



American  
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Hygienists'  
Association

# Journal of Dental Hygiene

THE AMERICAN DENTAL HYGIENISTS' ASSOCIATION

DECEMBER 2013 VOLUME 87 NUMBER 6

- Improving Oral Health Literacy – The New Standard in Dental Hygiene Practice
- Improving Oral Health Outcomes from Pregnancy through Infancy
- The Relationship Between Postmenopausal Osteoporosis and Periodontal Disease
- Teledentistry: A Systematic Review of Clinical Outcomes, Utilization and Costs
- Dental Hygienists' Knowledge, Attitudes, and Practice Behaviors Regarding Caries Risk Assessment and Management
- Knowledge, Attitude and Practice Regarding Oral Health Among the Rural Government Primary School Teachers of Mangalore, India
- Dental Fluorosis and Lumbar Spine Bone Mineral Density in Adults, ages 20 to 49 years: Results from the 2003 to 2004 National Health and Nutrition Examination Survey

# Journal of Dental Hygiene

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The *Journal of Dental Hygiene* is the refereed, scientific publication of the American Dental Hygienists' Association. It promotes the publication of original research related to the profession, the education, and the practice of dental hygiene. The Journal supports the development and dissemination of a dental hygiene body of knowledge through scientific inquiry in basic, applied and clinical research.

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## Telling Them to Brush and Floss is Just Not Working

I was a speaker at a fascinating conference recently, titled "Behavioral Changes to Improve Oral Health: Innovations & Interventions." The workshop was a collaboration within the University of Pennsylvania between the Leonard Davis Institute of Health Economics, the Center for Health Incentives and Behavioral Economics, and the School of Dental Medicine. The purpose of the conference was to stimulate cross-disciplinary, creative approaches to improving oral health behaviors. The interesting feature of the conference was that there were experts from the disciplines of economics, marketing design, psychology, management and communications, as well as dentistry and dental hygiene. This is the first time that I know of professionals other than dental and medical groups who have collaborated on topics regarding oral health behavior.

Oral health behavior is a perplexing problem. When one considers that an individual need only spend about 5 to 6 minutes per day to maintain healthy teeth and gingiva, it is difficult to understand the lack of compliance. The literature tells us that meticulous biofilm removal with a toothbrush and interdental cleaning once a day is adequate to prevent gingivitis,<sup>1</sup> but even once per day is not accomplished by most Americans. Dental hygienists have been battling the war on compliance/adherence to oral care instructions for as long as we have had the profession - 100 years now! Interestingly, patients typically know that oral health is important but only as it relates to its importance to oral health. They are not well versed on the importance to systemic health, oral cancer, possible sleep apnea issues, etc. If they had the facts, would it make a difference in what they are willing to do to keep their oral health in check? And, are dental hygienists teaching the facts or are they teaching every patient the same thing - to brush twice per day and floss once per day? If so, they need to review the

evidence and adapt their instructions accordingly.

Do instructions work? They might work if patients remembered the recommendations. But, the literature tells us that 30 to 60% of oral health information is forgotten by the patient within an hour of instructions and that half of all health recommendations are not adhered to by the patient.<sup>2</sup>

Many academic institutions are starting to emphasize other behavioral strategies to promote change in patient behavior. Motivational interviewing is a focused, goal-oriented approach to eliciting behavior change in clients.<sup>3</sup> It helps patients/clients explore and resolve ambivalence to behaviors. Rollnick and Miller note that motivation to change is elicited from the patient/client, and that it is the patient/client's responsibility, not the dental hygienist's, to voice and resolve his/her ambivalence to the behavior (oral health behavior in this case). And perhaps one of the hardest things for dental hygienists to accept is that direct persuasion based on "urgency of the problem" will most likely increase resistance in the patient and not promote positive change. So, we are back to wondering what will work and how we can facilitate positive oral health behaviors in patients. During her time as First Lady, Hillary Clinton evoked the adage "It takes a village to raise a child."<sup>4</sup> Perhaps it will take a "village" of cross-disciplinary professionals to figure out how to promote behavior change to improve the oral health of our citizens. Telling them to brush and floss just is not working!

Sincerely,

Rebecca Wilder, RDH, BS, MS  
Editor-in-Chief, Journal of Dental Hygiene

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# Linking Research to Clinical Practice

## Oral Cancer Screenings

Denise M. Bowen, RDH, MS

The purpose of Linking Research to Clinical Practice is to present evidence based information to clinical dental hygienists so that they can make informed decisions regarding patient treatment and recommendations. Each issue will feature a different topic area of importance to clinical dental hygienists with A BOTTOM LINE to translate the research findings into clinical application.

**Walsh MM, Rankin KV, Silverman S Jr. Influence of Continuing Education on Dental Hygienists' Knowledge and Behavior Related to Oral Cancer Screening and Tobacco Cessation. *J Dent Hyg.* 2013;87(2):95-105.**

**Purpose:** There are more than 35,000 new cases of oral and pharyngeal cancers (OPC) diagnosed each year. Most OPCs are diagnosed in advanced stages, requiring aggressive treatment and resulting in higher morbidity and mortality than when diagnosed early. The overall 5 year survival rate of OPC is approximately 60%. Early detection of OPC lesions are the key to survival. A major risk factor for OPC is chronic tobacco use. The purpose of this paper is to report changes in dental hygienists' knowledge, attitudes and behaviors 6 months after attending a standardized lecture format continuing education (CE) course on early OPC detection and tobacco cessation counseling compared to baseline values.

**Methods:** A total of 64 CE courses were given for dental professionals throughout the 10 U.S. public health districts to determine if OPC screenings and tobacco cessation counseling behaviors could be modified at 6 months post-training. Questionnaires were obtained at baseline and 6 months later using a pre- and post-test design.

**Results:** A total of 1,463 dental hygienists participated at baseline and 543 at a 6 month follow-up. Data showed a significant difference in knowledge and behavior compared to baseline values.

**Conclusion:** CE appeared to have a significant influence on participants' OPC and tobacco cessation knowledge and behavior, and could potentially make a difference on prevention, early detection and ultimately on OPC control.

### Commentary

Licensed dental professionals have the responsibility and opportunity to screen patients for OPC. Previously, screenings primarily were recommended for high risk individuals with risk factors such as smoking, chewing tobacco and excessive alcohol consumption. These historic high risk groups remain; however, HPV 16 is becoming the fast growing segment of the OPC population, and many people with HPV infections are unaware of the viral infection which presents no outward signs or symptoms. Interestingly, a March 2013 Consumer Report regarding health screening tests stated that most people should not waste time on oral cancer screenings, among others, and suggested only those at high risk are indicated because OPC is relatively uncommon.<sup>1</sup> The visual OPC screening, however, differs from other screening tests in that it is noninvasive, uses no radiation and usually is provided at low or no cost to dental patients. As indicated, 35,000 new cases of OPC are diagnosed each year. OPC also kills 8,000 people annually in the U.S., and early detection lowers the stage of the cancer at diagnosis and improves 5 year survival rates. These statistics highlight the need for OPC screenings, and raise questions regarding OPC screening and counseling practices by dental hygienists and public awareness of OPC screening in dental practice.

This study assessed changes in dental hygienists' knowledge, attitudes and behaviors 6 months after a CE course on early OPC detection and tobacco cessation counseling. Although dentists and dental hygienists attended this course, results for dental hygienists only were reported. While 94.3% performed screenings at baseline, only 50.9% palpated the neck and 66% updated tobacco use status of continuing patients. For counseling, 46% discussed roadblocks to quitting and 61.8% identified rewards of quitting with patients not ready to quit. With patients express-

ing a readiness to quit, 24.7% discussed setting a quit date, 22.7% discussed triggers, and 40.8% discussed pharmacologic options for quitting. Only 76% informed patients when doing an OC exam. Few reported using adjunctive tissue diagnostic techniques such as toluidine blue, brush biopsy or technologies based on tissue reflectance and/or autofluorescence. These findings concur with a 2005 study of New York dental hygienists and dentists indicating the large majority (82% dentists; 72% dental hygienists) reported routinely performing OC examinations while routine tobacco-use counseling was reported by only 12% of dentists and 21% of dental hygienists.<sup>2</sup>

Findings showed significant improvement in dental hygienists' counseling of patients not ready to quit about roadblocks to quitting and rewards of quitting. In counseling patients ready to quit, there was significant improvement in discussing a quit-date, tobacco use triggers and pharmacotherapy options, and in following-up with those who made a quit attempt. More dental hygienists also performed comprehensive OPC exams, including tongue retraction, to view lateral borders and neck palpation. The percentage of hygienists who informed patients of the procedure when doing an OPC screening and in using brush biopsy as an adjunctive tissue diagnostic technique also improved. These improvements in behaviors indicate the potential impact of a CE course on early OPC screening, although participants reporting 6 months later (37%) might have reflected behavior changes of those who experienced greater impact or interest.

Although baseline data indicated that almost all of the participants were aware of the importance of regular OPC exams and regularly perform visual OPC exams, a need existed for improvement in thoroughness of screenings. Comprehensive counseling of patients about quitting tobacco use was reported by fewer dental hygienists. These findings could be related to time allocated for a dental hygiene appointment or the use of referrals for tobacco cessation counseling, topics not assessed in this study. Dental hygienists are well versed in the "Ask, Advise and Refer" program, the primary aim of the American Dental Hygienists' Association's educational campaign for tobacco cessation,<sup>3</sup> and it is likely that many of the respondents referred their patients for cessation assistance rather than providing it directly. Improvement was noted in the percentage of dental hygienists who informed patients of the OPC screening procedure while performing the examination after the CE course. The authors highlighted this finding as "very important because public awareness about the risk factors and methods of early OPC detection is very low and increased awareness can help both patients and health care providers detect lesions early."

**Awojobi O, Scott SE, Newton T. Patients' perceptions of oral cancer screening in dental practice: a cross-sectional study. *BMC Oral Health*. 2012;12(55): doi: 10.1186/1472-6831-12-55.**

**Background:** Oral cancer is increasing in incidence in the UK and indeed worldwide. Delay in diagnosis is common; up to half of patients are diagnosed with advanced lesions. Thus, it is essential to develop methods to aid early detection. This study aimed to assess dental patients' experiences and awareness of oral cancer and screening within general dental practice.

**Methods:** A cross-sectional questionnaire survey of 184 English-speaking adults, with no previous history of oral cancer, was conducted. The questionnaire collected data on participant's knowledge of oral cancer, experience of screening, attitudes and feelings towards having a screening, anticipated help-seeking behaviors, health-related behaviors (particularly risk factors) and sociodemographics.

**Results:** Twenty percent of respondents had never heard of oral cancer; 77% knew little or nothing about it and 72% did not know that their dentist routinely screens for oral cancer. Overall, attitudes to screening were positive - 92% of respondents would like their dentist to tell them if they were being screened for signs of oral cancer and 97% would like help from their dentists to reduce their risk.

**Conclusion:** Patients seem generally unaware of oral cancer screening by their dentist but are happy to take part in screening, would like to be informed, and welcome the support of their dentist to reduce their risk of developing oral cancer.

## Commentary

Informing patients that they are being checked for early signs of OPC during a routine examination presents a prime opportunity to provide patients with information about oral cancer and advice about OPC prevention and early detection. While studies of related practice behaviors by dentists and dental hygienists indicate that a high percentage of their patients receive OPC screenings, findings indicate that lower percentages of these individuals receive related counseling. This study explored the extent of missed opportunities by surveying a sample of adults (n=186) attending 2 general dental practices in London. Specific aims were to explore patients' awareness of OPC and OPC examination experiences.

Results indicated a low awareness about OPC and OPC screenings among responding dental patients (97% had never heard of OPC or knew little or nothing about it, 72% did not know that their dentist routinely screens for oral cancer, and 60% were unaware of ever

being screened) despite 78% having visited their dentist in the past year. Over 90% of participants wanted to know that their dentist was performing a screening and wanted help reducing risk. Some (39%) said they would not feel anxious about an OPC screening, and 25% indicated they might feel a little worried. These findings indicate that the concern identified in previous surveys of dentists about alarming patients might be overstated. Respondents at greater risk (alcohol use, smoking status) were significantly more likely to have positive attitudes about screening. Findings also indicated that a higher proportion of participants intended to seek help from their primary care provider than from a dentist for signs of OPC, indicating a low awareness of the key role licensed dental professionals play in OPC diagnosis, treatment and referral.

Although the vast majority of dentists in the UK and the U.S. report performing routine OPC screenings, results of this exploratory study in London indicate that a gap exists when communicating the procedure, findings, and related counseling with dental patients. Respondents expressed a desire for more information about prevention and detection of OPC.

## The Bottom Line

These studies addressed the provision of routine OPC screenings and related counseling by dentists and dental hygienists. The findings and conclusions indicate a need for improvement in OC screening behaviors, especially as related to counseling patients about OPC prevention and reducing associated risks. Improvement in the public's awareness of the dental professionals' key role in diagnosis, referral and treatment is needed. Based on the findings of both studies, the following conclusions are drawn:

- The vast majority of dental hygienists provide routine OPC screenings, however, greater attention could be paid to extending the tongue for visual inspection and palpating the neck.
- Tobacco cessation counseling practices are provided by most dental hygienists, however, only 76% inform patients of the OC screening procedure. The OC examination should be used routinely as an opportunity for education about OC prevention, risk factors and identification.

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3. American Dental Hygienists' Association. Ask. Advise. Refer: 3 minutes or less can save lives. ADHA [Internet]. [cited 2013 November 18]. Available from: [www.askadviserefer.org](http://www.askadviserefer.org)

- There is a need for improvement in the tobacco cessation information provided by dental hygienists to patients who are ready to quit (e.g., setting a quit date, tobacco use triggers and pharmacologic options), and those who are not yet ready to quit (e.g., roadblocks to quitting, potential rewards associated with quitting). Follow up with patients who have quit also is indicated.
- The public has low awareness about OC and OC screenings in dental practices, even when visiting their dentist annually.
- There is little to no evidence to show that informing patients of OC screenings would result in significant risk of anxiety, worry or concern. Further studies of public perceptions are warranted.
- Dental patients want to be informed of OC examinations when delivered and desire help with OC prevention and awareness from their oral health care provider.
- Continuing education courses regarding OPC screening and related counseling have the potential to improve dental hygiene knowledge, attitudes and behaviors.

## Summary

Dental hygienists are in a prime position to enhance early detection of OC because they see their patients regularly and have the opportunity to provide OC screenings and counseling. Dental hygienists need to be diligent about comprehensive screening for OPC and provide counseling to prevent OPC and reduce risk. Patients may be unaware of OPC screening during dental visits but want to have screenings, desire to be informed, and welcome the support of their oral health care provider to reduce their risk of developing oral cancer.

*Denise M. Bowen, RDH, MS, is Professor Emerita at Idaho State University. She has served as a consultant to dental industry, as well as government, university and private organizations and is a member of the National Advisory Panel for the National Center for Dental Hygiene Research in the U.S. She has received national awards for excellence in dental hygiene, has written numerous published articles, textbook chapters and continuing education programs related to nonsurgical periodontal therapy, preventive oral self-care, research methodology and dental hygiene education.*

# Critical Issues in Dental Hygiene

## Improving Oral Health Literacy – The New Standard in Dental Hygiene Practice

Lisa E. Bress, RDH, MS

### Introduction

Dental caries, periodontal disease and oral and pharyngeal cancers continue to burden a significant portion of the American public. According to the most recent NHANES survey (1999 to 2002), 41% of children ages 2 to 11 had tooth decay in their primary teeth, 50% ages 12 to 15 had tooth decay in their permanent teeth and 95% of adults ages 40 to 59 had a history of coronal tooth decay.<sup>1</sup> Untreated decay is close to crisis proportions in children from lower income families, with children and adolescents having twice as much untreated decay as those from higher income families.<sup>1</sup> The proportion of children ages 2 to 5 years with dental caries is disproportionately concentrated among families who qualify for Medicaid coverage.<sup>2</sup> In addition, 1 in 4 U.S. adults ages 60 and over are completely edentulous with a higher prevalence found among lower income adults.<sup>1</sup> Oral cancer also continues to affect lives in America with an estimated 36,000 citizens diagnosed annually and more than 7,800 cases ending in death.<sup>3</sup> Oral health diseases can negatively impact quality of life and often lead to difficulty with concentration and speech, low self-esteem, inadequate nutrition, and hours lost from work and school. Additionally, emergency room visits, hospital stays and treatment requiring general anesthesia increase with dental problems. The Centers for Disease Control estimates that Medicaid expenditures for operating room cases range from \$1,500 to \$5,000 per child per year.<sup>3</sup>

### Oral Health Literacy

Thirteen years following the Surgeon General's report affirming that oral health is an essential

### Abstract

**Purpose:** Oral diseases continue to burden a significant portion of the American public, especially those in low-income groups. The misconception that oral health is less important than general health exists among America's citizens even though it has been 13 years since the Surgeon General's report affirmed oral health as an essential component of general health. Research has shown that poor oral health literacy (OHL) affects oral health, can negatively influence quality of life and has a significant financial impact on society. National initiatives to increase the OHL levels of American citizens include training health care professionals about effective communication skills and disseminating oral health information to groups outside of dentistry. This paper describes a new course on OHL and communication techniques for dental hygiene students at the University of Maryland, School of Dentistry.

