The Role of Dental Hygiene in Caries Management: A New Paradigm

Douglas A. Young, DDS, MS, MBA; Lucinda Lyon RDH, DDS, EdD; Shelly Azevedo, RDH, BS, MS

Abstract

Purpose: Dental caries is the most common disease of children and remains a significant oral health problem worldwide for both children and adults. The traditional paradigm of treating dental caries solely by "drilling and filling," brushing and flossing and lowering sugar intake has evolved. Current science in the management of dental caries suggests a clear focus on the reduction of responsible infectious agents, remineralization of non–cavitated lesions and minimally invasive restorative approaches whenever possible. The paradigm shift is away from a purely surgical approach toward more preventive and curative clinical protocols. This paper provides a review of this caries management methodology and explores the role of the dental hygienist in this paradigm change.

Key words: caries balance, CAMBRA, remineralization, non–cavitated lesion, minimally invasive dentistry

This study supports the NDHRA priority area, Clinical Dental Hygiene Care: Assess how dental hygienists are using emerging science throughout the dental hygiene process of care; Investigate how dental hygienists use emerging science to reduce risk in susceptible patients (risk reduction strategies).

The Role of Dental Hygiene in Caries Management

The concept of prevention as the most ideal approach to caries reduction is not new to dental hygiene. It was this very idea that motivated Dr. Alfred Fones to create the school which graduated the first formally educated dental hygienists in 1914. In addition to providing clinical instrumentation, the larger historical role of dental hygiene has been in helping to prevent dental disease through education. This has been accomplished primarily by an emphasis on removal of biofilm by mechanical means including brushing, flossing, tongue scraping and, in more recent years, chemotherapeutic modalities. Data has shown that these strategies are proven to be beneficial in patients with oral biofilm control problems. However, the majority of adults do not follow an adequate home–care routine. Average brushing times are low, and only a minority of patients regularly floss. The advantages of topical fluoride in a variety of forms has been firmly established. In 2001 the Center for Disease Control and Prevention (CDC) advised that it was beneficial for patients of all ages to drink water with optimal fluoride concentration and brush twice daily with a fluoridated toothpaste. Since then, the CDC has reported that “nearly 70% of U.S. residents who get water from public water systems now have fluoridated water.” The percent of caries reduction from topical fluoride varies depending on when the study was conducted and the type and frequency of fluoride used. A meta–analysis consisting of 8 studies using fluoride varnish conducted by Helfenstein demonstrated an overall reduction of 38% in dental caries. Regular fluoride application has been delivered in the dental office as a preventive measure or as additional therapy for higher risk patients. However, a survey of 498 dental hygienists in the United States in 2000 revealed that, although a majority of respondents recognized that adults, including a growing number of geriatric patients with patterns of root caries, could benefit from topical fluoride application, the dental hygienists were not consistently offering this treatment in their practices. The degree to which the historically low rate of third party reimbursement for preventive services contributed to the findings of this survey was not explored. Data regarding use of fluoride varnishes were not included in this survey.

Dental sealants, often placed by the dental hygienist, provide a clear benefit to prevention of occlusal carious lesions. A recent report of the American Dental Association Council on Scientific Affairs noted that glass ionomer sealants are an option for consideration when isolation is
compromised. To further improve the cost–benefit ratio of sealant treatment, the American Academy of Pediatric Dentistry has discussed a risk–based use of sealants. Despite the considerable benefits of sealants, the long–term success of sealant therapy is dependent upon consistent follow up and repair when necessary. One–time sealant placement does not impart long–term caries protection unless the sealant remains in place and intact. Dental hygienists have played an important part in the ongoing assessment of sealant integrity by evaluation at regular dental hygiene re–care visits.

Given the fact that ingestion of sugars and other fermentable carbohydrates at high frequency plays a pivotal role in caries development, dental hygienists have utilized dietary counseling and home care instruction for many years with the hope of helping patients reduce or restrict related acid exposures. However, today’s reality is that Americans are consuming sugars in record amounts. In 2007 the average American consumed 100.6 pounds of sugar per year, or 1.9 pounds per week. Annual soft drink consumption in 2005 reached nearly 54 gallons per capita, or slightly more than 1 gallon per week per person, bringing with it a host of nutritional, as well as dental, concerns. These trends were confirmed by a study comparing consumption of sugar sweetened beverages by adolescents via NHANES data during the years 1988 to 1994 and 1999 to 2004. This data confirmed that adolescents from the 1999 to 2004 study cohort consumed approximately 7% more sugar sweetened beverage serving equivalents per day.

