Evidence-Based Dentistry

Caries Risk Assessment/Treatment Programs in U.S. Dental Schools: An Eleven-Year Follow-Up

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Abstract: The purpose of this survey was to identify the number and characteristics of caries risk assessment/treatment (CRA/Tx) programs in U.S. dental schools in 2009 and compare the results to those of the 1998 survey. A survey of U.S. dental schools was conducted in 2009 using the same eleven-question survey instrument as in 1998. Results were analyzed using stratified random sampling and chi-square tests for six of the questions. Additionally, data from the other questions were directly compared. Two questions showed a statistically significant difference: an increase in programs supervised by one school department and the number of schools using CRA as a graduation requirement. Positive changes are occurring in the development of CRA/Tx programs in U.S. dental schools. A wide variety of approaches to teaching this subject, including use of terminology and treatment philosophies, is evident. The evolution of this subject has been slow and varied over the past eleven years. Changing from a mainly surgical approach model to a medical model is occurring, but a more integrated method is needed to clarify terminology, diagnosis, treatment, and communications with researchers, clinicians, teachers, patients, and third-party payers.

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Keywords: caries risk assessment programs, caries treatment, caries diagnosis, dental education

Submitted for publication 4/14/10; accepted 7/27/10

The philosophy of teaching dental caries management and prevention in most predoctoral dental programs in the United States has seen a shift away from the traditional surgical model to a more conservative, risk-based medical model. The time and effort to train dental students to critically evaluate patients’ risk for developing dental caries and then implementing patient-specific strategies to manage the disease will likely result in a powerful evolution of the dental profession as these students increasingly populate the dental workforce. Evidence-based literature has increased our knowledge of the etiological factors for caries development as well as expanded our appreciation for preventive measures that focus on preservation of tooth structure. The idea that a dentist must use surgical procedures and restorative materials to treat dental caries is slowly, and sometimes grudgingly, being replaced by more scientific and thoughtful approaches. In order to evaluate the progress and trends of dental caries management and prevention instruction in U.S. dental schools, this survey was conducted to identify the number and characteristics of caries risk assessment and treatment programs in 2009 and to then compare the results to those of an identical survey administered in 1998.

Methods

The same eleven-question survey (see Figure 1) that was developed by the authors of the spring 1998 survey was mailed to the fifty-eight U.S. dental school deans in the fall of 2009. A second letter was mailed as a reminder to those schools not initially responding. The deans were asked to have the faculty member most familiar with caries risk assessment and treatment at their schools complete the questionnaire. All responses received were securely stored and were recorded and tabulated by the end of December 2009. Statistical analysis was performed on the data obtained from the responses to questions 1, 2, and 4–7 using stratified random sampling, with years as the strata. Then, a contingency chi-square test was used to test for differences between years.
1. Does your school curriculum have a caries risk-training program for predoctoral dental students?  
   Yes  No

2. Does this area of training come under the oversight of a single department?  Yes  No

3. If so, which department(s)?  
   _________________________

4. Are students required to perform caries risk assessments as graduation requirements?  
   Yes  No
   Competency?  Yes  No

5. What are the components of your program?  
   Lectures: Yes  No  Laboratory: Yes  No  Research: Yes  No  Clinic: Yes  No
   Treatment  Tests Used
   __ a. Post-radiation therapy  __ a. Salivary flow volume testing
   __ b. Dietary analysis/counseling  __ b. Microbial analysis
   __ c. Caries control excavation and restoration  __ c. Plaque indices
   __ d. Chlorhexidine treatment  __ d. Salivary buffering capacity
   __ e. Topical fluoride application (office)  __ e. Other
   __ f. Topical fluoride application (home)
   __ g. Other fluoride (rinses, toothpaste, systemic, etc.)
   __ h. Fluoride releasing varnish application
   __ i. Xylitol chewing gum
   __ j. Sealants
   __ k. Other

6. Do you charge a fee for these services?  Yes  No
   ADA codes used:  0425  2940  1204  9940  1351

7. Do you have a specific recall program for low/moderate/high risk patients?  Yes  No
   Please describe recall programs.
   a. Low:
   b. Moderate:
   c. High:

8. Upon what criteria do you base the recall frequency/treatment?  
   a. Frequency criteria:
   b. Treatment criteria:

9. What are your criteria for caries risk patient classification?  
   a. Low risk:
   b. Moderate risk:
   c. High risk:

10. How do you diagnose and manage an initial carious lesion?  
    
11. When do you restore a radiographically visible carious lesion?  
    a. Enamel lesion only
    b. Outer 1/3 of dentin
    c. Middle 1/3 of dentin
    d. Inner 1/3 of dentin

12. Any additional comments?

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Figure 1. Caries risk assessment/treatment program dental school survey questionnaire
Results

A summary of the results from both surveys can be found in Table 1. Forty-two of fifty-five dental schools (76 percent) responded to the 1998 survey. Forty of fifty-eight dental schools (69 percent) responded to the 2009 survey. Not all questions were answered on every questionnaire.

**Question 1.** Eighty-one percent of the respondents in 1998 reported having a caries risk assessment training program for predoctoral students compared to 90 percent of the 2009 respondents. This difference was not significant when making a statistical comparison using the Pearson’s chi-square test at a 0.05 confidence level.

**Question 2.** In 1998, 28.5 percent of the responding schools reported that CRA/Tx training was supervised by one school department or division. In 2009, 51 percent of the respondents reported oversight of the training through one department. Using the chi-square test, a significant change was seen for the dental school organizational structure that trains students in the subject of CRA/Tx.

**Question 3.** Eighteen different disciplines/departments/divisions were reported as the managers or shared managers of their caries risk programs in 1998, and twenty-nine of the responding programs were affiliated with operative, restorative, or general dentistry departments. By comparison, twenty-three different areas were listed as the managers or co-managers of programs in the 2009 survey. Restorative dentistry was listed twenty times, operative dentistry seven times, and general dentistry seven times. Cariology was not mentioned in 1998, but was listed four times in 2009. This question was not suited to the criteria for our statistical analysis testing method.

**Question 4.** A statistically significant difference was seen in the results for this question using the chi-square test at an 0.05 confidence level. When comparing CRA/Tx programs in the curriculum as requirements, 36 percent of the respondents in 1998 reported having CRAs as requirements. Fifty-nine percent of the respondents reported having CRAs

<table>
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<th>Table 1. Results of 1998 and 2009 CRA surveys</th>
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<td><strong>Primary Caries Treatment</strong></td>
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<td>Inner 1/3 of dentin</td>
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<td>Other</td>
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*Indicates a statistically significant difference when using the Pearson random stratified analysis test at the 0.05 confidence level.
as requirements in 2009—a significant difference. Thirty-eight percent of responding schools reported having CRAs as a clinical competency in 1998, but 58 percent of responding schools listed CRAs as a clinical competency in 2009. This is a marked increase, but not statistically significant.

**Question 5.** When comparing program components (lectures, clinical, laboratory, and research) between the two surveys, no statistical differences were seen. Three new treatment modalities—tobacco cessation, behavioral intervention, and amorphous calcium phosphate—were listed in 2009. Regarding tests, Biofilm ATP (Oral BioTech) was newly listed in 2009, and Fiber Optic Transillumination was not listed in 2009.

**Question 6.** No statistical difference was seen in the percent of schools assessing fees for CRA services. Some schools in 2009 reported that they included the individual fees in the general fee for a comprehensive examination.

**Question 7.** No significant difference at the 0.05 confidence level was found in the results identifying a specific recall program for high, moderate, and low risk patients. Sixty-three percent of respondents in 1998 reported having such programs, but only 43 percent indicated that they had specific programs in 2009. New responses in 2009 included an extreme risk category, categories for low and high risk only, and recalls based on their CRA screening form.