**Keywords:** oral health literacy, effective communication skills, oral health disparities, patient - provider interactions

This study supports the NDHRA priority area, **Health Promotion/Disease Prevention:** Assess strategies for effective communication between the dental hygienist and client.

component of general health,<sup>4</sup> the misconception that oral health is less important than general health continues to exist among American citizens, including health care workers, legislators, insurance companies, educators, and community leaders. At a recent Institute of Medicine (IOM) meeting, U.S. representative Elijah Cummings stated that "People don't know what they don't know," drawing attention to the significance of oral health literacy (OHL) as a method to improving oral health (Cummings, personal communication, March 29, 2012). Health literacy and OHL have been increasingly visible in the literature since the release of the 2004 Institute of Medicine's report emphasizing the right of all individuals to receive health care information in ways that can be understood.<sup>5</sup> Literacy skills impact an individual's health more than age, income, employment status, education level, and racial or ethnic group.<sup>6</sup> The U.S. Department of Health and Human Service's Healthy People 2010 report defines health literacy

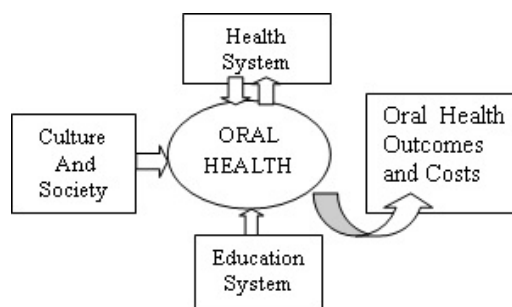


and OHL as “the degree to which individuals have the capacity to obtain, process and understand basic (oral) health information and services needed to make appropriate oral health decisions.”<sup>7</sup> Skills associated with OHL include the ability to read, comprehend verbal communication, speak clearly, write competently and use math. In addition to one’s own literacy, OHL involves the ability to navigate an increasingly complex health care system which is affected by an individual’s culture and the context in which information is communicated.<sup>8</sup> For example, cultures differ in their communication styles, the meanings they assign to words and gestures, and their comfort levels when discussing the body, health and illness.<sup>5</sup> These cultural influences, combined with patient anxiety, fear, pain or other physical discomforts, may affect the comprehension of information exchanged, which can limit the patient’s ability to make positive health decisions. The health care system continues to become more complicated while the mismatch between the literacy demands in the health system and the health literacy skills of most American adults persists.<sup>5</sup> The U.S. educational system also plays an important role in improving health literacy by educating the country’s youth about health and teaching basic literacy skills. Figure 1 illustrates the intricacy of the factors affecting health literacy in the U.S.<sup>5</sup>

### OHL and the Dental Setting

In the dental setting, a patient’s OHL level, or ability to decipher oral health information and act upon it, factors into whether they will consent to treatment procedures and/or follow health behavior recommendations. The terminology and printed materials used by oral health care providers to explain disease status and care regimens can be obstacles if they are not communicated at a level that the patient can understand. When these important messages are lost, it is less likely that patients will be empowered to make positive health decisions. Oral health care professionals may think they are being understood when communicating with patients, however, if the patient’s ability to understand the terminology and comfort-level are not considered by the provider, messages may not get through to the patient as intended. Professional terms such as periodontal disease, dental caries and pH levels are often foreign to non-dental individuals. With the increase in cultural diversity in the U.S., language barriers are more likely to occur between patient and provider. In addition, fear, emotional stress and/or lack of trust can prevent patients from being open to self-care recommendations and dental treatment options. When patient-provider channels of

Figure 1: OHL Framework



communication are compromised, OHL levels are negatively affected, which may lead to increased oral disease.<sup>5,9,10</sup>

Patient populations with limited OHL skills are associated with the highest levels of disease and the worst oral health outcomes.<sup>5,9,10</sup> The effects of low OHL can have a domino effect on society and may be passed down from generation to generation.<sup>11-13</sup> Children of parents/caregivers with low OHL levels tend to have more dental infections which may result in difficulty eating, concentrating in school, increased emergency room visits and hospitalizations.<sup>14</sup> Children who suffer from dental disease often grow into adults with dental problems, which may lead to difficulty in acquiring a job, decreased self-esteem and poor general health.<sup>15</sup> Incorporating OHL and effective communication techniques into oral health care practice, together with disseminating this knowledge to individuals outside of dentistry, can help address the oral health care crisis among America’s most vulnerable patient populations.

Dental hygienists are in a unique position to make a difference in the national movement to improve oral health through increasing OHL. Providing oral health education has been a significant component of dental hygiene practice since the early 1900s, yet a significant portion of the population remains affected by oral disease. This discrepancy may be improved if information from oral health professionals was presented in a more effective manner. Because one of the primary roles of dental hygienists is effectively communicating with patients to improve health outcomes, it is logical that they be at the “center” of improving the OHL of American citizens. Through the use of effective, 2-way communication, dental hygienists can inspire patients to begin valuing oral health and to take an active role in their health decisions. When patients trust their health care provider and the information presented, oral health messages have a better chance of resonating with the patient. Studies in medicine have shown a correlation between physician-patient communication

and following recommended health care protocols - this correlation could apply to oral health outcomes as well.<sup>16</sup>

In addition to improving the OHL levels of patients, dental hygienists are in a position to disseminate oral health knowledge beyond the dental setting to community leaders, educators and health care providers outside of dentistry in an effort to shift the focus from treating oral disease to preventing oral disease. If messages such as this are promoted to outside groups, perceptions of oral health may begin to change in America. Dental hygienists can embark on this challenge by networking in professional organizations such as the American Dental Hygienists Association (ADHA) and the American Dental Association (ADA), state-level advocacy groups, and through outreach activities such as community oral health presentations in elementary schools, Boys and Girls Clubs, and similar organizations that reach beyond the dental setting and have the potential to impact lives.

### **OHL and Dental Hygiene Curricula**

A key element to advancing oral health in America is changing the communication practices of oral health professionals. According to the 2004 IOM report, health professionals have limited education and practice opportunities to develop communication skills that result in optimal provider-patient interactions that can lead to positive oral health outcomes.<sup>5</sup> Between this limited training and the increase in oral health disparities among American citizens, the need to incorporate communication skills into professional education at the undergraduate, graduate and continuing education levels has been recognized by several health professions as a vital component to meeting the goal of improving health in America.<sup>5</sup> To fulfill the charge of improving provider communication skills, the American Medical Association (AMA), the ADA and the ADHA have integrated effective provider communication into their standards of care, thus recommending the inclusion of communication instruction into professional health curricula in the fields of medicine, nursing, pharmacy, dentistry and dental hygiene.<sup>17-19</sup>

Oral hygiene instruction has been a part of dental hygiene curricula since the profession was established. Dental hygiene students are traditionally taught about oral diseases and become experts on numerous self-care devices and techniques to encourage patients to improve their self-care habits. In recent years, research has shown that assessing patients' health literacy levels and ap-

plying compatible communication techniques should be incorporated into oral health practice, beginning with its insertion into dental and dental hygiene education and continuing education programs.<sup>17,20</sup> Infusing these topics into dental hygiene curricula will help prepare dental hygienists to effectively communicate with patients during and following their formal academic training. Interpersonal relationships, which are built upon the quality of patient-provider communication, appear to be as important to patients as the clinical aspects of oral health care.<sup>21</sup> According to Rozier and Horowitz, negative provider-patient interactions are more likely to result in negative oral health outcomes, whereas positive provider-patient interactions have been shown to decrease anxiety, and increase motivation and satisfaction.<sup>22</sup> If students can develop and embrace the importance of high-quality communication techniques during their formative education, there is an increased likelihood that these skills will continue into professional practice following graduation.

### **OHL Course Description**

The dental hygiene program at the University of Maryland, School of Dentistry incorporated a 1 credit, stand-alone OHL and communication course into the required core curriculum for the first time during the Fall 2011 term. The course prepares dental hygiene students to effectively communicate with patients from diverse groups. Introductory information focuses on defining OHL, its role in general health, how it affects patients' oral health status, and its relevance to dental and dental hygiene practice. The importance of inter-personal relationships between the dental hygienist and the patient is emphasized as a critical component to addressing the oral health crisis in America. Students learn how to assess patient literacy levels both informally, through specific responses and interactions when collecting health history and risk assessment data (e.g., continual sipping of soda and/or gestures indicating confusion with the dialog may indicate a lower OHL level) and formally, through the use of validated literacy assessment questions such as those developed by Chew et al<sup>12</sup> and Pfizer's health literacy assessment tool called The Newest Vital Sign.<sup>23</sup> Oral administration of formal health literacy instruments is suggested in situations when a patient's reading or language skills are in question. Students are then introduced to specific communication techniques compatible with various OHL levels.

The next component of the course focuses on barriers to effective communication and basic

techniques to overcome these obstacles. These barriers can be road blocks in the exchange of information between health provider and patient. Barriers are unique to the individual and can be physical, psychological and/or sociocultural in nature. Physical and psychological barriers may include fear, lack of trust and physical discomforts in the dental chair (e.g., pain, loud noise, temperature discomforts). Sociocultural hurdles, such as language barriers and perceived insensitivity by health care providers, could influence patient frequency of dental visits, adherence to self-care recommendations and oral health outcomes.<sup>24</sup> The course explores various cultures via small group discussions to help prepare students to recognize and appreciate diverse attitudes, values, and self-care habits within and between cultures. Students learn that “non-verbal cues make up 80% of interpersonal messages” and may indicate feelings of discomfort, surprise, fear and/or confusion.<sup>25</sup> Some examples include not making eye contact, opening eyes widely and cocking the head to one side.<sup>26</sup> It is explained that non-verbal cues may indicate a potential barrier to patients making positive oral health decisions and achieving optimal oral health outcomes. Regardless of the specific barrier, students learn the significance of their role in eliminating communication obstacles. This, in turn, increases the likelihood of improving OHL and positive health outcomes.

Following course instruction on communication barriers, specific communication techniques are presented to help elicit accurate information from the patient and ensure a clear understanding of information between provider and patient. Examples of communication techniques that are covered in the course include:

1. The use of plain language instead of scientific jargon (Table I)
2. Maintaining eye contact while speaking with patients
3. Asking open ended questions such as “What do you do to take care of your teeth?” as opposed to “How often do you brush and floss?”
4. Presenting a limited number of concepts at one time
5. Utilizing patient-friendly visual materials
6. The “teach back method” which enables providers to confirm if patients understand and can perform health information and techniques presented

As students become more culturally competent and proficient in assessing OHL and using communication techniques, the course shifts its focus to the application of these techniques in all aspects of

dental hygiene care, beginning with the gathering of health history and risk assessment data. It is essential that health care providers communicate in a manner that elicits accurate information from the patient in order to determine disease risk and formulate customized dental hygiene care plans.

### **Course Activities and Assessments**

Course content is delivered primarily via classroom presentation and videotaped samples of interactions between dental hygiene students and patients, and dental hygiene students and supervising dentists. Students participated in role-playing activities with fellow classmates to gain experience with the various communication techniques prior to utilizing them in the clinical setting. The culminating course assignment is a video role-play based on an assigned patient case history. Students work in groups and “act out” all interactions between health care provider and the patient and/or caregiver. Students also include a presentation to a “dentist” to demonstrate their ability to adjust their communication style from a patient with low OHL to an oral health professional with high OHL.

By watching the communication techniques applied in the video, student comprehension of course concepts was assessed by the course instructor, including the student’s ability to adjust their methods when needed. Because students were aware that they would be on camera, they carefully selected roles for each group member and prepared a script with dialog that was consistent with the OHL data for the patient in their assigned case. Many students even donned costumes to extenuate their given part (e.g., a wig, hat and a mustache to play a father of a patient). Students learned to consider details such as when to sit the patient up to achieve eye contact and when to use specific terminology to explain dental caries and/or periodontal disease that was different from those learned in their basic science and pre-clinical courses. In addition, they had to consider when and how to adjust the inflection of their voices when patients or caregiver student actors appeared anxious, angry or perplexed about what was being discussed.

### **Student Feedback of the Course**

Students evaluated the course anonymously via an opinion/Likert scale evaluation instrument, with questions rating the quality of the audiovisual material, scheduling, correlation between the material presented and what was assessed on the assignment in addition to an overall rating of the

Table I: Dental terms and plain language alternatives

Dental Term/Phrase	Plain Language Alternative	Dental Term/ Phrase	Plain Language Alternative
Caries	Cavities, Tooth decay	Erosion	Wearing away of tooth surface due acid in foods and drinks
Periodontal disease	Gum disease/infection	PH level	Acid level
Inflammation	Pain, swelling, heat, redness	Gingival margin	A turtle- neck of tissue around the tooth
Bacteria	Germs or bugs	Calculus	Hardened plaque
Root canal	Removal of damaged tooth nerve	Palate	Roof of your mouth
Extraction	Pull a tooth	Abscess	Pocket of infection
Amalgam or composite	Filling material	Extraction	Pull a tooth
Crown	Cap or cover over your teeth	Halitosis	Bad breath
Denture	False teeth	Tempromand-ibular	
Joint	Joint that attaches jaw to skull		
Sealants	Coating painted on teeth to prevent cavities	Side effect	Effect caused by a medicine you take
Xerostomia	Dry mouth	Pulp	Tooth nerves
Orthodontics	Braces	Chronic	Constant; life-long condition
Carcinoma	Cancer	Probe reading	Measurement of how much gum is supporting the teeth
Plaque	Whitish substance made from germs / bugs that build up on the teeth and gums like dust		
Caries disease process	Acid attack - when sugar and bacteria/ plaque bugs combine on a tooth surface, it results in holes or cavities to form		
Periodontal disease process	When plaque is not removed, it hardens and sits on the gums causing them to become puffy and red. If not removed, it builds up under the gums and sits on the bone that supports the teeth. The longer it sites on the bone, the more the bugs in the plaque and calculus will eat away at the bone. The more the bone is eaten away, the less support there is for the teeth. The less support there is, the more likely teeth can become loose and fall out.		

course. Overall responses were positive. Students indicated that the videotaped role-playing assignment allowed them to pull the course concepts together in a fun and meaningful way. Overall, students felt the course helped further prepare them to interact with patients in the clinical setting, however, some expressed that scheduling of the course during winter semester was stressful due to requirements in other courses. Some students commented that the videotaped role-playing assignment was too time consuming for a 1 credit course, and that student comprehension and ability to apply course concepts could be evaluated in a manner that was less time intensive.

### Modifications to the Course Based on Evaluation Results

Based on student feedback and faculty discussion, learning activities and evaluation strategies related to OHL and patient communication will be delivered at multiple points throughout the 2-year dental hygiene curriculum at the University of Maryland. The majority of the course concepts will be presented in the classroom toward the end of the fall term for first-semester dental hygiene students. Students will then practice communication techniques through role-playing activities in a simulation lab which will enable multiple faculty members to provide feedback to student groups. Evaluation strategies for the fall 1 credit course

Table II: Learning activities and evaluation strategies

Learning Activities	Topic(s)	Evaluation Strategies
<ul style="list-style-type: none"> <li>Classroom presentation with group discussion</li> <li>Videos of student interactions with patients and supervising dentists</li> <li>Role play activities based on patient caries or periodontal disease case histories with faculty supervision</li> </ul>	<ul style="list-style-type: none"> <li>Defining OHL, its role in general health, its effect on oral health and dental and DH practice.</li> <li>Barriers to effective communication</li> <li>Assessing OHL levels</li> <li>Cultural Competency</li> <li>Communication techniques</li> <li>The OHL framework, (Figure 1) is used to describe the numerous factors affecting OHL in the USA</li> </ul>	<ul style="list-style-type: none"> <li>Quiz evaluating students' comprehension of terms and concepts presented in class</li> <li>Group assignment to develop a script for a videotaped role-play of interactions between student RDH and patient, and student RDH and supervising dentist based on patient case histories</li> <li>Student interactions with patients are evaluated in clinic by supervising dental hygiene faculty members</li> <li>Group video based on previously submitted script</li> <li>Students' communication techniques and oral health behavior sessions with patients in clinic are evaluated routinely.</li> </ul>
<ul style="list-style-type: none"> <li>Guest presentations and classroom discussion</li> </ul>	<ul style="list-style-type: none"> <li>The role of oral health in health care reform</li> <li>Medical - Dental Collaboration regarding the role of oral health in general health</li> <li>The Maryland Oral Health Plan</li> <li>Maryland Dental Action Coalition Program (MDAC) and initiatives to improve oral health in Maryland</li> </ul>	<p>Oral health presentations to target groups such as:</p> <ul style="list-style-type: none"> <li>Healthy Start - clients and para-professionals</li> <li>Woman Infants &amp; Children (WIC)- clients and paraprofessionals</li> <li>Judy Center- elementary school children</li> <li>Head start program – children and caregivers</li> <li>Hospital nursing staff</li> <li>Professional students outside of dentistry</li> </ul> <p>**Participants will complete a pre and post-test to evaluate effectiveness of student presentations</p>

will include a quiz on concepts presented in class and a group assignment to submit a script for a video role-play. The script will encourage students to apply communication techniques but will take less time than developing a full-length video.

Senior dental hygiene students will have the opportunity to utilize OHL course concepts both with patients in clinic and for combined assignments from community oral health and senior seminar courses. Student groups are required to develop plans for a community oral health program to address access to care needs for a low-income population for the community oral health course, which provides a target audience for students to deliver an oral health presentation for the senior

seminar course. Combining requirements from the 2 courses will encourage dissemination of oral health information, providing students with more experience using communication techniques. This also aligns closely with Maryland's Oral Health Plan which aims to improve the oral health of at-risk communities. Lastly, students will gain additional exposure to individuals from various cultural, socioeconomic and geographic groups, further developing their cultural competency.

## Conclusion

Oral disease still plagues a significant portion of the American public even though it is, in most cases, preventable. Those most affected by oral

disease are from lower-income groups, as they lack the health care knowledge and financial resources to seek treatment. Poor oral health impacts overall health and negatively influences quality of life in terms of nutrition, self-esteem and the ability to attend work and/or school. Challenges of navigating an increasingly complex health care system persist, further perpetuating oral disease in America. Disease experienced in childhood may continue into adulthood, increasing the likelihood of inadequate parent modeling of proper oral health behaviors to their children. A solution to this vicious cycle is to shift the focus in America from treating oral disease to preventing disease through increasing OHL. Once American citizens, including health care workers, legislators, insurance companies, educators and community leaders, perceive oral health and general health as equally important, the goal of improved oral health in America is attainable.

Increasing OHL among all population groups is critical in addressing poor oral health in the U.S. Dental hygienists are in a unique position to make a difference in this initiative as their primary role is prevention via patient education and

establishing positive patient interactions. Communicating more effectively with patients can overcome a cadre of barriers and assist in empowering patients to make positive oral health decisions. Educating dental hygienists on effective communication techniques and on the significance of increasing OHL levels are consistent with national initiatives to integrate this content into professional health education curricula. This OHL and communication course was a success as measured by student evaluations, and could serve as a model for other dental hygiene programs.