Although mechanical biofilm removal, fluoride, dental sealants and nutritional counseling have all been vitally important parts of disease prevention, they have not yielded the level of caries risk reduction that oral health care providers have been searching for on behalf of our patients. Current science suggests that there are updated treatment protocols based on the medical model of disease assessment and management, which can improve the oral health of patients.

The Science and Implementation of Caries Management by Risk Assessment into Practice

The traditional method of treating dental caries was to restore resulting damage to tooth structure and return the dentition to proper form and function. In this model preventive measures often only included oral hygiene instruction and reminding the patient not to ingest refined sugar. Over the last 2 decades, science has revealed that the caries process and treatment is more complex than can be managed by this traditional model alone.

Caries management by risk assessment (CAMBRA) is an evidence–based approach to preventing, reversing and, when necessary, repairing early damage to teeth us-
ing minimally invasive restorative techniques. In contrast to traditional management, this contemporary model places emphasis on the whole disease process, rather than just the cavitated stage of lesion progression. A number of organizations have developed protocols based on this assessment, diagnosis and treatment methodology. Among them are the American Dental Association, the American Academy of Pediatric Dentists and the California Dental Association (CDA), which dedicated 4 complete journals to the subject. The first 2 issues of the CDA Journal, February and March 2003, summarized the current science of caries management. In October and November 2007, 2 additional issues were published, which focused on practical implementation of caries management by risk assessment. The CDA has generously made these journals available online (www.cdafoundation.org/journal). The October 2007 issue contains caries risk assessment forms for both the pediatric and adult patients, protocols and product examples that can be downloaded for use in practice. The November issue may be of particular interest to dental hygienists as it contains articles addressing the role of allied health professionals in implementation. All 4 of these journal issues may be downloaded for additional CAMBRA information and to access forms, tables and figures for use in practice.

CAMBRA differs from the traditional restorative approach in treating dental decay by assessing each stage of lesion progression. A number of organizations have developed protocols based on this assessment, diagnosis and treatment methodology. Among them are the American Dental Association, the American Academy of Pediatric Dentists and the California Dental Association (CDA), which dedicated 4 complete journals to the subject. The first 2 issues of the CDA Journal, February and March 2003, summarized the current science of caries management. In October and November 2007, 2 additional issues were published, which focused on practical implementation of caries management by risk assessment. The CDA has generously made these journals available online (www.cdafoundation.org/journal). The October 2007 issue contains caries risk assessment forms for both the pediatric and adult patients, protocols and product examples that can be downloaded for use in practice. The November issue may be of particular interest to dental hygienists as it contains articles addressing the role of allied health professionals in implementation. All 4 of these journal issues may be downloaded for additional CAMBRA information and to access forms, tables and figures for use in practice.

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patient for their unique individual risk factors, using the caries balance method first described by Featherstone. Figure 1 illustrates the analogy of the “balance,” where disease indicators and pathogenic factors of a patient are weighed against the competing protective factors. The dynamic interaction of these 2 sides of the balance determines risk for future disease. By evaluating the caries balance of a patient, a clinician can determine what behaviors are increasing a patient’s risk for disease and take corrective action. This strategy lead to the development of an evidence-based questionnaire form to measure caries risk and to determine effective treatment options based on that risk (Table 1). Utilizing this new protocol, it has become possible to develop a treatment plan designed to reduce cavitation, arrest decay by stopping demineralization or reverse the caries process via remineralization. The CAMBRA approach has proven successful in a recent blinded randomized clinical trial when compared to the traditional restorative approach.