**Question 8.** Most schools in both surveys said they base their recall frequency on “Caries Risk Assessment Factors,” but these factors varied considerably. Some base recalls on periodontal concerns only, and some now use CAMBRA (Caries Management by Risk Assessment) criteria. Developed by expert consensus at the California Dental Association meeting in 2002, CAMBRA is a “system of recommendations and guidelines that form the basis of practical caries intervention and prevention both for individuals and communities, and was crafted for use with children as well as with adults.” Only one school in 2009 reported having no recall program. Treatment at recalls was reported in 1998 to be based on caries risk factors, radiography, and other clinical assessments. In 2009, newly listed treatment criteria included CAMBRA intervention and the ICDAS (International Caries Detection and Assessment System) code. This system, focused on epidemiology, was developed in 2002. It is an integrated system for caries detection and assessment, which uses an evidence-based visual clinical examination to detect lesions in enamel and dentin.

**Question 9.** Criteria for a patient’s risk categorization varied widely in both surveys. In 1998, 76 percent of respondents listed “no new caries or caries history” as their criterion for “low” caries risk. In 2009, “no new caries” was listed nine times (34.5 percent), but CAMBRA or modified CAMBRA criteria, Previser, Journal of the California Dental Association (JCDA), American Dental Association (ADA), or customized local forms were listed also. Previser for dentists is a software program that gives numeric scores for caries disease. It suggests that these numeric scores provide a measured and objective way to predict risk and track changes in risk level and disease severity over time. It also asserts that it provides a way to evaluate effectiveness and outcomes.

In 1998, 69 percent of responses were given as “active caries or no new caries within the past year” for “moderate” caries risk. In 2009, no factor stood out as a predominant criterion for selecting the moderate risk category. Three respondents said they do not use the moderate category. Again, CAMBRA or modified CAMBRA, JCDA, ADA, Previser, and customized local forms were listed when determining the moderate caries risk category in 2009. For high risk patients, “multiple new or active caries” was the most common response among respondents in 1998. In 2009, no specific criterion was seen as a predominant factor in the determination of high-risk patients. CAMBRA or modified CAMBRA, Previser, JCDA, ADA, and customized local forms among others were seen as newly listed criteria. One respondent used a classification that consists of caries-free, caries-inactive, caries-prone, and caries-active categories.

**Question 10.** In 1998, regarding the diagnosis of initial primary caries lesions, 60 percent of respondents used clinical and radiographic techniques, 17 percent used FOTI (Fiber Optic Transillumination), and 40 percent used explorers. In 2009, 65 percent reported using visual, with or without magnification; 56 percent radiography; 18 percent tactile examinations; 9 percent “Diagnodent” (KaVo); and 3 percent FOTI. Initial management of these lesions was listed as “attempted remineralization” in 1998. Responses in 2009 varied greatly. Fluoride treatment of some kind was listed by 41 percent of the respondents. Nonsurgical, noninvasive, minimally invasive, or medical management was listed by 15 percent. Remineralization was listed by 18 percent, and restoration was listed by 23 percent of respondents in 2009.

**Question 11.** In 1998, 17.5 percent of respondents would restore a radiographically visible lesion
in the enamel only, whereas 55 percent would restore a lesion in the outer 1/3 of the dentin, 10 percent would restore a lesion in the middle 1/3 of the dentin, and 5 percent would wait to restore a lesion until it reached the inner 1/3 of the dentin. The 2009 findings show 1 percent of respondents restoring a radiographically visible lesion in the enamel only, while 72.5 percent would restore a lesion in the outer 1/3 of the dentin, 4 percent of 2009 respondents would in the middle 1/3 of the dentin, and 3 percent would delay restoration of a lesion until it reached the inner 1/3 of the dentin. Responding schools in 2009 gave multiple overlapping responses to this question showing some difficulty in understanding its meaning. Other responses included board examination criteria for both surveys and only when clinical evidence of cavitation was determined on three 2009 responses.

Question 12. Several comments from both sets of respondents told of programs in the process of development, difficulties with recall program implementation, and ongoing curriculum changes. In 2009, many schools discussed the use of CAMBRA or modified CAMBRA guidelines. One 2009 respondent reported giving all patients a CRA evaluation in their initial comprehensive examination. Three respondents stated that some of the survey questions need to be clearer for them to make a definitive response.