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# Critical Issues in Dental Hygiene

## Improving Oral Health Outcomes from Pregnancy through Infancy

Lori Rainchuso, RDH MS

### Introduction

Oral health plays a crucial role in the overall health and well-being of a pregnant woman and her newborn child.<sup>1-3</sup> The 2000 Surgeon General's oral health report called for the elimination of oral health disparities. The report drew attention to the importance of changing attitudes and beliefs among health care providers, as well as in the community. In addition, the importance of oral health treatment during pregnancy is highlighted as an important strategy to potentially improve maternal and infant health.<sup>4</sup>

Pregnancy is not the time to defer dental examinations and necessary treatment. Dental care can be rendered safely throughout the pregnancy, though experts agree that due to first trimester morning sickness, and the third trimester level of comfort and risk of postural hypotension, the second trimester of the gestational period is most ideal.<sup>3,5,6</sup> According to a study utilizing oral health data from the Centers for Disease Control Pregnancy Risk Assessment Monitoring System, many women do not receive dental care during their pregnancy.<sup>7</sup> In addition, only half of the women who reported actually having a dental problem during their pregnancy were seen by a dental professional.<sup>7</sup>

Despite numerous research publications, professional guidelines and government reports regarding the importance of good oral health throughout pregnancy, health care professionals from both the medical and dental spheres continue to under-treat women during pregnancy.<sup>5,6,8</sup> It

### Abstract

**Purpose:** The purpose of this paper is to provide an overview of current professional guidelines regarding oral health care through pregnancy and infancy stages, and to include risks associated with treatment, as well as health care providers' beliefs and attitudes surrounding treatment of these specific populations. Although dental treatment during the second trimester is ideal, there is no indication that preventive or restorative dental treatment during any trimester of pregnancy can cause harm to the mother or developing fetus. Despite these recommendations, routine dental care is often voluntarily avoided or postponed for the duration of pregnancy. Post-delivery, preventive oral care is typically postponed for a child until 3 years of age, years after the first tooth has erupted. While most health care professionals agree on the importance of good oral health in every stage of life, it is not being addressed. Whether it is based on misconceptions or lack of knowledge, health care providers are performing inadequate oral care for these patients.

Recommendations to increase health care during pregnancy and infancy should include improved advocacy of the established oral health care guidelines within each professional organization. In addition, curriculum revision should occur at the university level, to ensure future health care professionals will have a strong oral health foundation. Lastly, a collaborative effort needs to occur between all health care providers to better treat the patient's overall health, not only the specifics of one professional discipline. As health care professionals we are all responsible for the complete well-being of our patients, and an interdisciplinary approach will better ensure we accomplish this task.

**Keywords:** pregnancy, oral health, infant oral health, oral disease prevention, anticipatory guidance, dental home, interdisciplinary collaboration

This study supports the NDHRA priority area, **Health Promotion/Disease Prevention:** Assess strategies for effective communication between the dental hygienist and client.

is recommended that all health care professionals who serve pregnant women provide the following: an oral health risk assessment, counseling of etiology and transmission of cariogenic bacteria to their newborns, referral to an oral health provider for a



comprehensive examination and assistance in the establishment of a dental home for their infant.<sup>2,9</sup> Early intervention and guidance during the perinatal period from all health care providers is imperative for the mother and infant.<sup>2</sup>

### **Current Health Care Perceptions**

An Oregon study revealed that general practicing dentists' perceptions and perceived barriers had the strongest direct effect on their not providing care to patients during pregnancy. Of these barriers, the most significant were: perceived time, economic costs and dissatisfaction with reimbursement compensation.<sup>10</sup> The greatest perceived barrier was indicated as economic cost: 72.9% of dentists indicated that compensation by insurance companies was inadequate for time spent counseling pregnant patients.<sup>10</sup>

The survey revealed that dentists in Oregon have a high level of incorrect knowledge about routine and emergency procedures concerning prenatal women. For restorative services, almost one third of dentists indicated they would not perform composite restorations at any stage of pregnancy. Approximately 50% indicated they would not perform composite restorations during a dental emergency. For nonsurgical periodontal treatment the survey revealed that 57% would not provide this service during the first trimester of pregnancy, 22% during the second trimester and 46% would not provide this service during the third trimester of pregnancy, and 69.2% would not provide this service during a dental emergency involving a severe periodontal abscess and infection. More than half of the dentists indicated they were reluctant to perform routine services during the pregnancy, and three-quarters were reluctant to perform services to relieve pain or swelling associated with a dental emergency. Despite the established perinatal guidelines attitude barriers remain, and negatively impact general dental practitioners' current practices.<sup>10</sup> Although the research focused on the state of Oregon, this is expected to be a nationwide trend of practice.

Dental professionals are not the only ones responsible for the under-treatment of oral health care during pregnancy. Research shows that obstetrician-gynecologists (OBGYNs) have not been addressing the oral health needs or conducting oral health assessments for their pregnant patients. A national study, assessing how OBGYNs addressed oral health during pregnancy, showed 84% out of the 351 respondents agreed that routine dental care during pregnancy is important.<sup>11</sup> Those surveyed also thought periodontal disease could have adverse effects on pregnancy outcomes, however,

they seldom asked about the pregnant patient's current oral health, inquired about dental visits or provided oral health information. In addition, over a third of the respondents stated that they did not advise patients to see a dentist for routine dental care. The study also revealed that most do not discuss pre-planning methods for preventing dental caries in young children (95%, 91%).<sup>11</sup>

The study asked basic oral health knowledge questions in which the majority (57%) acknowledged they were not qualified to recognize symptoms of periodontal disease, and that training in medical school and residency, on the screening and assessment of oral health issues, was non-existent or inadequate. Furthermore, most respondents stated they were not familiar with any oral health and pregnancy guideline publications.<sup>11</sup> In addition, the study showed that a majority of OBGYN physicians recognize the importance of good oral health during pregnancy, yet they do not address it. With improved advocacy and promotion of oral health education, OBGYNs may become more comfortable with assessing and addressing oral health with their pregnant patients.<sup>11</sup> By assimilating the current dental guidelines regarding oral care of the pregnant patient into an OBGYN standard of care practice, improvement of overall health for both mother and child could be achieved.

### **Oral Health Care Guidelines and Recommendations**

Pregnancy commonly creates physical effects that may negatively impact routine oral self-care. Women frequently experience nausea which often leads to avoiding oral hygiene practices like tooth brushing, increasing the possibility for dental caries. In addition, women may be experiencing frequent vomiting, which compounds the risk of tooth erosion and dental caries.<sup>1</sup> To counteract the acidity of the oral cavity after vomiting, and reduce the risk of tooth erosion, it is recommended to swish with a teaspoon of baking soda dissolved in a cup of water, and to avoid brushing immediately after a vomiting occurrence.<sup>2</sup> Once the acid is neutralized, the teeth may be brushed using a soft-bristled toothbrush and fluoridated toothpaste.<sup>2</sup>

Furthermore, increased appetite and frequent snacking of cariogenic foods may also contribute to caries development. Pregnancy is an ideal time for dental professionals to conduct a dietary analysis. Patients should be educated on the importance of eating nutrient dense foods that promote oral health. Providers should include a discussion regarding the relationship of frequent snacking on simple carbohydrate foods, sweetened beverages

(including juices) and caries development.

Untreated dental caries in mothers increases the risk of caries development among their children, as maternal transmission and early childhood caries (ECC) has been established.<sup>5,12</sup> The vertical transmission of *Streptococcus mutans*, from mother to child, has been well documented. Mothers with poor oral health and high levels of cariogenic bacteria are at a greater risk for infecting their children with the bacteria and increasing their children's caries risk at an early age.<sup>13,14</sup> Therefore, decreasing the maternal cariogenic bacterial load is vital to the prevention or delaying of the infant developing ECC.<sup>3,5,12,15</sup> The cariogenic bacteria is transferred by way of saliva exchange through various behaviors such as cleaning the infant's mouth with a saliva-moistened cloth, sharing of eating utensils or cleaning a dropped pacifier or teething toy via the parent's mouth.<sup>3,5,12,15</sup> Oral health counseling during the perinatal stage can be beneficial in the prevention of ECC development.

Strategies that will decrease mother-to-child transmission of cariogenic bacteria include the treatment of the mother's present dental caries, improved oral self-care, dietary counseling, fluoride and xylitol. Xylitol supplementation has shown benefits in reducing maternal levels of cariogenic bacteria.<sup>3,5,16</sup> Xylitol is a naturally occurring sugar alcohol that has been shown to lower *Mutans streptococci* levels in biofilm and saliva, resulting in reduced dental caries.<sup>17</sup> Evidence suggests that the use of xylitol sweetened chewing gum (at least 2 to 3 times a day by the mother in dosages of 5 to 10 grams) has a significant impact on mother-child transmission of *Mutans streptococci* and decreasing the child's caries rate.<sup>14,17-20</sup> One study showed that mothers who chewed xylitol gum (at least 2 to 3 times a day on average, starting at the sixth month of pregnancy, and continued for 13 months) had children significantly less likely to show *Mutans streptococci* colonization than the control group children ages 9 to 24 months. The children whose mothers did not chew xylitol gum acquired *Mutans streptococci* 8.8 months earlier than those whose mothers did chew the gum. The study suggested that maternal xylitol gum chewing may show beneficial effects to reducing transmission of cariogenic bacteria.<sup>21</sup>

### **Rendering of Dental Care during Pregnancy**

Patient positioning modifications during the third trimester of pregnancy should be considered. Lying back in the dental chair can be uncomfortable in the final weeks of pregnancy. Due to the increased size of the uterus, it is advised to use a pillow or rolled

up towel, to elevate the right hip and displace the uterus to the left. Having the patient lean to their left side releases uterine pressure off the inferior vena cava, and promotes oxygenation. Semi-supine position may also be advised for patient comfort. These simple positioning modifications can prevent dizziness, nausea and supine hypotensive syndrome. In addition, dental appointments should be short in duration (Table I).<sup>2,5,13</sup>

Guidelines for dental radiographs during pregnancy have been established. Recommendations advise that dental radiographs are safe throughout pregnancy, and that x-ray exposure for a diagnostic procedure does not cause harmful effects to the developing embryo or fetus.<sup>22</sup> Dental professionals should follow the ALARA (As Low as Reasonably Achievable) principles to minimize the patient's exposure to radiation. The number and types of radiographs will depend upon the clinical conditions and patient's health history. As standard practice, precautions should be taken, therefore, protective aprons and neck shields should be worn.<sup>23</sup>

Fluoride therapy during pregnancy can be advantageous in the strengthening of enamel and the prevention of dental caries. Professional fluoride varnish application for caries prevention has been endorsed by the American Dental Association.<sup>16</sup> Since it has not been cleared for marketing by the U.S. Food and Drug Association for this purpose, it remains an "off-label" use of the product. There are many benefits to using fluoride varnish, such as time efficiency, patient acceptance and compliance over other professional fluoride methods.<sup>16</sup> Additionally, pregnant women should be advised to use a fluoridated toothpaste and over-the-counter mouth rinse containing 0.05% sodium fluoride once a day or 0.02% sodium fluoride rinse twice a day for enamel remineralization and caries prevention.<sup>2</sup>

Routine prophylaxis and periodontal scaling and root planing may be provided during pregnancy. According to the American Academy of Periodontology, "For pregnant women, proper periodontal examination and treatment, if indicated, can have a beneficial effect on the health of their babies."<sup>24</sup> Furthermore, advanced periodontal treatment may be rendered safely, during the beginning of the second trimester. To ensure the health of both mother and child, the American Academy of Periodontology urges for the prompt treatment of acute periodontal infections during any stage of pregnancy.<sup>24</sup>

Professional guidelines regarding pregnancy advocate for continuation of restorative care.<sup>3,5,6</sup> Restorative therapy to remove carious lesions to improve the mother's oral health and reduce the

cariogenic bacterial load can occur during pregnancy.<sup>5,6,9</sup> Short term exposure of dental composite restorations and sealants suggests no health risks. Furthermore, amalgam placement has been reaffirmed as safe, when best practices are utilized.<sup>25,26</sup> There is no significant data for long term usage of these dental treatments.<sup>5</sup>

A study reporting the associations between adverse pregnancy outcomes and essential dental treatment did not significantly increase the risk of any adverse outcomes to mother or fetus. The research included both temporary and permanent restorations, endodontic therapy and extractions.<sup>6</sup> In addition, dental professionals administered local anesthesia as deemed appropriate during treatment. The study was conducted during the gestational period of 13 to 21 weeks.<sup>6</sup>

### **Infant Oral Health**

Dental care during pregnancy includes educating the mother about the importance of infant oral health. An infant should receive a dental exam at age 6 months, or by the eruption of the first primary tooth. Parents should establish a dental home for infants by 12 months of age. Early establishment of a dental home is crucial in ECC prevention and intervention.<sup>3,5,9,14,27</sup>

Anticipatory guidance helps a parent learn what to expect during their infant's present and future developmental stages. Oral health preventive counseling should include oral hygiene, fluoride exposure, nutrition and diet, nonnutritive oral habits (such as pacifier use and thumb sucking), dental trauma, and injury avoidance.<sup>2,9</sup> Best practice brushing technique involves lifting the lip away to expose the cervical one-third portion of the anterior teeth. This technique has a 2-fold purpose, to effectively brush at the gumline and examine for early carious lesions. Parents should be advised to brush their child's teeth twice daily, using a smear layer of fluoridated toothpaste on a child size toothbrush is advised for an infant of moderate to high caries risk, and a pea-sized amount of fluoridated toothpaste for children older than 2 years of age. Parental brushing from infancy, as well as supervised brushing up to 8 years of age, is recommended for effective removal of biofilm, and to prevent excessive intake of fluoridated toothpaste.<sup>5</sup> All necessary precautions should be taken during tooth develop-

ment to prevent fluorosis.<sup>16</sup> Lastly, dietary education includes the discussion of the cariogenicity of certain foods and beverages, the consequence from frequent consumption of sugary beverages and foods, and the demineralization process. The dental team should discourage parents putting their infant to bed with a bottle containing anything other than water, after the first tooth eruption.<sup>9,14</sup>

## **Conclusion**

When rendering best practices, dental professionals may safely treat women during pregnancy. Pregnancy is not a time to postpone preventive or therapeutic dental care. Pregnancy can be an opportunistic time when women may be more receptive to oral health information and treatment, and for women of low-socioeconomic status, may be the only time they are eligible to receive dental care coverage.<sup>8,15,18,21,28</sup> Oral health promotion during pregnancy will ensure both improved oral health for the mother, and encourage a healthier future for the oral cavity of the child. In order for optimal care during pregnancy and infancy to occur, the future health care model must involve interdisciplinary collaboration.

Oral health care during pregnancy should be a shared responsibility among the prenatal professional, patient and dental team. To increase oral health access to these specific populations, the following must occur: OBGYNs informing patients of the importance of oral health and disease prevention during pregnancy, increasing patients' knowledge base to enable self-advocacy and educating dental professionals about the importance of treating patients during pregnancy and infancy. The dental community must promote an awareness of oral health being an essential part of overall care, and discourage the belief of oral health as a form of supplemental care. Improving the communication of health care disciplines, as well as, encouraging medical-dental student collaboration and interdisciplinary scholarship among health professionals, will ultimately provide mutual patients with better overall health care and well-being.

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# Review of the Literature

## The Relationship Between Postmenopausal Osteoporosis and Periodontal Disease

Diane Z. Dodd, RDH, MS; Dorothy J. Rowe, RDH, MS, PhD

### Introduction

Two of the major public health problems of the aged population today are osteoporosis and periodontal disease. The social and financial costs of bone fractures and tooth loss are common among the aged.<sup>1</sup> The cost to the U.S. health system is estimated to be approximately \$20 billion annually for emergency calls, surgical treatment, physiotherapy and rehabilitation, time missed from work, and emotional distress due to impaired lifestyles.<sup>2</sup>

Osteoporosis is a systemic disease involving loss of bone mineral density, resulting from an imbalance between bone formation and resorption.<sup>3</sup> Osteoporosis and related fractures are the primary health care concern in America, being more prevalent than coronary disease, stroke and breast cancer.<sup>4</sup> Postmenopausal osteoporosis is the most common form of osteoporosis. The risk of fracture increases exponentially after menopause, manifesting itself in wrist fractures after the age of 50, vertebral fractures after the age of 60 and hip fractures after the age of 70. The Report of the United States Surgeon General states that half of all American citizens older than 50 will be prime candidates for low bone mineral density by 2020, predicting that 1 in 3 women will be affected.<sup>5</sup>

Unlike osteoporosis, periodontal disease is a localized inflammatory response to bacteria in the mouth, causing alveolar bone loss. Because the number of older people in the population worldwide has increased and more of these older adults are retaining their teeth, the potential for greater prevalence of periodontal disease is increasing.<sup>2</sup>

Interest in the relationship between osteoporosis and periodontal disease has increased over the

### Abstract

**Purpose:** The purpose of this literature review is to summarize the scientific evidence, examining the relationship between postmenopausal osteoporosis and periodontal disease, and to determine if the relationship is causal or casual. A total of 8 electronic databases were searched to identify studies that included the following keywords: osteoporosis, periodontal disease, alveolar bone loss, estrogen deficiency, tooth loss and postmenopausal. Relevant abstracts were retrieved and critically evaluated. Based on the inclusion criteria of dentate postmenopausal women, selected articles were identified to read for more thorough examination. Of the 5 longitudinal studies reviewed, 4 (80%) showed an association between osteoporosis and periodontal disease. A relationship between the 2 diseases was demonstrated in 20 (80%) of the 25 cross-sectional studies. All 3 of the case-control studies showed an association. These data suggest a positive association between osteoporosis and periodontal disease. Determining whether this relationship is causal will require more longitudinal studies. Based on these findings, it is recommended that medical and dental professionals enhance their collaborative actions for prevention, evaluation and treatment of oral diseases and osteoporosis, in order to improve the health of these postmenopausal women.