### Table 2: Caries Management by Risk Assessment (CAMBRA) Criteria

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Frequency of Radiographs</th>
<th>Frequency of Recall Exams</th>
<th>SalivaTest (Saliva Flow &amp; Bacterial Culture)</th>
<th>Antimicrobials Care Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Risk</td>
<td>Bitewing radiographs every 24–36 months</td>
<td>Every 6–12 months to reevaluate caries risk.</td>
<td>May be done as a baseline reference for new patients</td>
<td>Per saliva test if done</td>
</tr>
<tr>
<td>Moderate Risk</td>
<td>Bitewing radiographs every 18–24 months</td>
<td>Every 4–6 months to reevaluate caries risk.</td>
<td>May be done as a baseline reference for new patients or if there is suspicion of high bacterial challenge and to assess efficacy and patient cooperation.</td>
<td>Chlorhexidine gluconate 10 ml rinse for one daily for one week every month. Xylitol (6–10 grams/day) gum or candies. Two to three candies four times per day.</td>
</tr>
<tr>
<td>High Risk*</td>
<td>Bitewing radiographs every 6–18 months or until no cavitated lesions are evident.</td>
<td>Every 3–4 months to reevaluate caries risk and apply fluoride varnish.</td>
<td>Saliva flow test and Bacterial culture initially and at every caries recall appt. to assess efficacy and patient cooperation.</td>
<td>Chlorhexidine gluconate 0.12% CHX in water base rinse for one minute daily for one week each month. (6–10 grams/day) gum or candies. Two to three candies four times per day.</td>
</tr>
<tr>
<td>Extreme Risk** (High risk plus dry mouth)</td>
<td>Bitewing radiographs every 6 months or until no cavitated lesions are evident.</td>
<td>Every 3 months to reevaluate caries risk and apply fluoride varnish.</td>
<td>Saliva flow test and bacterial culture initially and at every caries recall appt. to assess efficacy and patient cooperation.</td>
<td>Chlorhexidine gluconate 0.12% CHX in water base rinse for one minute daily for one week each month. (6–10 grams/day) gum or candies. Two to three candies four times per day.</td>
</tr>
</tbody>
</table>

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

### How the Dental Hygienist May Implement CAMBRA

In this new paradigm of caries management, CAMBRA includes innovative procedures such as saliva assessment, bacterial culturing, a broader choice of therapeutic interventions and ongoing patient data collection (caries risk assessment) to properly diagnose and manage the disease of caries. These duties are best implemented utilizing a dental team approach. A dental assistant trained in CAMBRA protocol may assist patients with the caries risk assessment form (Table 1), collect diagnostic data (including salivary testing) and provide initial patient education. The dental hygienist may play a key role in planning treatment recommendations based on the dental hygiene examination and data provided by CAMBRA diagnosis and assessment tools. As with all other areas of preventive care, dental hygienists should be actively involved in using the evidence gathered to determine an intervention plan including treatment and products unique to the patient’s caries risk and caries balance, establishment of ongoing care frequency, reinforcement of at–home protocol implementation and treatment modifications based on future assessment or reevaluation.

An example of how an intervention plan may be developed based upon the caries risk of the patient was recently published by Jenson4 and is summarized in Table 2. This table suggests how the appropriateness of different interventions such
Clinical Guidelines for Patients 6 years and Older

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Frequency of Recall</th>
<th>Fluoride</th>
<th>pH Control</th>
<th>Calcium Phosphate</th>
<th>Topical Supplements</th>
<th>Sealants (Resin-based or Glass Ionomer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Risk</td>
<td>Monthly</td>
<td>OTC fluoride–containing toothpaste twice daily.</td>
<td>Not Required</td>
<td>Not Required</td>
<td>Optional</td>
<td></td>
</tr>
<tr>
<td>Medium Risk</td>
<td>Every 3–6 months</td>
<td>OTC fluoride–containing toothpaste twice daily plus: 0.05% NaF rinse daily.</td>
<td>Not Required</td>
<td>Not Required</td>
<td>Optional</td>
<td></td>
</tr>
<tr>
<td>High Risk</td>
<td>Every 1–3 months</td>
<td>OTC fluoride–containing toothpaste twice daily plus: 0.05% NaF rinse daily.</td>
<td>Not Required</td>
<td>Not Required</td>
<td>As per ICDAS Sealant Protocol</td>
<td></td>
</tr>
</tbody>
</table>

**Resin-based and severe xerostomia are extreme risk patient.** 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.

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

As frequency of radiographs and periodic exams, saliva test, antibacterials, topical fluoride, pH control, calcium phosphate and sealants may vary depending on caries risk of the patient.

