices and recognize a dental agenda lurking behind all this frou-frou.

Nevertheless, the fact that the practice needs a chief financial officer seems to indicate the venture is a success. If so, there will be a scramble for Northern Smiles, Western Smiles, Midwest Smiles, etc., franchises that will make the Oklahoma Land Rush of 1889 look like a stroll in the park.

Looking back, it is small wonder that Hilton Head dentist had to have his attention called to the potential bonanza of the dental spa by his hygienist. The typical male, offered a menu that included botox injections, facials, and collagen treatments along with eyebrow waxing and hand and arm massaging, might decide to reschedule, showing a clean pair of heels. But Kirby the hygienist and Canham the dentist suspect they are on a roll and have formed a new company called Absolute Skincare operating in the same office, according to Frost the reporter. No telling what would happen if you arrived announcing that you wanted to avail yourself of "the works." The anti-aging facial alone at \$125 might not be a covered benefit, but, as L'Oréal says, "You're worth it."

A 2004 survey by the ADA and Colgate-Palmolive Company found that less

than 5 percent of dental offices offered amenities above and beyond the usual music/TV/Kleenex/anesthesia available in the other 95 percent. Our thought is tattoo parlors are doing a land office business with applications that pretty much last a lifetime, even if sobriety isn't a factor and discomfort and massive regrets are frequent companions.

It is not too late to jump aboard the feel-good dental spa bandwagon where the results of pampering are good for upward of 48 hours. Sipping a good vintage from the Napa Valley is nearly

as intoxicating as the relaxing scents of lavender and tangerine that waft over your masseur's soothing small talk. We'll wait for you.

In the meantime, we installed a small, relaxing waterfall thing we bought at Costco for \$24.95 as an initial entry into the magical world that lies ahead. The only response to the merry tinkling of the waterfall other than a puddle on the floor, has been an increase in requests for the restroom key. We will schedule a deep-wallet massage to ascertain the next step. ■■■■