**Keywords:** osteoporosis, periodontal disease, alveolar bone loss, estrogen deficiency, tooth loss, and postmenopausal

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years. The influence of osteoporosis on the progression of periodontal disease was not studied until Groen's report in 1968.<sup>6</sup> Recently, investigations linking oral and systemic diseases have become popular in the medical and dental fields. Both osteoporosis and periodontal disease occur more frequently after the age of 35, and they share several risk factors (Table I).<sup>7</sup>

Knowing the role that osteoporosis plays in the destruction of alveolar bone may help to identify methods which would be useful for diagnosing both osteoporosis and periodontal disease.<sup>8</sup> The American Academy of Periodontology considers that postmenopausal osteoporosis is a risk factor for periodontal disease.<sup>9</sup> On the other hand, osteoporosis

is not an etiologic factor in periodontal disease, but may affect the severity of pre-existing periodontal disease.<sup>10</sup> The purpose of this comprehensive literature review is to summarize the scientific evidence, examining the relationship between postmenopausal osteoporosis and periodontal disease, and to determine if the relationship is causal or casual.

## Methods and Materials

The search strategy consisted of identifying key terms: osteoporosis, periodontal disease, alveolar bone loss, estrogen deficiency, tooth loss and postmenopausal. Literature was searched in 8 databases: PubMed, CINAHL, Web of Science, Google Scholar, Cochrane Library, Melvyl, PsychINFO and NCBI. Over 520 articles were identified and screened for potential inclusion on the basis of their abstract. Inclusion criteria limited studies to dentate postmenopausal women and periodontal disease. Additional articles were identified from reference lists of selected articles. The full texts of 107 articles were read for thorough examination. The types of studies included in this review were longitudinal, cross-sectional and case-control studies.

## Review of the Literature

This literature review identified and examined the scientific evidence, which had investigated the relationship between osteoporosis and periodontal disease. The authors found that researchers had used a variety of methods in those studies, both in their study designs and their assessments of osteoporosis and periodontal disease. Because methods affect results and conclusions, it is critical to understand the methodology of the studies. Therefore, this review will begin with an explanation and evaluation of the methods to assess osteoporosis and periodontal disease.

### Assessment of Osteoporosis

The disease condition of osteoporosis is usually determined by a measurement of bone mineral density (BMD). BMD is expressed in terms of the number of standard deviations (SD) from the mean of healthy individuals, matched to age and sex (the Z-score), and the number of SD from the mean of healthy young sex-matched individuals (the T-score).<sup>11</sup> According to the World Health Organization, osteoporosis is considered to be present when BMD is 2.5 SD below the BMD of the young normal individual. Osteopenia is defined as bone density levels between 1 SD and 2.5 SD below normal BMD.<sup>11</sup> Fracture risk is approximately doubled for every 1 SD below the young adult mean BMD.<sup>12</sup>

Table I: Modifiable and non-modifiable risk factors of osteoporosis and periodontal disease

Risk Factor	Osteoporosis	Periodontal Disease
<b>MODIFIABLE</b>		
Smoking	X	X
Medications	X	X
Oral Hygiene	?	X
Poor Nutrition	X	X
Calcium and Vitamin D	X	X
Stress	?	X
Living in Poverty	X	X
<b>NON-MODIFIABLE</b>		
Age	X	X
Sex	X	?
Genetics	X	X
Race	X	X
Medical conditions	X	X
Medications	X	X
Family History	X	X

Table II: Outcome measures to assess osteoporosis and the percentage use of each measure

Assessment	Abbreviation	Usage
Dual Energy X-ray Absorptiometry	DXA	81%
Dual Photon Absorptiometry	DPA	2%
Digital X-ray Radiogrammetry	DXR	2%
Quantitative Ultrasound	QUS	4%
Computerized X-ray densitometry	CXD	4%
Dental Panoramic Radiograph	DPR	7%

There are several tools available to measure BMD (Table II). The most widely recognized is dual-energy x-ray absorptiometry (DXA). Non-invasive DXA is reliably used around the world to identify patients with low BMD because of its high precision and resolution, high accuracy, low radiation dose, and low cost.<sup>13</sup> Although it requires visiting a separate facility, which can be inconvenient, it remains the gold-standard assessment of osteoporosis. Dual-photon absorptiometry (DPA) is similar in concept to DXA, however, it is not as advantageous because it has a longer scan time and shorter source life.<sup>7</sup> Prior to the development of computerized densitometry, digital x-ray radiogrammetry (DXR) was used. This less precise technique esti-

Table III: Classification of mandibular inferior cortical (MIC) appearance to indicate bone loss

Classification*	MIC Appearance	BMD Status
C1 Normal cortex	Endosteal cortical margin even and sharp on both sides	Normal
C2 Mild to moderate cortex erosion	Endosteal margin with semi-lunar defects (lacunar resorption) or endosteal cortical residues	Probable bone loss
C3 Severely eroded cortex	Cortical layer exhibiting heavy endosteal residues and obvious porosity	Severe bone loss

\*According to the method of Klemetti et al<sup>20</sup>

mates BMD by evaluating a standard radiograph of the hand.<sup>14</sup> A less common assessment test used by 2 studies in this review is the Quantitative Ultrasound (QUS) of the calcaneal and phalanges.<sup>15,16</sup> It provides a measure of skeletal status by determining a Stiffness Index (SI), a measure of bone strength, which is sensitive to bone structure.

Another type of osteoporosis assessment method measures the thickness of the mandibular inferior cortex (MIC) below the mental foramen on a dental panoramic radiograph (DPR).<sup>17</sup> The cortical bone was chosen over the trabecular bone due to its greater consistency among readings, which may be due to trabecular bone being more easily influenced by dental infections.<sup>18</sup> The porosity of the MIC is classified using the Klemetti Index (Table III).<sup>19</sup> This classification system is an excellent means to determine undiagnosed osteoporosis.<sup>20</sup> Based on MIC findings of erosion or thin cortical width on DPR, younger postmenopausal women could be identified as osteoporotic.<sup>21</sup> A decrease in MIC thickness by 1 mm was shown to increase the likelihood of osteoporosis by 47%.<sup>22</sup> Mild to moderate MIC erosion on the DPR correctly reflected the presence of osteoporosis 83% of the time, and a normal MIC reading predicted a normal BMD 60% of the time.<sup>18</sup> This means that normal spine BMD would correlate with normal MIC evaluations on DPR greater than half the time. This method has great potential because DPRs are taken as part of routine dental examinations.

### Assessment of Periodontal Disease

Many dental conditions affect the postmenopausal age group, including tooth loss and periodontal disease and prevalence increases with age.<sup>2</sup> In the reviewed studies, periodontal disease was assessed with a diversity of outcome measures (Table IV). In general, studies lacked concise and widely accepted assessment criteria for diagnosing periodontal disease, making comparisons among studies and conclusions challenging. Gomes-Filho proposed a gold standard of the combination of

Table IV: Outcome measures to assess periodontal disease and the percentage use of each measure

Outcome Measures	Abbreviation	Usage
Gingival Index	GI	3%
Gingival Recession	GR	5%
Bleeding on Probing*	BOP	15%
Clinical Attachment Loss*	CAL	13%
Probing Depth*	PD	17%
Calculus Index	CI	4%
Plaque Index	PI	8%
Alveolar Bone Loss	ABL	2%
Alveolar Bone Density	ABD	2%
Alveolar Bone Height	ABH	<1%
Alveolar Crestal Height	ACH	2%
Alveolar Crestal Density	ACD	4%
Alveolar Bone Mass	ABM	<1%
Community Periodontological Index of Treatment Needs	CPITN	3%
Decayed Missing Filled Teeth	DMFT	<1%
Tooth Count	TC	10%
Mandibular Inferior Cortex	MIC	2%

\*"Gold standard" clinical descriptors as identified by Gomes-Filho<sup>24</sup>  
Some studies used more than one outcome measure

periodontal bone resorption (>3 mm) with 3 other clinical descriptors for the disease: pocket depth (PD) (>4 mm), clinical attachment level (CAL) (>3 mm) and bleeding upon probing (BOP).<sup>23</sup> These 3 clinical descriptors had the greatest frequency among the reviewed studies, with probing depth used 17% of the time, CAL 13% and BOP 15%, confirming that Gomes-Filho made a logical choice. Using a standardized grouping of these 3 clinical outcome measures in future studies would facilitate studying the association between periodontal disease and osteoporosis.



Table V: Relationship of osteoporosis and periodontal disease, determined by investigations using the longitudinal study design, listed in sequential order beginning with the most recent

Citation	Population	Osteoporosis	Periodontal Disease	Relationship
Gomes-Filho IS 2012	48 Brazilian >50 years old	DXA	PD GR BOP CAL	Yes
Jonasson G 2009	40 Swedish aged 49 to 80	DXA	ABM	Yes
Jonasson G 2006	131 Swedish aged 22 to 75	DXA	ABM	Yes
Famili P 2005	398 women >65 years old	DXA	PD CAL	No
Hildebolt CF 2002	49 women mean age 60	DXA	ACH	Yes

### Investigations Studying the Relationship

Common risk factors between osteoporosis and periodontal disease can be both modifiable and non-modifiable (Table I). Examining the relationship between the 2 diseases requires addressing these factors as well as the type of study design. Studies will be discussed according to the type of study design used by investigators: longitudinal, cross-sectional and case-control.

### Investigations using the Longitudinal Study Design

Five longitudinal studies were reviewed (Table V), all of which used DXA as an osteoporosis assessment, and 4 showed an association between osteoporosis and periodontal disease. In a recent study, the recurrence of periodontitis among women who had been non-surgically treated for periodontal disease occurred with greater severity in women with osteoporosis than in those without osteoporosis.<sup>24</sup> Studies by Jonasson found that mandibular trabecular patterns could be used as an indicator of osteoporosis.<sup>25</sup> They demonstrated that skeletal bone loss was associated with a decrease in alveolar bone mass and that less alveolar bone was a highly significant predictor of future fracture risk. The long observation time of 10 years in this study makes the results highly credible. The study conclusions also suggest that DPRs could be used to screen patients prior to recommending further osteoporosis testing.<sup>26</sup> In the Hildebolt study, after 3 years of hormone replacement therapy, osteoporotic postmenopausal women had significant increases in their alveolar crestal height (ACH).<sup>27</sup> This increased bone mass was observed throughout the body, indicating the positive relationship between systemic and oral bone loss.

One study did not show a relationship between osteoporosis and periodontal disease. Famili stud-

ied a total of 253 dentate women, and found no difference in absolute or percentage change in BMD between women with or without periodontal disease.<sup>28</sup> The lack of association did not seem to result from a lack of reproducibility of probing depth and recession/hyperplasia measurements because the intra-examiner kappa index indicated significant reliability. Another explanation for the findings may be that the population was older and had greater numbers of missing teeth, possibly due to periodontal disease that occurred earlier in life.

### Investigations Using the Cross-sectional Study Design

The 25 cross-sectional studies are listed in sequential order beginning with the most recent (Table VI). The majority of these studies (81%) used DXA as the measurement of BMD, while the periodontal disease assessments varied greatly. Twenty cross-sectional studies showed an association between osteoporosis and periodontal disease with varying degrees of significance. The studies of most interest were those using DPR to determine MIC classification of oral bone loss. Using this technique, the likelihood of osteoporosis was increased by a 1 mm decrease in MIC thickness.<sup>22</sup> Another study found that mild to moderate MIC erosion was associated with osteoporosis 83% of the time.<sup>18</sup>

Another approach with potential to link osteoporosis and periodontal disease was the study of cytokines, the presence of which was observed in both diseases.<sup>8</sup> Cytokines, such as receptor activator of nuclear factor K B ligand (RANKL) and osteoprotegerin (OPG), play a critical role in the production of bone-resorbing osteoclasts. Their presence in both conditions illustrates the common mechanism of osteoclast formation and bone resorption. Other biochemical markers of bone turnover, such as serum C-terminal telopeptides, have also been identified in both conditions. Levels were higher

Table VI: Relationship of osteoporosis and periodontal disease, determined by investigations using the cross-sectional study design, listed in sequential order beginning with the most recent

Citation	Population	Osteoporosis	Periodontal Disease	Relationship
Pepelassi E, 2012	90 Caucasian ages 45 to 70	DXA	GI BOP CAL PD GR	Yes
Dvorak G, 2011	204 >45 years of age	DXA	BOP PD DPR	No
Henriques PS, 2011	100 Brazilian women	DXA	DMFT	Yes
Jabbar S, 2011	370 post-menopausal	DXA	Self-assess	Yes
Slaidina A, 2011	79 women aged 49 to 81	DXA	Tooth count	No
Sultan N, 2011	80 Goan women >50 years	DXR	PI GI CAL ABL	Yes
Vishwanath SB, 2011	60 Indian aged 50 to 60 years	DPR QUS	PI BOP PD CAL ABD	Yes
Al Habashneh, 2010	400 Jordanian postmenopausal	DXA	ACH CAL PD BOP	Yes
Nicopoulou-Karayianni, 2009	651 pre/post menopausal	DXA	Tooth count	Yes
Brennan-Calanan, 2008	1,256 post-menopausal	DXA	PI ACH	Yes
Lopes FF, 2008	39 Brazilian post-meno	DXA	CAL	Yes
Vlasiadis KZ, 2008	141 post-menopausal	DXA DPR	Tooth count MCW MIC	Yes
Naitoh M, 2007	30 post-menopausal	DXA	CT	No
Drowdzowska, 2006	67 post-menopausal	DXA QUS	Tooth count	Yes
Kulikowska-Bielaczyc, 2006	65 post-menopausal	DXA	CPITN	No
Taguchi A, 2006	158 Japanese aged 46 to 64	DPR	MIC	Yes
Inagaki K, 2005	356 Japanese pre- and post-	CXD	CPITN	Yes
Wactawski-Wende, 2005	1341 post-menopausal	DXA	ACH PD CI BOP PI tooth count	Yes
Shen EC, 2004	34 Taiwanese women	DXA	PI PD CAL GR	Yes
Gur A, 2003	1,171 women ages 40 to 86 years	DXA	Self-reported tooth count	Yes
Taguchi A, 2003	82 Japanese aged 46-68 yr	ALP NTx*	MIC	Yes
Persson RE, 2002	1,101 women aged 60 to 75	DXA	MIC	Yes
Lundstrom A, 2001	210 70-year-old women	DXA	DPR BWX BOP PD GR PI ABL	No
Ronderos M, 2000	5,922 post-menopausal	DXA	PD CAL CI BOP	Yes
Tezal M, 2000	70 Caucasian aged 51 to 78 years	DXA	CAL ABL PD PI BOP CI	Yes

\*ALP-Alkaline phosphatase, NTx-N-telopeptide cross-links

in an osteoporotic postmenopausal population, as compared to a non-osteoporotic population.<sup>22</sup> The NHANES III study found that calculus played a significant role in a 3-way interaction with CAL and BMD.<sup>29</sup> Women with the highest calculus scores exhibited an inverse association between BMD and CAL. Thus, these data demonstrate a relationship between more severe periodontal disease and greater systemic bone loss.

Modifiable lifestyle factors influenced the association of BMD and tooth loss (Table IV). More damaging behaviors, such as smoking, were related

to less number of teeth and less bone.<sup>30</sup> Dentition count was related specifically to cortical bone in skeletal sites.<sup>15</sup> Loss of posterior teeth related positively to low BMD of the spinal column.<sup>2</sup> The same results were found in the large osteodent study including 665 women in 4 European centers, and confirmed an association between osteoporosis and having less than a full complement of teeth.<sup>31</sup> Inagaki used the criterion of at least 20 teeth, because that number had been set as a major goal of the national oral health campaign in Japan, called 80-20 (80 year-olds retaining 20 teeth).<sup>32</sup> Even with a maximum of teeth, osteoporosis was pres-

Table VII: Relationship of osteoporosis and periodontal disease, determined by investigations using the case-control study design, listed in sequential order beginning with the most recent

Citation	Population	Osteoporosis	Periodontal Disease	Relationship
Passos JS, 2010	139 Brazilian postmenopausal	DPR	PD CAL BOP PBR	Yes
Gomes-Filho, 2007	139 Brazilian postmenopausal	Densitometry	PD GR GI CAL BOP	Yes
Bollen AM, 2000	93 osteoporotic 394 controls	Self-reported	MIC	Yes

ent. That study also confirms that low BMD may not become evident until past the age of 80, and that the reason for tooth loss may not be known. This makes it difficult to use tooth loss alone as an accurate measurement in the analysis of periodontal disease.

A total of 10 studies that showed an association between osteoporosis and periodontal disease were similar in their statistical analysis, although not always similar in their use of assessments. The most recent study, conducted in 2011, confirmed a significant association of age and years since menopause with BMD, showing the importance of specifying those criteria in osteoporosis studies. These postmenopausal women exhibited severe periodontal disease, which was significantly associated with osteoporosis.<sup>33</sup> Alveolar bone density of the maxilla and mandible showed highly significant positive correlation with DXA T-scores, demonstrating the same effects of both disease processes.<sup>16</sup> Three other studies with similar multivariate analyses found >3 times the likelihood of ACH loss in postmenopausal women with osteoporosis.<sup>34-36</sup> The association was stronger in women 70 to 85 years of age, compared to subjects <70 years of age, which confirms the age-related findings in the previously discussed studies by Sultan<sup>33</sup> and Vishwanath.<sup>16</sup> Four cross-sectional studies had the periodontal assessment of CAL in common. Postmenopausal women with osteoporosis had a 2.5 times greater risk of having periodontal disease than women without osteoporosis, confirming the previous findings regarding ACH.<sup>37</sup> Osteoporotic women presented with higher CAL values than those with normal BMD, while CAL measurements of osteopenic women did not differ from those with normal bone density levels.<sup>38</sup> This would suggest that early diagnosis of low BMD prior to confirmed periodontal disease may be beneficial to prevent periodontal disease. Another study also found that osteoporotic sites had significantly higher interproximal CAL values than non-osteoporotic sites in postmenopausal women.<sup>7,39</sup> The statistical results of all these studies suggest osteoporosis as a risk indicator for periodontal disease in postmenopausal women.