The following is a brief summary of some of products commonly used to intervene in the caries process:

- **Topical fluoride:** over–the–counter (OTC) and prescription high fluoride containing dentifrices such as Prevident (Colgate Oral Pharmaceuticals, New York, NY) or Control Rx (3M ESPE, St. Paul, MN), OTC 0.05% sodium fluoride rinses such as Act (ACT Products, Chattanooga, TN) or Fluorigard (Colgate Oral Pharmaceuticals, New York, NY), prescription 0.2% sodium fluoride rinses such as Oral–B Fluorinse (Procter & Gamble Company, Cincinnati, Ohio) and high concentration 5% sodium fluoride varnish such as Duraflor (A.R. Medicom Inc., Lachine, Quebec) or Vanish (3M ESPE, St. Paul, MN).
- **Resin–based and Glass Ionomer Sealants:** Resin based materials are retained via a micro–mechanical bond. Glass Ionomer sealants utilize a chemical ion exchange bond and have fluoride releasing properties.
- **Xylitol products** such as chewing gum and mints have been shown to reduce dental caries and the vertical transmission of caries pathogens from mother to child.
- **Antibacterials** may include agents such as chlorhexidine, (Periogard, Colgate Oral Pharmaceuticals, New York, NY) or Peridex, 3M ESPE, St. Paul, MN) or iodine such as Betadine (Purdue Products, Stamford, CT).
- **Calcium–phosphate based products** may be used for sensitivity, remineralization and for patients with reduced salivary flow.
- **pH neutralizing products,** such as sodium bicarbonate rinses, CariFree rinses and neutralizing gel, Denclude desensitizing toothpaste (Colgate Oral Pharmaceuticals, New York, NY) and ProClude desensitizing prophylaxis paste (Colgate Oral Pharmaceuticals, New York, NY) may aid in combating acidity when salivary flow is reduced.
- **Emerging products** such as casein phosphopeptide (CCP) and amorphous calcium phosphate (ACP) products (MI Paste, GC America, Inc. Alsip, IL) have been demonstrated to show delivery of calcium and phosphate to enamel surfaces and amorphous, calcium sodium–phosphosilicate (NoveMin, NovaMin Technology Inc, Alachua, FL) to aid in fortifying tooth structure. The CariFree system (Oral Biotech, Albany OR) presents...
a combination of tools to screen for caries susceptibility, and facilitate rapid bacterial testing. This brief list of products provides only a few examples of those available.

The growing variety of caries-related interventions requires a well-trained CAMBRA team. Given the dental hygienist’s training in evidence-based evaluation of preventive care strategies and products, additional opportunity to bring knowledge and training to the dental team has presented itself with this new treatment philosophy.

For effective management of caries as a curable, preventable infectious disease, caries activity and caries risk must be assessed at regular intervals and the severity of lesion progression monitored so that treatment methods can be adjusted accordingly for ideal results.31 Though this risk assessment approach differs somewhat with how dentistry has historically viewed and structured compensation for dental services, third party carriers are beginning to see the benefit of this model and compensate accordingly. The ADA Current Dental Terminology book (CDT7) for 2007 to 2008 contains codes for a number of preventive services, including Caries Susceptibility Testing (D 0425), Bacteriology Studies (D 0415), Oral Evaluation Patient (less than 3 years), Counseling Primary Caregiver (D0145) and Topical Fluoride Application for Therapeutic Measures Moderate to High-risk Caries Patient (D 1206). From a business standpoint, CAMBRA protocol has been recognized as good for both practices and patients.24

Table 3: Occlusal Protocol***

<table>
<thead>
<tr>
<th>ICDAS code</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definitions</td>
<td>Sound tooth surface; no caries change after air drying (5 sec); or hypoplasia, wear, erosion and other non–caries phenomena.</td>
<td>First visual change in enamel; seen only after air drying, or colored change “thin” limited to the confines of the pit and fissure area.</td>
<td>Distinct visual change in enamel; seen when wet, white or colored, “wider” than the fissure/fossa.</td>
</tr>
<tr>
<td>Histologic Depth</td>
<td>Lesion depth in P/F was 90% in the outer enamel with only 10% into dentin.</td>
<td>Lesion depth in P/F was 50% inner enamel and 50% into the outer 1/3 dentin)/</td>
<td>Lesion depth in P/F with 77% in dentin.</td>
</tr>
<tr>
<td>Sealant/ restoration Recommendation for Low Risk</td>
<td>Sealant Optional DIAGNOdent may be helpful</td>
<td>Sealant Optional DIAGNOdent may be helpful</td>
<td>Sealant Optional or Caries Biopsy if DIAGNOdent is 20–30</td>
</tr>
<tr>
<td>Sealant/ restoration Recommendation for Moderate Risk</td>
<td>Sealant Optional DIAGNOdent may be helpful</td>
<td>Sealant Recommended DIAGNOdent may be helpful</td>
<td>Sealant Recommended or Caries Biopsy if DIAGNOdent is 20–30</td>
</tr>
<tr>
<td>Sealant/ restoration Recommendation for High Risk *</td>
<td>Sealant Recommended DIAGNOdent may be helpful</td>
<td>Sealant Recommended DIAGNOdent may be helpful</td>
<td>Sealant Recommended or Caries Biopsy if DIAGNOdent is 20–30</td>
</tr>
<tr>
<td>Sealant/ restoration Recommendation for Extreme Risk **</td>
<td>Sealant Recommended DIAGNOdent may be helpful</td>
<td>Sealant Recommended DIAGNOdent may be helpful</td>
<td>Sealant Recommended or Caries Biopsy if DIAGNOdent is 20–30</td>
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* 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 with 88% into dentin. The growing variety of caries–related interventions has been recognized not possible. Patients should be given a choice in material selection.