Discussion

The ability to reliably predict the risk of developing new caries lesions is essential to the comprehensive management of this disease in all patients. Teaching students how to identify high-risk individuals, developing an appropriate management strategy, and implementing practical preventive measures to improve outcomes are the basis for using a medical model approach. This survey was conducted to see how much progress has been made in the past eleven years toward improving U.S. teaching programs in caries risk assessment and treatment.

Due to the confidential nature of the survey, individual school responses could not be revealed. The design of questions 1, 2, 4, 5, 6 and 7 allowed for comparison of the data obtained on both surveys by using random stratified sampling and Pearson's contingency chi-square testing. For the other questions, their results are reported using comparisons of the raw data. Even though some questions could have been stated in a clearer, updated manner, the survey instrument was intentionally left unchanged to better suit the results for statistical analysis. Only two questions' results showed a statistically significant difference over the eleven-year period: the administrative supervision of the program and graduation requirements.

A marked increase in the number of schools using CRA as a clinical competency occurred, although not statistically significant. In 2005, Anusavice stated that “a shift in emphasis appears to have occurred in dental schools toward assessment of caries risk, modern management of the disease, and delayed restoration until the probability of cavitation has increased to a critical threshold.”10 Our results support his statement, but show a very slow and varied response across the country.

A few schools list ICDAS criteria, while other schools report using CAMBRA criteria for assessing risk. Still others—the majority—have developed their own hybrid programs for the assessment and management of dental caries. Pitts in 2001 suggested that “a key area, which will need to be addressed to build and achieve consensus, is clarity about the definitions and nomenclature used.”11 Based on the current diverse responses to this survey, his hope for consensus and clarity appears to be only gradually evolving.

The 2009 survey responses for primary lesion diagnosis included the use of Diagnodent as a diagnostic tool for early detection of caries. Zero et al. concluded that “the development of technology to detect and quantify early caries lesions and to directly assess caries lesion status (active versus inactive) may prove to be the best way to identify patients that require intensive preventive intervention.”12 Some applications of this technology appear to be taking place in a few dental schools. Based on our results (question 10), evidence-based caries diagnosis and management techniques remain a goal for many to achieve. Until the technology and associated evidence become widely available, schools are relying on traditional methods. Visual inspection as described in Figure 4 of the ICDAS II Decision Table6 may be the most precise way to classify lesions. A few schools in the 2009 survey indicated that they use these criteria.

Creating a cadre of faculty members at each school that accepts and is willing to implement the medical model philosophy and the new technology can be a difficult hurdle to overcome. Some general comments received in the questionnaire (question 12) indicated difficulty in getting all faculty members at their schools to adopt the medical model for caries management. Fontana and Zero reported that “their
greatest challenge was reaching all part-time faculty for training and calibration.”

Students can, at times, be confused when a school’s faculty does not speak in unity on this subject. Some of the other general comments to question 12 in both surveys indicate the numerous challenges in changing the culture among administrators, faculty members, students, and patients. These comments support the statement by Doméjean-Orliaguet et al. that “emphasize the difficulties of introducing practical caries risk assessment and management of caries as a disease into a teaching or general practice environment when the traditional approach has been that restorative dentistry fixes caries.”

**Conclusions**

The results of this survey show that there is progress toward developing and implementing effective evidence-based caries risk assessment and caries management programs in U.S. dental schools. However, wide variations in interpretation and application of the programs exist. Improvements in evidence-based caries detection and treatment technology, increasing acceptance of the medical model, improved training and calibration of faculty members, and standardization of terminology and teaching methods are occurring. Many dental educators, researchers, and clinicians are trying their best to improve these programs. Acceptance of this philosophy by students, patients, and faculty members—in a situation in which so many competing demands are placed on a student’s overall training—will be a constant and formidable task. But as noted by Calderón et al., “Due to the overwhelming need for early caries prevention, dental schools should provide students with the skills necessary to feel confident and willing to perform CRA and prevention counseling for all age groups.”

Considerable time, effort, evidence-based knowledge, counseling, and patience are necessary to treat caries in a comprehensive and scientific manner. Changing any culture is difficult and will take patience and perseverance over time to make this method the norm in our profession.

**REFERENCES**