Of the 25 cross-sectional studies, 5 did not show

an association between osteoporosis and periodontal disease. In 3 of these 5 studies, the number of teeth was not related to systemic BMD.<sup>40-42</sup> This may indicate that the number of teeth may not be relevant in the assessment of a relationship. Peri-implantitis was not found to be associated with osteoporosis, but peri-implantitis is a very specific class of periodontal disease with specific bacteria.<sup>43</sup> In another study, the MIC assessments significantly differed between normal and osteoporotic groups, however, the authors attributed this difference to functional demands of occlusion on bone remodeling in the mandible.<sup>44</sup> If the local effects of occlusion and the attached muscle, as well as smoking, had been factored out, the results might have demonstrated a more convincing difference.

### Investigations Using Case-control Study Design

The 3 case-control studies matched postmenopausal women with osteoporosis to women with normal bone levels (Table VII). Postmenopausal women with a history of osteoporotic fractures tended to have increased resorption and thinning of the mandibular inferior cortex, as compared to their matched controls.<sup>17</sup> In postmenopausal women with low educational levels, subjects with osteoporosis were predisposed to more severe periodontal disease than their matched controls without osteoporosis.<sup>1,23</sup> Case-control studies have the potential to assess associations between an exposure (osteoporosis) and an outcome (periodontal disease), but not whether the exposure preceded or caused the outcome. This is a limitation of the case-control study design.

### Conclusion

This comprehensive literature review demonstrates the possible association between postmenopausal osteoporosis and periodontal disease: postmenopausal women with low systemic BMD tended to have greater loss of alveolar bone and clinical attachment. Four reasonable hypotheses for these results include destructive lifestyle risk factors, susceptible genetic factors, increased production of inflammatory mediators and less initial BMD in both systemic and oral bones.<sup>7</sup> However, the evidence is inadequate to determine the most likely hypothesis.

Demonstration of a relationship between osteoporosis and periodontal disease is complex because both are multifactorial diseases sharing multiple risk factors.<sup>43</sup> A major issue affecting the ability to relate osteoporosis with periodontal disease is the lack of uniformity in diagnosing periodontal disease. Specific criteria have not been established, as evidenced by the fact that 21 different assessments in a variety of combinations had been used in the studies of this review. Because these different outcome measures influence the definition of periodontal disease, determining whether periodontal disease is associated with osteoporosis may not currently be feasible. A precise measurement of periodontal disease is needed to validate investigations on this topic.<sup>1</sup> Furthermore, well-designed longitudinal studies, addressing all these factors, are recommended to determine whether the relationship between osteoporosis and periodontal disease is causal.

Based on the findings of this study, cross-communication and patient referral between medical and dental professionals are recommended to im-

prove the health of the postmenopausal public. The radiographic information gathered in dental offices can be used to screen patients for undiagnosed low BMD of the jaws, not to diagnose osteoporosis. The goal is to recognize the potential risks for low BMD and potential fracture, and to refer patients to their medical doctor.<sup>45</sup> Collaborative actions for prevention, evaluation and treatment of oral diseases and osteoporosis in postmenopausal patients can offer benefits in terms of reduced tooth loss, less periodontal disease and less loss of BMD. These outcomes would yield a healthier life for postmenopausal women, ultimately reducing co-morbidities and oral health care costs.

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# Review of the Literature

## Teledentistry: A Systematic Review of Clinical Outcomes, Utilization and Costs

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### Introduction

Teledentistry is the use of information technology and telecommunications for dental care, consultation, education and public awareness in the same manner as telehealth and telemedicine.<sup>1</sup> Teledentistry can also be used to assist general dentists with specialty work and improve services to underserved populations with no or limited access to care.<sup>2,3</sup> Alongside the many branches of telemedicine, the number of teledentistry programs has been steadily increasing.<sup>2</sup>

Systematic reviews help summarize and critically synthesize the available body of literature and are useful in clinical decision-making and program planning, especially in a newer research area where quality and scope of studies is variable.<sup>4</sup> Systematic reviews also help to identify areas in which research is currently lacking.<sup>4-7</sup> While there is a growing body of literature on teledentistry, no systematic reviews have been published.

Jennett et al conducted a systematic review of the socio-economic impact of general telehealth.<sup>8</sup> Dentistry was one of several areas examined in a brief overview of the types of socio-economic outcomes used in the teledentistry studies and the number of studies demonstrating benefits on those outcomes. This paper provides a systematic review of the scientific literature in order to evaluate the efficacy, effectiveness and costs of teledentistry used for direct patient services, specifically clinical outcomes, health care utilization and costs related to teledentistry. These outcomes were selected to reflect a common objective of teledentistry programs - to provide access to quality services while minimizing costs.

### Abstract

**Purpose:** The purpose of this systematic review is to identify clinical outcomes, health care utilization and costs associated with teledentistry. Relevant databases were searched for articles on teledentistry published until March 2012, reference lists examined and key journals hand searched. Of a possible 58 articles, 19 studies met the inclusion criteria.

Clinical outcomes were generally improved following a teledentistry intervention and satisfaction with teledentistry was consistently high. The few studies examining health care utilization reported mixed findings, but preliminary evidence suggests cost savings for health care facilities.

There is a consistent trend in the literature supporting the efficacy and effectiveness of teledentistry. Further research is needed to identify the effectiveness, efficiency, utilization and costs of teledentistry as it could provide the key to improving access to care.

**Keywords:** telemedicine, telehealth, teledentistry, videoconference, outcomes, dental hygiene, access to care

This study supports the NDHRA priority area, **Health Promotion/Disease Prevention:** Identify, describe and explain mechanisms that promote access to oral health care, e.g. financial, physical, transportation.

### Methods and Materials

#### Search Strategy

For the present study, teledentistry is defined as the use of communication and information technologies to provide clinical services from a distance. Electronic databases were searched to identify relevant articles. Searches were limited to the English language and publication date from the earliest available date for each database to March 2012. Literature searches were conducted using PubMed/Medline, EMBASE, CINAHL with Full Text, PsychINFO, EBM Reviews (e.g. Cochrane Database of Systematic Reviews, ACP Journal Club, Database of Abstracts of Reviews of Effects, Cochrane Central Register of Controlled Trials, Cochrane Methodology Register, Health Technology Assessment and NHS Economic Evaluation Database), Scopus, Education Resource Information Center (ERIC), Google Scholar and Turning Research into Practice (TRIP). The search strategies

included subject headings and subheadings (if available) combined with keyword searching. The search concepts included teledentistry, telemedicine, telehealth, remote consultation, cost effectiveness, outcome, dentistry and dental services.

### Selection Criteria

Studies were included if they were designed as an interventional study (experimental and observations based on judgments from teledentistry images), used quantitative or qualitative approaches, and presented findings related to outcomes or costs. There were no restrictions for age or care setting (e.g., home, community or facility).

Studies were excluded if they included only telephone interventions (unless telephone intervention was one group of the study, with a video component in the other, or unless other technologies were paired with the use of the telephone), the technology was smart home monitoring devices, examined telehome care of patients with chronic disease who received only nursing interventions with no dental care objective, reported only the development phase of the technology (i.e., feasibility of the technology in a lab setting), examined only the support for caregivers of patients, were program descriptions or reports not designed as research studies, and were redundant articles which dealt with the same intervention and did not report any new outcomes.

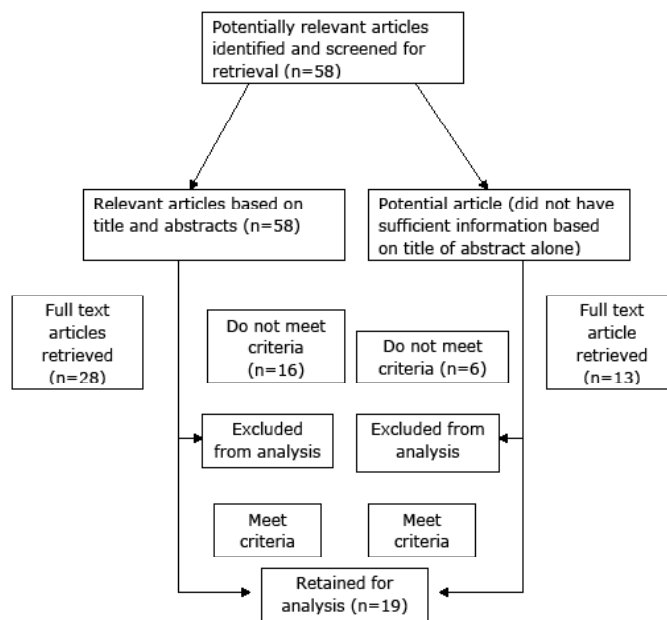
Studies were also excluded if they provided insufficient information to allow adequate interpretation of the study design, measures or results, or if they were only found in abstract form, in abstracts or posters from conference proceedings.

Based on the identified criteria, potential eligible articles were first determined by examining article titles and abstracts from the database searches. Full-text articles were then retrieved and evaluated for relevance. Articles were excluded at this point if they failed to meet the criteria after the full texts were examined. Figure 1 represents the flow chart of identifying relevant articles for analysis. A second researcher reviewed all articles using the same criteria for inclusion and exclusion. The 2 reviewers compared selected articles, discussed differences of opinions holding each selection to the inclusion criteria and confirming the relevance and findings from the selected articles. A total of 19 articles were retained for analysis.

### Data Extraction and Outcome Measures

The articles were reviewed and a data extraction form was used to include details pertaining to the

Figure 1: Flow chart of identifying relevant studies for analysis



study quality, such as study design, number of subjects and study population, as well as the description of the program and technology used. The following types of reported outcomes of interest were recorded:

- Clinical: Outcomes related to service delivery, such as attendance and adherence to programs and recommendations, as well as health care provider and staff satisfaction with the program
- Health care utilization: Events that occur outside the program's scope and that the program may aim to reduce or increase, such as hospitalizations and admissions
- Costs: From the perspectives of patients, providers or organizations, all costs (savings and/or expenses) associated with the use of teledentistry

## Results

As Figure 1 indicates, 19 studies were retained after the initial screening of 58 titles, abstracts and the full-text retrieval of pertinent articles.<sup>9-27</sup> The search strategy and selection criteria did not limit the type of experimental or observational design.

### Clinical

Articles of clinical outcomes focused on validity, accuracy and reliability of teledentistry in screening for dental caries, identification of oral mucosal lesions and orthodontic consults and referrals (Figure 2).



## Dental Caries

Five studies comparing clinical and teledentistry screenings for dental caries examined the following: feasibility validity, reliability prevalence and inter-examiner agreement.<sup>10,17,20,22,27</sup> Dental caries, restored teeth, missing or extracted were scored as decayed filled surfaces (DFS) deft for the primary dentition, or decayed, extracted, filled teeth (DEFT) for the permanent dentition.<sup>10,17,20,22</sup>

Clinical screening methods varied among the studies from use of a mirror only to use of a mouth mirror, light and explorer by a calibrated pediatric dentist.<sup>17,27</sup> Not only did methods for clinical examination differ, but also the number of intraoral images captured for teledentistry screenings ranged from no specific number reported to 6 images.<sup>10,27</sup> Cameras used to capture images and number of teeth captured in an image also varied among the 5 studies.<sup>10,17,20,22,27</sup>

Type of personnel differed among the studies. In one study, 6 telehealth assistants captured images of children in 6 Head Start centers for transmission to a dental examiner who would screen for DFS to determine prevalence of dental carries.<sup>20</sup> In another, a registered dental hygienist and registered dental assistant performed both clinical and teledentistry screenings.<sup>10</sup> In another study examining the validity of teledentistry screening, the clinical screening was performed by an experienced dentist using light, mirror and explorer to establish a gold standard against which the teledentistry screening by 4 dentists was measured.<sup>22</sup>

No statistical difference was found between teledentistry and clinical screening for dental caries. Sensitivity ranged from 98 to 100% . The use of teledentistry screening and clinical screenings for dental caries in young children was shown to be both cost-effective and valid.<sup>17,22</sup> The Kappa statistic for reliability between clinical and teledentistry screenings for early childhood caries ranged from 0.58 to 0.61.<sup>10,17</sup> Identification of primary teeth in need of restoration resulted in Kappa 0.93.<sup>10</sup>

There was no significant difference between the use of clinical and teledentistry screenings in assessing prevalence of early childhood caries.<sup>27</sup> The mean of DFS with clinical examination was 1.40 (SD=4.07) and with teledentistry was 1.56 (SD=4.15).<sup>27</sup>

## Orthodontics

Teledentistry examination to identify the need for orthodontic referral was found to be as effective as referral from clinical examinations.<sup>13</sup> Orthodontic

Figure 2: Oral Lesions and Conditions Documented in Teledentistry Assessments

Oral Lesions:
<ul style="list-style-type: none"><li>• dental caries (initial and advanced)</li><li>• mucocele</li><li>• fibrous hyperplasia</li><li>• leukoplakia</li><li>• candida</li><li>• ulceration</li><li>• tongue lesions</li><li>• fibro epithelial polyps</li><li>• amalgam tattoos</li><li>• denture granulomas and keratosis</li><li>• orofacial granulomatosis</li><li>• sialosis</li><li>• aphthous ulcer</li><li>• epidermoid carcinoma</li><li>• Pyogenic granuloma</li></ul>
Malocclusions:
<ul style="list-style-type: none"><li>• open bite</li><li>• overjet</li><li>• overbite</li><li>• bilateral Class III molars</li><li>• maxillary incisor irregularity</li><li>• posterior crossbite</li></ul>
Gingivitis
Dental trauma
Fractures
Root canal orifices

referral rates for teledentistry and clinical examinations were compared. Acceptance by orthodontists of children screened using teledentistry or clinical methods was also reported.<sup>13</sup> Sensitivity for referrals using teledentistry was 80% and specificity 73%. Use of teledentistry for referrals resulted in a positive predictive value of 0.92. The negative predictive value was 0.50, which occurred due to half of the children (n=22) that would have been accepted by an orthodontist if a clinical examination had been performed. The Kappa score of 0.46 reflects moderate agreement of orthodontist acceptance of teledentistry referrals. The teledentistry group was less likely to refer an individual who did not need orthodontic care than those who made referrals based on clinical examinations.<sup>13</sup>

Teledentistry has been used in offsite clinics to assess orthodontic need and to provide instruction for students providing interceptive orthodontics. When compared to a second group of students at a site with face-to-face faculty supervision, the assessment of need and development of interceptive appliances was found to be as effective as the site where faculty were present.<sup>19</sup>

## Endodontics

The accuracy and reliability of teledentistry for identifying canals within extracted molars resulted in moderate agreement among 20 examiners. A total of 88% of canals in the 50 permanent molars were identified correctly from photographs. Dentists with >10 years of experience were more accurate in detecting canals than those with less experience. Accuracy of detection was also greater in mandibular molars than maxillary molars.<sup>26</sup>

## Oral Lesions and Screening for Oral Trauma

Access to an oral medicine specialist or oral pathologist for diagnosis of lesions is often limited, or long waiting periods exist. One feasibility study compared 2 specialists' teledentistry diagnosis of 25 cases to final diagnosis.<sup>21</sup> Biopsy was performed in some cases to obtain exact pathology. The 2 examiners agreed on correct pathology in 60% of the cases. In the 10 remaining cases the examiners were not accurate with the diagnosis or they were not in agreement. One examiner correctly identified 88% of the 25 cases.<sup>21</sup> In the final analysis, weighted kappa only resulted in fair agreement ( $K=0.28$ ).

Of 37 patients in Belfast who had been on wait lists for clinical examinations by an oral medicine specialist, teledentistry examinations found 8 patients needing urgent biopsies, and 24 patients with common oral lesions were treated in the community dental service under a consultant's supervision via teledentistry.<sup>23</sup>

Telemedical centers in Switzerland provide free consultations for triage associated with trauma or other conditions. Looking toward future changes to decrease costs in the Swiss health system that would require all individuals have a teledental or telemedical consult prior to accessing a health care provider, one group of researchers conducted a retrospective study of dental triage data obtained over 7 years to determine the nature and advice provided.<sup>24</sup> Of the 371,988 telephone sessions, most were provided by medical personnel, contacts occurred after hours and involved dental trauma to children ( $n=3,430$ , average age 8.6 years).<sup>24</sup>

In summary, there are fewer studies that examined satisfaction outcomes as compared to clinical outcomes. Nevertheless, there is a trend of good attendance at teledentistry programs and good compliance with 5 studies (26%) reporting on satisfaction.<sup>12,13,15,18,25</sup> While 4 of these studies reported the clinicians' perspective, only 1 study examined both patient and clinician perspectives.

Overall, the findings are very encouraging, with patients and therapists reporting positive perceived benefits, convenience and usefulness of the teledentistry program. Dental professionals rated overall satisfaction with equipment functioning. Radiographs were rated good, and photos and study models were rated either good or excellent.<sup>25</sup> In one study, clinician's found moderate satisfaction with diagnostic information and more concern over equipment security than patient confidentiality.<sup>14</sup>

## Health Care Utilization

A total of 3 studies reported health care utilization outcomes.<sup>11,13,27</sup> The commonly reported outcomes include the effect on referral rates, inappropriate referral rates, failed appointments, prevalence of caries and general dental practitioner visits.<sup>13,27</sup> Inappropriate orthodontic referrals were lower in the teledentistry group (8.2%) compared to the control group (26.2%). Previous inappropriate orthodontic referral rates were up to 45% resulting in poor use of professionals' and patients' time.<sup>13</sup>

In a comparative-effectiveness study, the care utilization in preschool urban children enrolled for teledentistry examinations was as effective and accurate as traditional clinical exams for dental caries screening.<sup>27</sup> No significant difference was found between groups.

## Costs

Two studies presented some type of cost analysis of the teledentistry intervention.<sup>11,15</sup> One examined costs from the patient's perspective using a questionnaire to obtain information concerning distance, travel time and cost to visit a specialist's hospital. Cost of time from work and overnight accommodations were also assessed. Travel time resulted in an average of 12 hours lost productivity for those from Orkney and 2.5 hours for patients from Kingussie.<sup>11</sup>

Ignatius et al's 2005 report studied cost of teledentistry technologies for 26 dental specialist trainees in 8 cities in Finland.<sup>15</sup> Costs were calculated for travel, purchase and equipment operation. The use of teledentistry was estimated to save each student at least 43,600 Euros.