Describing different stages of occlusal decay can be problematic due to the morphology of pits and fissures. A recently proposed nomenclature system, the International Caries Detection and Assessment System (ICDAS), has been created to aid in such description and treatment planning (Table 2). For example, the occlusal pits and fissures are coded based on appearance using a numeric code from 0 to 6 that correlates clinical appearance with a definition that has been documented histologically.44 Jenson et al published a protocol using this ICDAS information based on the caries risk of the patient which may help guide the clinician in their treatment planning decisions (Table 3).18

Included in Table 3 is laser fluorescence technology, which can be
Table 3: Occlusal Protocol

<table>
<thead>
<tr>
<th>Risk</th>
<th>ICDAS code</th>
<th>Depth</th>
<th>Lesion depth in P/F</th>
<th>Sealant or Minimally invasive restoration needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Risk</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recommendation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Sealant = Helpful
- Sealant Optional = Needed
- Minimally invasive restoration = Recommended
- Minimally invasive restoration (if DIAGNOdent is 90% in the outer 1/3 dentin)/ enamel and 50% into the outer 1/3 dentin)/ or 50% in dentin.
- Minimally invasive restoration (if DIAGNOdent is 100% reaching inner 1/3 dentin)

- Lesion depth in P/F was 90% in the outer 1/3 dentin)/ enamel and 50% into the outer 1/3 dentin)/ or 50% in dentin.
- Lesion depth in P/F was 100% in dentin.
- Lesion depth in P/F with 100% in dentin.

- Localized enamel breakdown, with no visible dentin or underlying 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

Lesion(s) and xerostomia are extreme risk patients

As with any care a practice provides, the entire dental team must understand and support the CAMBRA treatment methodology for it to be truly successful. The dental hygiene profession has a significant opportunity to move this new information forward by demonstrating the professional roles of educators, researchers, clinicians and advocates of change on behalf of our patients.

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The Contemporary Role of the Preventive Team

Implementing CAMBRA protocols in dental hygiene practice has provided a format for individualized treatment based upon a risk-assessment. A collaborative team of the dental hygienist, trained assistant and dentist is believed to have the greatest ability to successfully initate CAMBRA protocols in the practice. Referral relationships with nutritional counselors, nutritionists or registered dieticians may also be beneficial and productive. Together, these allied health professionals, working with the dentist, may take responsibility for review of the medical history, risk assessment, radiographs, intraoral photos, saliva assessment and bacterial testing, treatment planning, patient education, fluoride varnish, sealants and recommendation of appropriate home care regimens. Using the team approach in delivering these services is the foundation for moving towards a more comprehensive and individualized treatment plan for the patient.

Successful integration of CAMBRA depends not just on the dental hygienist, but the entire practice. The key to successful implementation is educating the patients and team in the value of prevention and early therapeutic intervention. The dental hygienist’s role in clinical practice has always supported and encouraged behavioral changes that will last a lifetime. Integrating CAMBRA into the dental hygiene process of care is a natural progression of evidence-based practice.

As with any care a practice provides, the entire dental team must understand and support the CAMBRA treatment methodology for it to be truly successful. The dental hygiene profession has a significant opportunity to move this new information forward by demonstrating the professional roles of educators, researchers, clinicians and advocates of change on behalf of our patients.
Integrating significant paradigm shifts in treatment philosophy and methodology is challenging. However, most professionals will agree that the concepts of dental disease and the practice standards for treating it are vastly different today than they were even 10 years ago. Dental hygienists can be leaders in the implementation of CAMBRA. In doing so, we honor the past as dentistry’s first preventive care “specialists” and contribute to a future of exciting new preventive strategies and improved patient oral health outcomes.

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References