## Discussion

The findings from the current systematic review are in part supported by those reported by other telemedicine systematic reviews not related to dentistry. These reviews consistently report that there are a few areas of telemedicine, such as teledermatology, teleradiology and telemental health, where

there is emerging evidence for the efficacy of telemedicine, but few studies supporting the cost benefits of telemedicine, and no evidence of the long term outcomes of telemedicine.<sup>28-33</sup>

More specifically, this systematic review of teledentistry showed that although there is heterogeneity between studies in terms of study designs, clientele, settings and outcomes measured, a trend exists supporting the efficacy and effectiveness of teledentistry. Many quality studies, including studies with control groups, reported similar or better clinical outcomes when compared to conventional interventions. Use of teledentistry resulted in slightly higher DFS scores than those found in clinical examinations of the same children<sup>10,17,20,22,27</sup> When screening groups of young children, referral for care based on a false positive is not as detrimental as non-referral based on a false negative.

One study reported the incorporation of a 1 credit hour, 15 week teledentistry course in a dental hygiene program.<sup>16</sup> Students' knowledge, attitudes and confidence were evaluated prior to and following the course. Confidence, knowledge and attitudes were significantly different on 9 of the 10 item questionnaire following the course. Including a teledentistry course within the curriculum provides oral care professionals the skills needed to improve access to care.

Overall, satisfaction ratings regarding the use of teledentistry were very high from both patients and therapists, regardless of the patient population, setting or study design. However, certain measurement issues limit the usefulness of the reported data. For example, the tools used to measure satisfaction are for the most part poorly described and not standardized. The underlying satisfaction concept is often vague, making the interpretation of satisfaction findings unclear. Findings are generally limited to satisfaction with the technology, the service received/given, but there are no details of the service delivery or their experience in the program.

The findings in this review are similar to the conclusions arrived at by Mair<sup>33</sup> as well as Williams et al<sup>34</sup> in their systematic reviews of studies reporting patient satisfaction with telemedicine. Continuing to measure user satisfaction in the current manner will simply confirm previous findings of acceptability of the technology, but will not increase the understanding of the underlying processes of teledentistry use. A better understanding of satisfaction remains an important area for future research in teledentistry.

The use of teledentistry for screening of oral diseases to determine prevalence and treatment

needs, and provide access to specialists for consultations, is promising. Oral diseases impact health and quality of life for many. Expanding the roles of dental hygienists and removing practice restrictions would increase the number of oral care providers who could perform screenings, care and referrals using teledentistry.

Reduced costs or better resource utilization is often cited as one of the main goals of teledentistry.<sup>11,15</sup> In conducting cost analyses, it is crucial to identify from which perspective the analysis is being conducted - in other words, who is defraying the costs or achieving the savings, be it the patient, caregiver, clinician, health care organization, health care system, reimbursement agency, society and so on. None of the studies presented here calculated costs using the same elements.

While the studies in this review included calculations of costs incurred or saved from an organizational or patient perspective, the costs were not related to clinical or health care utilization outcomes. If outcomes are similar between a teledentistry program and an alternative program, then cost-minimization or the cheaper of the 2 interventions is an appropriate measure of costs. If outcomes are different, then it is more relevant to identify how much more or less a teledentistry program costs compared to an alternative, taking into account the change in clinical outcomes of each program. Cost differentials such as the incremental cost-effectiveness ratio can be useful in this case.

It may also be pertinent to examine whether certain resources or programs will no longer be available if a teledentistry program is introduced, particularly in a context of limited public health care funding. Monetary costs have to be weighed against the quality of life for individuals who remain on long waiting lists for consultations, referrals or care and children with undiagnosed dental caries who suffer with pain from infection, develop sepsis and die as Deamonte Driver in 2007.<sup>35</sup>

Likewise, costs associated with prolonged waits to receive a diagnosis for certain oral lesions results in increased morbidity and mortality.<sup>23</sup> Dental hygienists utilizing teledentistry in underserved or no access areas could screen, provide care and prevent the progression of an oral disease beyond repair or recovery.<sup>23</sup>

### **Limitations of this Systematic Review**

It is generally accepted in meta-analyses and systematic reviews that clinical trials, particularly RCTs and other quasi-experimental designs, are best

suiting for assessing the efficacy and cost-effectiveness of an intervention, and thus provide stronger evidence on which to base conclusions.

Common methodological weaknesses in these studies included lack of blinding of dentists, patients or assessors. While in teledentistry it is not always feasible to design studies with patients and dentists who are not aware of group assignment, use of outside assessors reduces the potential for evaluation bias. Many of the studies used convenience samples based on geographical location of patients or patient preference, clearly introducing the possibility of selection bias. A total of 12 studies (60%) had sample sizes of fewer than 20 subjects, and only 1 of the studies provided power calculations.<sup>13</sup> Small sample sizes can lead authors to conclude that no significant difference exists between groups, i.e. a Type II error, whereas the study may have insufficient power to identify a significant difference.<sup>28,29</sup> Nevertheless, larger studies often remain challenging to carry out, as many of the teledentistry programs are still in their pilot phases and there is often limited availability of the patient population concerned.

Another limitation of this systematic review is that it uses studies published in peer-reviewed journals. It is well documented that there is a publication bias toward studies that have positive findings.<sup>36</sup> Therefore, studies that do not demonstrate any effect or report a negative effect of teledentistry may not carry as much weight in the synthesis of the data because they were not identified through

the search. Moreover, this review did not include patient assessment studies as the focus was on intervention programs.

## Conclusion

This systematic review identified a substantial amount of scientific literature in the relatively new area of teledentistry. Although there is heterogeneity between studies in terms of study designs, settings and outcomes measured, there is a consistent trend supporting the efficacy and effectiveness of teledentistry. Further research in the area of teledentistry, with methodologically stronger studies examining clinical outcomes, health care utilization and costs in greater depth are critical for evidence base. From the data available, teledentistry seems to be a promising path for access to care in rural and urban settings.

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## Dental Hygienists' Knowledge, Attitudes and Practice Behaviors Regarding Caries Risk Assessment and Management

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### Introduction

Tooth decay is a common, preventable problem for people of all ages. Increasingly over the past decade, dental hygienists have been urged to perform caries risk assessments (CRA) in their practices to increase the probability that patients will receive appropriate caries preventive treatment. In 2003, then Surgeon General Richard H. Carmona sent out a call to action for all oral health professionals to become part of the solution in reducing oral disease and improving oral and general health for all Americans.<sup>1</sup> Since that time, statistics on caries disease incidence have shown little change. Caries disease prevalence in children ages 2 to 5 has increased from 24 to 28%.<sup>2</sup> Among all adolescents ages 12 to 19, 20% currently have untreated decay. Adults are retaining more teeth and, with the exception of adults ages 50 to 64 who live below the federal poverty level, caries incidence in adults over age 20 has decreased only slightly.<sup>3,4</sup> In the modern history of caries management (post-1850), the disease has been treated by surgically removing the infected portion of tooth and replacing it with a restoration, yet this surgical management technique has not modified the bacterial infection or disease process.<sup>5</sup> Therefore, more conservative and preventive strategies for managing caries disease have been established.<sup>6</sup> Current methods for CRA include a range of objective and subjective methods.

### Assessing Caries Risk

Risk assessment procedures used in

### Abstract

**Purpose:** Lifelong control of disease processes associated with dental caries should be an essential part of the process of care for practicing dental hygienists. The purpose of this study was to identify the knowledge, attitudes and practice behaviors among dental hygienists regarding caries risk assessment (CRA) and management.

**Methods:** Utilizing the American Dental Hygienists' Association (ADHA) Survey/Research Center database of all registered dental hygienists in the U.S., 2,500 actively licensed dental hygienists were randomly selected and sent a web-based survey via SurveyMonkey™. The survey included items about practice characteristics and questions regarding knowledge, attitudes and practice behaviors regarding CRA and management. Second and third emails were sent to non-respondents. A 4-point Likert type scale (1=never, 2=sometimes, 3=frequently and 4=always) was used to rate the occurrence of caries management recommendations used in the practice setting. Frequencies and percentiles were used to evaluate demographic, knowledge and attitude information.

**Results:** The response rate was 9% (n=219) - 87% were ADHA members. Participants reported a high level of comfort (89%) in performing CRA, yet only 23% used an established CRA/management instrument. Over-the-counter fluoride dentifrices (70.1%), individualized oral hygiene instructions (86%) and individualized recare intervals (73.7%) were most often used as caries management recommendations, while low-dose fluoride rinses (45%) and prescription strength sodium fluoride gel or paste (42%) were used less frequently. Dental hygienists scored high on knowledge of CRA with the exception of white spot lesions as a risk factor (42%) and efficacy of chlorhexidine in caries management (61%).

**Conclusion:** There is a need to improve practicing dental hygienists' knowledge and involvement in the active management of caries. Focused training in the use of established CRA/management tools should be designed to improve their knowledge and influence practice behaviors.

**Keywords:** caries risk assessment, caries management, white spot lesion, caries incidence, dental hygienists' knowledge attitudes and practices

This study supports the NDHRA priority area, **Clinical Dental Hygiene Care:** Investigate how dental hygienists use emerging science to reduce risk in susceptible patients (risk reduction strategies).

dentistry should provide sufficient data to accurately quantify a person's disease susceptibility and allow for preventive measures. Risk assessment fosters the treatment of the disease process instead of treating the outcome of the disease, gives an understanding of the disease factors for a specific patient and aids in individualizing preventive discussions, individualizes, selects, and determines frequency of preventive, therapeutic, and restorative treatment for a patient, and anticipates disease progression or stabilization.<sup>7</sup> Models of CRA used in the clinical decision making process should include formal components of these assessment characteristics. Clinical management protocols are documents designed to assist in clinical decision-making - they provide criteria regarding diagnosis and treatment and lead to recommended courses of action.

Several tools are available and commonly used for dental caries risk assessment. To understand the differences and similarities in caries risk assessment models, the distinction between risk factors, risk indicators, clinical findings, circumstances and clinical conditions needs to be identified. The terminology varies among the models, but often describes the same factor, clinical sign, etc.<sup>8-11</sup> These risk assessment models are adjuncts to the clinical judgment of each clinician, as each clinician has his or her own understanding of caries identification and management protocol.<sup>7-11</sup> The Caries-Risk Assessment Tool (CAT) from the American Academy of Pediatric Dentistry (AAPD) is a framework for classifying caries risk in infants, children and adolescents based on a set of clinical findings, protective and biological factors that affect individual dental caries risk.<sup>7</sup> The Cariogram<sup>®</sup> Internet-based program operates in such a way that information on a number of factors - diet, bacteria, susceptibility and circumstances, can be collected on patients of any age.<sup>9</sup> Once entered into the program, the information is evaluated and a summary of results illustrating the future chance of avoiding caries becomes available for clinician and patient use. The California Dental Association caries risk assessment forms allow clinicians to assess caries risk of children ages 0 to 5 and for those patients 6 and older.<sup>10,11</sup> After identifying risk indicators, risk factors and protective factors, clinicians are able to provide dental caries management protocols specific to the patient 6 years or older or for the parent or primary caregiver of the patient under age 6. The American Dental Association (ADA) caries risk assessment forms were developed to help evaluate caries risk in infants and children ages 0 to 6 and for patients over 6 years of age.<sup>8</sup> Clinicians are able to quantify caries risk level at is relates to contributing, general health and clinical conditions. The CRA tools mentioned above are examples of the many methods available to assess and document dental caries risk in clinical settings. All CRA protocols require parent or

patient commitment along with anticipatory guidance and a treatment plan.

Caries risk assessment and management protocols should be based on evidence from current peer-reviewed literature, the judgment of expert panels, as well as clinical experience of practitioners.<sup>7,12,13</sup> Caries management by risk assessment (CAMBRA) is an evidence-based caries management protocol that gives the clinician management strategies allowing them to make appropriate restorative, therapeutic and preventive recommendations.<sup>10,11,13</sup> Once risk level has been established, recommendations of products and protocols will follow, depending on each patient's risk level. Recommendations may take the form of oral self care instructions, antimicrobial use to reduce oral flora, acid neutralizing rinses or sprays, sealants, fluoride varnish, xylitol products and minimally invasive restorative measures.<sup>13</sup>

### **Dental Hygienists' Role in CRA/Management**

Although clinical responsibilities vary based on individual state's scope of practice rules and regulations, the dental hygienists' role as a prevention specialist is constant throughout regions. Dental hygienists are trained to assess risk, educate and help patients manage and reduce risk for oral diseases.<sup>14</sup> Traditionally caries prevention recommendations have included effective brushing, flossing and avoidance of sugary foods, plus twice a year examinations along with fluoride applications. Dental hygienists may take a leadership role in the practice setting by reviewing the literature for development of office protocols in CRA and expanding the preventive and clinical care supplies for caries management. Ultimately, to assess risk, dental hygienists may use a simple, methodical protocol that includes conducting a risk assessment survey, recommending preventive strategies, non-operational, therapeutic procedures, and utilizing additional strategies for patients with special needs. While dental hygienists most likely have undertaken informal, i.e. unrecorded assessments of risk of future caries in individual patients, how they have made these assessments is generally not well understood. There has been no exclusive research in the U.S. on registered dental hygienists' knowledge, attitudes and practice behaviors regarding CRA and management. The entry-level and current practitioner needs to have the knowledge and attitudes necessary to provide the comprehensive care expected in dental hygiene practice today.

The purpose of this study was to identify the current knowledge, attitudes and practice behaviors among registered dental hygienists in the clinical setting involving CRA/management.



Figure 1: Years since Initial Dental Hygiene Licensure in the U.S. (%)

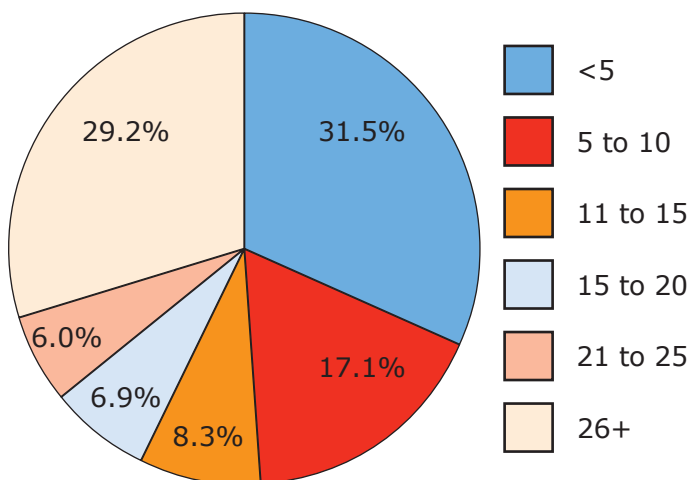
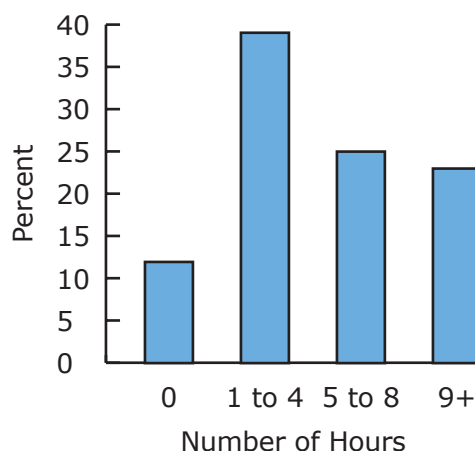


Figure 2: Reported Number of Hours of Caries Assessment Continuing Education Within Past 5 Years



## Methods and Materials

### Survey Instrument and Participants

This descriptive study utilized a cross-sectional survey design that quantitatively measured clinical dental hygienists' knowledge, attitudes (comfort and confidence) and practice behaviors regarding CRA and management. The questionnaire included sections designed to assess knowledge (10 true/false items), factors related to performance of CRA in practice (6 agree/disagree items), attitudes encompassing confidence and comfort (5 agree/disagree items) and caries management recommendations (2 items). A 4-point Likert type scale (1=never, 2=sometimes, 3=frequently and 4=always) was used to rate the occurrence of caries management recommendations used in the practice setting. Evidence-based factors that affect caries disease risk were used to develop the questionnaire. The use of chlorhexidine, xylitol and amorphous calcium phosphate products were included, though research on their efficacy in caries management is ongoing and current level of use is unknown.<sup>15-17</sup> A sixth section assessed professional characteristics and demographics.

Approval for the survey was secured from the Idaho State University Institutional Review Board. A dentist and dental hygienist, both experts in cariology, evaluated the survey instrument for content validity. Confusing verbiage, clarity and typographic issues were identified and corrected. The survey was then administered to dental hygiene faculty (n=8) at the University of the Pacific Arthur A. Dugoni School of Dentistry to determine instrument reliability using the test-retest method.<sup>18</sup> Wording was changed for clarity. An additional 4 clinically practicing dental hygienists pilot tested to assess time needed to complete and readability of questions. No further changes were made as a result of the pilot test.

Utilizing the ADHA Survey/Research Center database of all registered dental hygienists in the U.S., 2,500 actively licensed dental hygienists were randomly selected and sent a Web-based survey, via SurveyMonkey™. Instructions to participants reminded them of their anonymity with regard to survey responses. Second and third emails were sent to non-respondents.

### Statistical Analysis

Frequencies and percentiles were used to evaluate the demographic, knowledge, attitude and risk assessment and management techniques. The Spearman rank correlation coefficient was used to identify if knowledge and attitudes (comfort and confidence) were related. Statistical analysis was completed using the SPSS Statistical 19.0.0.

## Results

Of the 2,500 email surveys sent, only 216 were valid for analysis resulting in a response rate of 9%. Surveys with missing data were excluded. A total of 88% (n=190) of respondents were ADHA members, 31% were between 25 to 34 years of age and 61% were between 35 and 64 years old. A total of 32% of participants (n=68) reported having received licensure within the past 5 years, 39% (n=83) between 6 to 25 years and 29% (n=63) for over 26 years. Figure 1 shows the years since licensure of the survey participants. Figure 2 shows the hours of continuing education (CE) in CRA in the previous 5 years. A total of 86% of respondents (n=186) see patients of all ages in their primary dental hygiene practice setting. In addition to practicing in a clinical setting, other practice settings cited included educational and public health settings. Figure 3 lists the clinical practice settings noted by respondents.

## Knowledge Scores

Knowledge scores were high, with 77% (n=167) having 8 or more correct answers out of 10. Participants correctly identified caries as a transmissible disease (86%) and recognized the multifactorial nature of the disease (98%). History of caries lesions in the last 3 years, low socioeconomic status and reduced saliva flow were correctly identified as increasing risk for caries disease by 88, 86 and 99% of the respondents, respectively. Between 82 and 99% recognized fluoride varnish, xylitol and dietary counseling as factors reducing caries risk. Only 42% (n=90) of dental hygienists identified white spot lesions as incipient caries in enamel, and 60% (n=131) recognized chlorhexidine (CHX) (Peridex; 3M ESPE, Minneapolis, Minn.) as not being bacteriostatic or bacteriocidal to all caries pathogens (Table I).

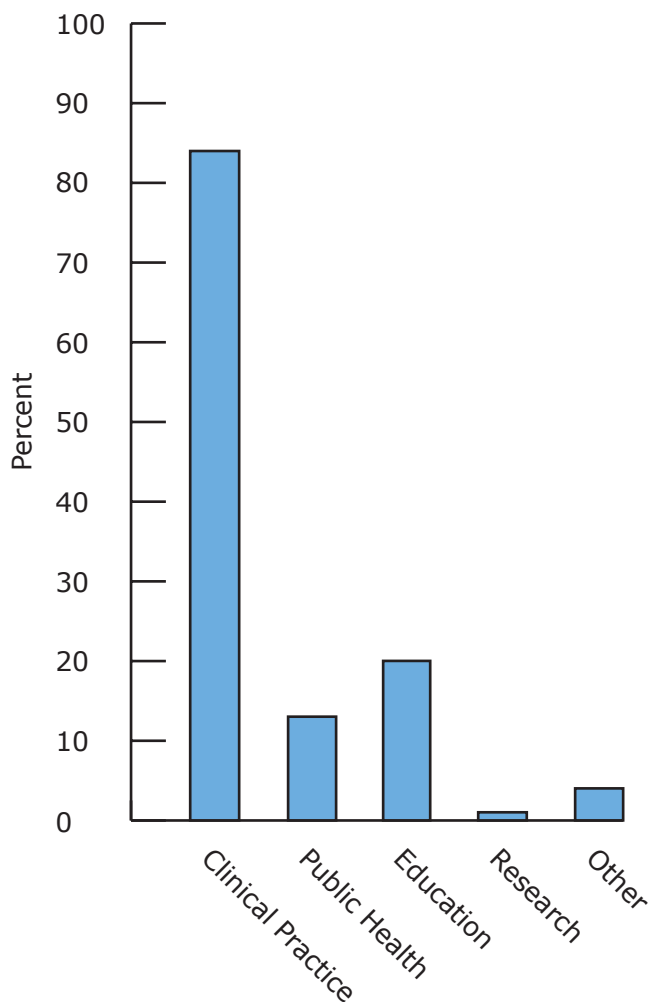
## Attitude (Confidence, Comfort) Scores

The vast majority (89 to 97%) of participants noted being comfortable and confident performing caries risk assessment in their primary clinical practice on all ages of patients, including those with special needs. Cronbach's alpha reliability coefficient was 0.76 for internal consistency of comfort with performing CRA. A total of 71% (n=154) felt they had enough time during an appointment to conduct a CRA and provide management recommendations. Respondents overwhelmingly felt confident in detecting incipient caries in their earliest stages (93%) and comfortable explaining CRA/management protocols (96%) to patients. However, 25% (n=53) affirmed caries management consisted primarily of restorative care (Table II).

## Practice Behaviors

Out of 216 respondents, 29% (n=62) used established forms to conduct CRA. Of those, 39% (n=24) used the established form employed the American Academy of Pediatric Dentists' Caries-risk Assessment Tool (AAPD CAT), 22% (n=14) used either the ADA or California Dental Association CRA forms, and another 39% (n=24) used other forms not listed in the survey. The remaining respondents 71% (n=154) stated no formal means of CRA were used. Participants were asked to describe evidence-based caries management products and protocols they use during care when making recommendations to patients at moderate or high risk. Over-the-counter fluoride dentifrice (70%), individualized oral hygiene instruction (86%) and an individualized recare interval (74%) were the most-used caries management recommendations. Low-dose fluoride rinses (45%) and prescription strength sodium fluoride gel or paste (42%) were less frequently suggested as caries management practices and amorphous calcium phosphate products

Figure 3: Practice Settings noted in Percentages



and xylitol gum, mints or lozenges were either never (22 and 9%, respectively) or only sometimes (38 and 35%, respectively) proposed. Table III details the responses regarding use of caries management recommendations.

## Discussion

Dental hygienists, as the primary preventive specialists of the dental team, are in a unique position to implement office based CRA/management programs. Risk assessment and management involving dental hygienists could positively impact or eliminate caries disease across all age ranges. This study provides baseline information necessary to better understand the current level of knowledge, attitudes (comfort and confidence) and practice behaviors concerning CRA and management by dental hygienists. Results indicate that the median age range of respondents was between 25 to 34 years of age, similar to national statistics on age of licensed dental hygienists. Unlike national statistics on dental hygiene practitioners, where the median number of years in practice is 17, over half surveyed had been licensed for less than 5 years (31.8%) or more than 26 years

Table I: Dental Hygienists' Knowledge of CRA/Management

Knowledge statements	True (n)	False (n)	Total n
Dental caries is a transmissible disease	*86.1% (186)	13.9% (30)	n=216
Dental caries is a multifactorial disease	*97.7% (211)	2.3% (5)	n=216
An individual with a history of carious lesions within the past 3 years is a high risk for future dental caries activity	*88.0% (190)	12.0% (26)	n=216
White spot lesions are considered carious lesions.	*41.7% (90)	58.3% (126)	n=216
Low socioeconomic status does not increase an individual's risk for dental caries disease.	13.4% (29)	*86.6% (187)	n=216
Decreased saliva flow increases risk for dental caries.	*0.5% (1)	99.5% (215)	n=216
There is no evidence to support the twice a year or more application of fluoride varnish to reduce risk of carious lesions in adults of high caries risk.	17.6% (38)	*82.4% (178)	n=216
Daily oral use of 6-10 grams of xylitol does nothing to reduce incidence of carious lesions.	9.3% (20)	*90.7% (196)	n=216
Patients at moderate or high risk of dental caries need to be counseled about the role of sugary and starchy foods in increasing caries risk.	*99.1% (214)	0.9% (2)	n=216
Chlorhexidine is known to kill all caries pathogenic organisms.	39.4% (85)	*60.6% (131)	n=216

Correct response designated by \*

Table II: Factors Influencing Utilization of Caries Risk Assessment

Factors Influencing Performing CRA	Agree (n)	Disagree (n)	Total n
Performing CRA is an integral part of dental hygiene practice.	98.6 (213)	1.4 (3)	216
Untreated dental caries disease can lead to life-threatening health complications.	96.8 (209)	3.2 (7)	216
Caries management mainly includes providing dental restorations.	24.5 (53)	75.5 (163)	216
I feel I have enough time to perform CRA on each patient.	71.3 (154)	28.7 (62)	216
I am confident in my ability to explain CRA results with the patient.	95.8 (206)	4.2 (9)	215
I am confident in my ability to identify carious lesions in the stages when they can be reversed.	93.5 (202)	6.5 (14)	216

(29.4%), 10 being the median number of years since licensure.<sup>19</sup> According to a 2007 ADHA Survey of Dental Hygienists, there were approximately 152,000 licensed dental hygienists in the U.S. and an estimated 130,000 (85.8%) were actively practicing.<sup>19</sup> Nevertheless, only 35,000 (23%) of currently licensed dental hygienists are ADHA members, a significant difference from respondents of this survey. Of those who responded, 87% were members of the ADHA, indicating the participants were not a representative sample of dental hygienists nationwide. Figure 4 shows the comparison between professional membership of respondents and dental hygienists

nationwide. Respondents' membership in the ADHA may have been beneficial in their knowledge and use of evidence based CRA and management protocols.

In this study, the most frequently used preventive approaches in caries management were recommending over-the-counter fluoride dentifrices, individualizing oral hygiene instruction and setting an individualized recare interval based on dental caries risk. Consistent use of prescription fluoride paste or gel is a key strategy for those at moderate to high risk for caries, yet less than half of respondents reported making this recommendation in their prac-

Table III: Dental Hygienists' CRA Management Recommendations

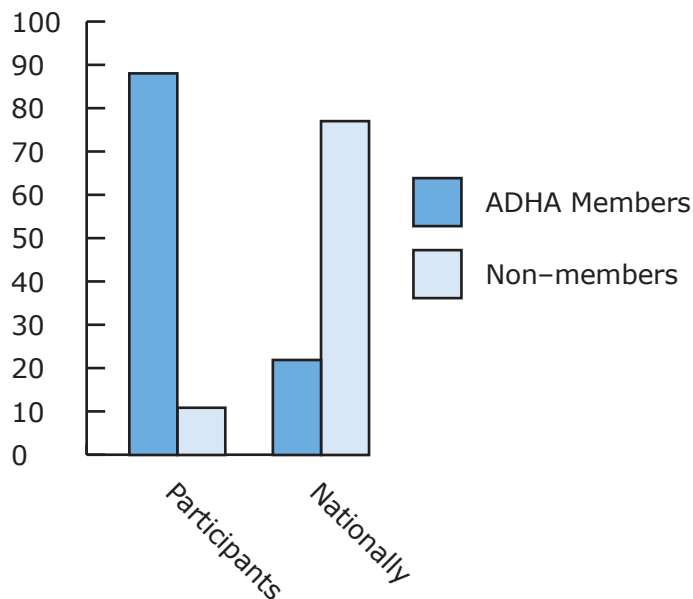
Preventive/Therapeutic Management Recommendations	Never (n)	Sometimes (n)	Frequently (n)	Always (n)
Fluoridated toothpaste	4.7% (10)	8.5% (18)	16.6% (35)	70.1% (148)
Low-dose OTC fluoride rinse	4.7% (10)	18.0% (38)	45.0% (95)	32.2% (68)
Neutral sodium Rx strength (5000 ppm) fluoride gel or paste	3.3% (7)	29.0% (62)	42.1% (90)	25.7% (55)
Xylitol gum, lozenges, or mints	9.4% (20)	34.9% (74)	33.5% (71)	22.2% (47)
Amorphous calcium phosphate products	21.5% (45)	38.3% (80)	30.6% (64)	9.6% (20)
Antimicrobial rinse	9.9% (21)	43.9% (93)	33.0% (70)	13.2% (28)
Individualized oral hygiene instruction	0% (0)	1.9% (4)	12.1% (26)	86.0% (184)
Individualized recare interval	0.5% (1)	9.4% (20)	16.4% (35)	73.7% (157)

tice setting.<sup>20</sup> Given the critical role of fluoride in the prevention and management of caries, these results suggest a need to update dental hygienists in the most effective, evidence-based protocols in the management of caries disease across all age groups. Although the majority of respondents recognized that dental caries management encompasses more than restoring the consequences of caries, 25% reported management to be traditional restorative care. This may result in great variability between the need for risk-based caries management and prevention and how practitioners apply these concepts in private and community settings. Fewer than half of responding hygienists considered evidence of incipient cavitation (white spot lesions) to be a significant risk indicator for caries. White spot lesions are described as the beginning of the caries lesion - the point at which demineralization outpaces remineralization and the enamel surface begins to weaken.<sup>16,21,22</sup> Clinical evidence shows that the early stages of demineralization may be reversible following exposure to fluoride, and treating incipient caries lesions with fluoride is the hallmark of non-invasive remineralization therapy.<sup>21,22</sup> Thus, dental hygienists need to be more familiar with the earliest stages of caries disease, as reflected by this study.

Data indicated participants' attitudes (confidence and comfort) about carrying out CRA for all age groups, including those with special needs, to be quite high. A larger than anticipated number of respondents (71%) felt they had sufficient time to assess caries during an appointment. This finding is surprising, considering the number of dental professionals citing time as a barrier to the incorporation of evidence-based decision making into clinical care as well as locating resources.<sup>23,24</sup> However, recent advances in electronic access to information and resources have enabled practitioners to implement many evidence-based protocols into care.

The use of 1 of the 4 established forms listed on

Figure 4: Percentage of ADHA members nationwide compared with survey participants



the survey — AAPD CAT, ADA, California Dental Association and Cariogram®, or a variation, combination or modification of established forms, was reported by 29% of participants. This finding is not alarming considering the variety of forms and risk assessment systems available to clinicians today. Though the Cariogram® caries risk assessment model has been validated in several small studies, only the California Dental Association caries risk assessment form for ages 6 to adult has been validated through a 6 year large retrospective study.<sup>12,25</sup> Currently used CRA forms or variations of established protocols are an important part of assessing and documenting current oral health status of each patient. Clinicians should look carefully at the variety of forms available to determine which best fits the need of each clinical setting. Terminology varies among the CRA forms and systems. Ease of use, need to adapt to computerization, target population and terminology consistent with the office philosophy will help den-

tists and dental hygienists choose the most useful tool. Current CRA methods should measure risk at the earliest possible stage.

While providing insight and useful baseline data, limitations to this study must be taken into account. The survey described only reported behaviors and practices, and answers were normative, rather than actual. Although participants selected to participate in this survey were randomly sampled, self-selection bias was a limitation. That is, dental hygienists who chose to respond to the survey may have been different than those who did not respond, thus biasing the results. While the survey provided descriptive data on knowledge and attitudes regarding CRA and management, the instrument lacked the flexibility to uncover the basis for such attitudes. Finally, response rate to the survey was extremely low. Those who responded to the survey were not a representative sample of dental hygienists nationwide. Therefore, results cannot be generalized to the total population. The valid response rate was 8.6% of the 2,500 email addresses targeted. Few national online surveys of practicing dental hygienists have been published for comparison. Of those published, response rates were significantly higher, perhaps due to different sampling methods, or those surveyed may have had increased interest in the topic.<sup>26,27</sup> Topic saliency has been shown to contribute to low response rate.<sup>28</sup> Research has shown, if interest in the topic is high, response rates tend to be high as well.<sup>29,30</sup> Conversely, low response rates may reflect a low perceived interest in the topic. Dental hygiene clinicians who do not routinely perform CRA in practice may have not responded to a survey of this nature.<sup>30</sup> Findings from meta-analyses of the literature on survey response rates indicate web-based surveys tend to have lower response rates than mailed surveys, possibly reflecting participants' comfort level with computer technology.<sup>30-32</sup>

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## Conclusion

Clearly, there is a need for further research to identify and validate CRA strategies that can be applied in dental hygiene practice. More importantly, studies are required to establish whether identification of moderate and high-risk individuals can lead to more effective long-term patient management that arrests or reverses the progression of carious lesions. Dental professionals must recognize and accept that the process of caries diagnosis today is more complex and involves thorough evaluation of known disease indicators and risk factors, a CRA, microbial measurements, radiographic evidence, and knowledge of the patient's medical and oral health histories. There is a need to improve practicing dental hygienists' knowledge and involvement in the active management of caries. Focused training in the use of established CRA/management tools should be designed to improve their knowledge and enhance practice behaviors.

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## Knowledge, Attitude and Practice Regarding Oral Health Among the Rural Government Primary School Teachers of Mangalore, India

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### Introduction

Children who suffer from poor oral health are 12 times more likely to have restricted-activity days, including missing school, than those who do not. Annually, more than 50 million hours are lost worldwide from schools due to oral diseases.<sup>1</sup> A school is not just a place for a student to receive education, but an institute which molds the behavior, attitude and perceptions towards life. The World Health Organization's Global School Health Initiative encourages "Health-Promoting Schools" to create a healthy setting for living, learning and working. This initiative is designed to improve the health of students, school personnel, families and other members of the community through schools.<sup>2</sup>

Oral disease can be considered a public health problem due to its high prevalence and significant social impact. Chronic oral disease typically leads to tooth loss, and in some cases has physical, emotional and economic impacts: physical appearance and diet are often worsened, and the patterns of daily life and social relations are often negatively affected.<sup>3-5</sup> Because of the failure to incorporate oral health into general health promotion, millions suffer intractable toothache and poor quality of life, and end up with few teeth.<sup>6</sup>

Elementary schools are suitable for the presentation of oral health information. Children, the potential recipients, spend a considerable amount of time in this setting. They can be reached at a time when their health habits are forming. Oral health information can be made available to all children, including those who may not have access to other sources of health information.<sup>7</sup>

### Abstract

**Purpose:** This study was conducted to assess the knowledge, attitude and practice regarding oral health among the Rural Government Primary school teachers of Mangalore, Karnataka, India.

**Methods:** A self-administered close ended questionnaire consisting of 16 items was distributed among the rural primary school teachers of Mangalore (n=165). Comparison of knowledge and attitude amongst the 3 age groups was done with Kruskal Wallis test. Comparison of mean scores between the genders was done using Mann-Whitney-U test. Comparison of mean scores across four educational qualification groups was done using Kruskal Wallis test.

**Results:** Out of 165 primary school teachers to whom the questionnaires were sent, 153 responded, yielding a 92.7% response rate. Results showed that significant difference ( $p < 0.01$ ) was seen across the 3 age groups for the mean practice scores. There was significant difference between the genders with females scoring better for the mean knowledge, practice and the total scores. Educational qualification did not make any significant difference in the knowledge and practice on oral health.

**Conclusion:** The study concluded that oral health knowledge was lacking among the primary school teachers of rural Mangalore, although practices were satisfactory. Oral health education program targeting only the teachers is of utmost importance in the light of the present study results.

**Keywords:** attitude, knowledge, oral health, practice, rural, school teachers

This study supports the NDHRA priority area, **Health Promotion/Disease Prevention:** Validate and test assessment instruments/strategies/mechanisms that increase health promotion and disease prevention among diverse populations.

Teachers play a vital role in shaping the behavior and overall comprehensive development of school children. School teachers are known to exert considerable influence on their pupils and to an extent on the community at large. School teachers are more authoritative on children than parents in the Indian context. The instructions imparted by the teachers are generally followed more religiously by the pupils. The advantages of using school personnel are the potential for improved continuity of instruction and lowered cost of the service.<sup>7</sup>



## Methods and Materials

### Study Design and Study Population

In a developing country like India with a population of more than 1 billion, where more than 70% of the people reside in rural areas,<sup>8</sup> schools can function like a bridge between the seekers and the providers of Oral health information. Studies that have investigated the oral health awareness among school children have revealed that they have a low level of oral health knowledge.<sup>9-11</sup> It is recommended that health education programs in the schools be conducted by adequately trained teachers.<sup>9-11</sup>

Teachers need to have a sound knowledge regarding constructive oral health habits to train their students. Children enter Grade I of the primary school between the ages of 5 to 6, and continue until grade 7, approximately 13 years of age. This is a highly appropriate age group to inculcate good oral hygiene habits. Previous study conducted on elementary school teachers in Michigan has shown that teachers' knowledge about oral health and oral hygiene practices are incomplete and inappropriate.<sup>7</sup> Very few studies assessing the oral health knowledge, attitude and practice of primary school teachers have been reported from this part of the country. A study conducted on primary school teachers in Dharwad, India have shown that school teachers have fair knowledge regarding oral health.<sup>12</sup> Such studies can be helpful to gather the baseline data on the existing knowledge of the school teachers and plan appropriate health education programs for them.

This study was conducted to assess the knowledge, attitude and practice regarding oral health among the Rural Government Primary school teachers of Mangalore, Karnataka, India.

### Description of the Study Area

Mangalore is located in Karnataka state along the south western coast of Indian peninsula, and is the administrative headquarters of the Dakshina Kannada district. There are 3 kinds of schools in Karnataka: government (run by the government), aided (financial aid is provided by the government) and un-aided private (no financial aid is provided).<sup>13</sup>

The Dakshina Kannada district is further divided into 6 subdivisions for the purpose of school administration: Mangalore city, Mangalore Taluk, Bantwal, Belthangady, Moodbidri and Puttur. There are total of 420 schools in Mangalore (both rural and urban) of which 100 schools are rural schools run by the State Government (Department of Education).<sup>14</sup>

There are 107,974 school children enrolled for the year 2010 to 2011 and total of 3,363 school teachers of which 1,307 teachers are working in Government schools in Mangalore (both rural and urban).<sup>15</sup>

This was a cross-sectional questionnaire study to assess the knowledge, study design and study population. The study population was all the primary school teachers of Mangalore rural. Ethical approval to conduct the study was obtained from Institutional ethical committee, A.B. Shetty Memorial Institute of Dental Sciences, Nitte University, Mangalore. Official permission was obtained from the Block Education Officer, Mangalore Taluk, before conducting the study. Informed consent was obtained from the school teachers participating in the study. Participants were assured that their responses would be kept confidential.

### Survey Instrument

A self administered, pre-tested close ended questionnaire consisting of 16 items was distributed among the rural primary school teachers of Mangalore (n=165). The questionnaire was prepared in the local language "Kannada." The questionnaires were mailed to all the primary school teachers of Mangalore rural along with an informed consent form and a self addressed paid postage envelope, in the month of December 2010. The responses were gathered in 15 days from the date of dispatch of the questionnaires.

The questionnaire collected sociodemographic information and the educational qualification of the school teachers. Questions were framed to assess the knowledge (n=10), attitude (n=1) and practice (n=5) of the rural primary school teachers regarding oral health. Knowledge questions were based on the primary and the permanent dentition, oral hygiene measures, dietary habits, and common myths about extraction in rural India. Consumption of homemade jaggery containing sweets (ladoos, kheer, halwas, etc.) is common in rural India.

### Questionnaire Reliability Analysis

The questionnaire was tested for reliability by test-retest method prior to conducting the study. The questionnaire was distributed to and collected back from 10 rural primary school teachers from 3 schools on 2 different days by the investigator. Reliability was assessed by split half reliability coefficient test ( $\rho=0.84$ , good reliability).

### Data Management and Processing

The first 10 questions assessed the level of knowledge of the primary school teachers on oral

health. Knowledge score for each individual was calculated by assigning a score of 1 for each correct answer. Scores for questions 1 through 10 were added together to get a “knowledge score” for each individual. Mean knowledge score was calculated by dividing the total knowledge scores of all individuals by the number of individuals.

Questions 11 through 15 assessed the oral hygiene practice of the primary school teachers. The mean practice score was calculated similar to the method of calculation of the mean knowledge score. Question 16 was an attitude question to understand the participant’s receptivity towards further health education sessions. Participants who were willing to know more about oral health were considered to have a positive attitude. “Total score” was calculated by adding all the correct responses of questions 1 through 16.

Kolmogorov-Smirnov statistic was applied to analyze the type of data. The total scores, knowledge scores and practice scores were separately tested to know whether each one of them followed the normal distribution. Since all 3 scores significantly deviated from normal distribution ( $p < 0.001$ ), data was deemed as non-normal and hence non-parametric tests were applied subsequently.

The participants were categorized into 3 categories based on their age as 34 years and below, 35 to 44 years and 45 years and above. Comparison of the knowledge and practice scores of the 3 age groups was done with Kruskal Wallis test. Individual’s age was further correlated with practice score using Spearman’s correlation. Comparison of mean scores between the genders was done using Mann-Whitney-U test. Comparison of mean scores across 4 qualification groups (Basic qualification, main education stream, Teacher’s Certificate Higher course and arts stream) was done using Kruskal Wallis test. Level of significance was set at 1% and probability value of  $< 0.01$  was considered as statistically significant. The data was entered in Microsoft Excel 2007 and the statistical analysis was performed using SPSS Version 10.0 (SPSS Inc., Chicago, IL, USA).

## Results

Table I summarizes the sociodemographic characteristics of the study participants. Out of the total 165 primary school teachers to whom the questionnaires were sent, 153 responded. The response rate was 92.7%. About half of the teachers were in the 45 years and above age group (54%). Most of the teach-

Table I: Sociodemographic Characteristics of Participants

		Number of individuals (%)
Age group (In years)	34 and below	28 (18%)
	35 to 44 years	43 (28%)
	45 and above	82 (54%)
	Total	153 (100%)
Gender	Female	108 (71%)
	Male	45 (29%)
	Total	153 (100%)
Highest level of Educational Qualification	Basic Education (10th and 12th grade)	22 (14%)
	Main stream Education*	15 (10%)
	Teacher’s Certificate Higher Course	98 (64%)
	Arts stream (BA, MA)	18 (12%)
	Total	153 (100%)

\*Main stream education refers to Diploma in Education (DEd), Bachelor in Education (BEd), Certificate in Physical Education (CPEd), Diploma in Physical Education (DPEd)

ers were females (71%). The majority were qualified with a “Teachers certificate Higher” course (64%).

Table II shows the number and percentages of the participants who answered the knowledge questions correctly. Most of the subjects (92%) knew that the teeth should be cleaned using a tooth brush. Half of them did not know the importance of milk teeth. Only 54% answered correctly that milk teeth are required for eating, speaking and maintenance of space. Very few participants (28%) answered that early loss of milk teeth can cause irregularities in occlusion. Only 38% of the teachers answered that teeth are required for lifetime and losing a tooth would make a difference. Almost all the subjects (99%) knew that the mouth has to be rinsed after every meal. When asked whether in between meal snacking causes tooth decay, 58% answered no. For the last question on sequelae of extraction, 50% answered that it might lead to blurring of vision, affects the brain and weakens the nerves.

Table III depicts the oral health practices of the primary school teachers of rural Mangalore. To the question regarding previous visit to the dentist, 88% of the respondents had visited a dentist earlier. Of those, 31% visited for restorations, 26% for extraction, 30% due to dental pain, 6% for oral prophylaxis, 2% for

Table II: Correct Responses of Participants for Knowledge Questions

Sl. Number	Question	Correct/Expected Answer	Participants Who Answered Correctly	
			Number	%
1.	Total number of milk teeth present in a child's dentition	20	133	87%
2.	How should teeth be cleaned?	Using tooth brush	141	92%
3.	Milk teeth are required for	Eating, speaking and space maintenance	83	54%
4.	First permanent tooth normally erupts at the age of	6 years	58	38%
5.	Early loss of milk teeth can	Cause irregularities of teeth/dentition	43	28%
6.	When should you visit a dentist	once in 6 months	140	92%
7.	Teeth are important for lifetime. Losing a tooth does not make any difference.	Only first statement is true	58	38%
8.	It is necessary to rinse your mouth	After every meal	151	99%
9.	Consumption of snacks between meals	Causes tooth decay	65	42%
10.	Removal or extraction of teeth	None of the above complications	77	50%

Table III: Correct Responses of Participants for Practice Questions

Sl. Number	Question	Correct/Expected Answer	Participants Correctly Identifying Desired Answer	
			Number	%
11.	Have you visited a dentist in the past	Yes	134	88
12.	How do you clean your teeth?	Using tooth brush and paste	141	92
13.	How often do you brush your teeth?	Twice a day	139	91
14.	How often do you change your tooth brush?	Once in 3 months	128	84
15.	What measures do you take when you get pain in your teeth?	Visit a dentist	145	95

their children's treatment and 5% for a routine check-up. Most of the teachers (92%) used tooth brush and tooth paste to clean their teeth, and 91% said they brushed their teeth twice a day. Changing of tooth brush once in 3 months was practiced only by 84% of the respondents. A majority (95%) visited a dentist in case of toothache, whereas 5% either visited a doctor, took a pill from the nearby pharmacist or kept a clove in their mouth. Clove is a household product found in almost all kitchens in India and is a common spice used in cooking. It is considered a handy household remedy for a toothache. All the respondents (100%) wanted to know more about oral health.

Table IV shows the comparison of the knowledge and practice scores across the 3 age groups. Though there was no significant difference among the age groups for knowledge and total scores, the 47 years and above age group scored better compared to the other age groups, which was statistically significant.

Table V compares the knowledge and practice scores between genders using Mann-Whitney-U test. Females scored better than the males for knowledge, practice and total scores which was statistically significant.

Table VI shows the comparison of knowledge and practice scores across different educational qualification groups using the Kruskal Wallis test. It was noted that the categorization into different groups based on educational qualification did not make any significant difference in the knowledge and practice on oral health.

## Discussion

The present study assessed the knowledge, attitude and practice regarding oral health among the primary school teachers of rural Mangalore.

Table IV: Knowledge and practice scores across different age groups

Age group	Number of individuals (%)	Knowledge score		Practice score		Total score	
		Mean (SD)	p-value*	Mean (SD)	p-value*	Mean (SD)	p-value*
34 and below	28 (18%)	6.5 (1.4)	0.42 (NS)	3.9 (1)	<0.001**	11.4 (2)	0.78 (NS)
35 to 44 years	43 (28%)	6.2 (1.2)		4.4 (0.5)		11.7 (1.3)	
45 and above	82 (54%)	6.1(1.3)		4.7 (0.5)		11.8 (1.5)	
Total	153 (100%)	6.2 (1.3)		4.5 (0.7)		11.7 (1.5)	

\*Comparison of three age groups with Kruskal wallis test

\*\* Individual's age was further correlated with practice score using Spearman's correlation that showed significant correlation (r=0.35,p<0.01, Significant)

NS - Not significant

Table V: Knowledge and practice scores compared between genders

Gender	Number of individuals (%)	Knowledge score		Practice score		Total score	
		Mean (SD)	p-value*	Mean (SD)	p-value*	Mean (SD)	p-value*
Female	108 (71%)	6.3 (1.3)	0.017**	4.6 (0.6)	0.0017**	11.9 (1.5)	0.003**
Male	45 (29%)	6.0 (1.3)		4.3 (0.8)		11.1 (1.6)	
Total	153 (100%)	6.2 (1.3)		4.5 (0.7)		11.7 (1.5)	

\*Comparison of mean scores between the genders using Mann-Whitney-U test.

\*\* p<0.01, significant

Table VI: Knowledge and practice scores across different Educational qualification groups

Highest Educational Qualification	Number of individuals (%)	Knowledge score		Practice score		Total score	
		Mean (SD)	p-value	Mean (SD)	p-value	Mean (SD)	p-value
Basic Education (10th and 12th grade)	22 (14%)	6.0 (1.2)	0.63 (NS)	4.5 (0.7)	0.13 (NS)	11.5 (1.4)	0.57 (NS)
Main stream Education*	15(10%)	6.4 (1.8)		4.1 (0.9)		11.5 (2.5)	
Teacher's certificate higher course	98 (64%)	6.2 (1.3)		4.6 (0.6)		11.8 (1.4)	
Arts stream (BA, MA)	18 (12%)	6.4 (1.2)		4.4 (0.5)		11.8 (1.3)	
Total	153(100%)	6.2 (1.3)		4.5 (0.7)		11.7 (1.5)	

\*Main stream education refers to Diploma in Education (DEd), Bachelor in Education (BEd), Certificate in Physical Education (CPEd), Diploma in Physical Education (DPEd)

NS - Not Significant

The questionnaires were mailed to all the teachers, with the intention of not disturbing the ongoing academic activities of schools. The questions were framed at a language level that was easy to comprehend and understand by the primary school teachers.

In India, a Bachelor of Education (BEd) is a course offered for those interested in pursuing career in teaching. The BEd degree is mandatory for teaching in higher primary schools (fifth through seventh grade) and high schools (eighth through tenth grade). The Diploma in Education (DEd) or TCH (Teachers Certificate Higher Course) is meant

for teaching in lower primary (first through fourth grade) and nursery (kindergarten) schools in India.

A search in the existing literature revealed very few reported studies assessing the knowledge, attitude and behavior of primary school teachers regarding oral health in India. The results of the present study show that the mean knowledge score across all age groups was 6.2±1.3, which is suggestive of an average knowledge regarding oral health among the teachers. The 34 years and below age group scored better than the other age groups with a mean score of 6.5±1.4, which indicates that the younger teachers had more knowl-

edge on oral health. This was in contrast to those reported in Dharwad, India where school teachers aged >50 years and those with postgraduate degrees had greater knowledge.<sup>12</sup> Females had a better score ( $6.3 \pm 1.3$ ) compared to males ( $6.0 \pm 1.3$ ). When the comparison of knowledge was made according to highest level of education, teachers in the main stream education ( $6.4 \pm 1.8$ ) and the arts stream ( $6.4 \pm 1.3$ ) performed better compared to their other counterparts.

With regard to the practice scores, the total mean score across all age groups was  $4.5 \pm 0.7$ . The 45 years and above age group scored better than the other age groups with a mean score of  $4.7 \pm 0.5$ . Though the younger teachers had better knowledge on oral health, they did not score well in the practice items. Females had a better score ( $4.6 \pm 0.6$ ) compared to males ( $4.3 \pm 0.8$ ). This finding is in accordance with previous studies which may be due to the fact that females are generally more hygiene conscious than males.<sup>9-11</sup> When the comparison of practice was made according to highest level of education, teachers qualified with Teachers' Certificate Higher Course ( $4.6 \pm 0.6$ ) fared better than others.

The attitude of the teachers was favorable, and all of them (100%) wished to have a dental health education program in the future. A study conducted on primary school teachers in Benin-City, Nigeria also demonstrated positive attitudes among the teachers.<sup>16</sup> However, a majority of primary school teachers in Lagos state, Nigeria, had negative attitudes about oral health issues.<sup>17</sup> The difference observed from the 2 different regions could be due to environmental and cultural factors, which can affect individual's attitude to health matters.<sup>16</sup> Most of the teachers in the current study visited a dentist for a dental treatment to relieve pain in the form of either an extraction or a filling. Only 6 teachers out of 153 respondents had visited a dentist for a routine checkup, which indicates that the utilization of dental services was mainly for pain relief, rather than for prevention.

Oral diseases and conditions are often chronic, painful and disfiguring. Together, they represent a huge economic and social burden of illness. While rarely fatal, the costs of these oral diseases and conditions have a large economic impact. An estimated total of 40.36 million hours are spent each year on check-ups or problems with teeth.<sup>18</sup> Some of the consequences of dental decay are acute and involve chronic pain, interference with eating, sleeping and proper growth, tooth loss, and

compromised general health. The competencies of dental hygienists focus on disease prevention and oral health promotion. Investing in public health dental hygienists who focus on oral disease prevention and oral health promotion will also decrease the need for costly oral disease treatment. It will build capacity within the public health system to improve oral health and not simply treating oral disease after it arises. Public health dental hygiene programs require a small investment with potentially large dividends. For example, a Canada-wide school based program would cost an estimated \$564 million — about 4.5% of the \$12.6 billion being spent on dental care today and 0.3% of total health spending.<sup>18</sup> Many of the services that dental hygienists provide can prevent future oral diseases, for example applying fluoride varnish on new teeth can reduce the amount of dental caries, educating the school teachers and school children on importance of maintain oral health. Dental hygienists can serve as a vital link to emphasize the value of good oral hygiene. They can provide remedial home oral hygiene practice instructions, apart from the treatment provided at their clinics. Dental hygienists can encourage regular dental attendance of the teachers, which in turn would be passed on to their students.

Teachers, apart from just merely providing education to the pupils, also have a moral responsibility of ensuring their health and safety. To accomplish this task, teachers need to have sound knowledge regarding health and oral health. While teachers are crucial to the implementation of school oral health education, they do not necessarily possess adequate knowledge and skills to enable them to deliver the programmes effectively. Teachers in all disciplines should be encouraged to include oral health in their teaching programs and activities. They should be inspired to make the curriculum exciting and stimulating for students to acquire good oral health knowledge and behaviors and to make healthy decisions. When teaching a practical skill such as tooth brushing technique, it is necessary for the teachers to learn, and be competent on brushing their own teeth effectively first. This is particularly important as teachers are often considered as role models by students.<sup>1,19</sup> The results of this study did not show favorable performance from the teachers. Most of the oral health promotion programs are targeting the school children only, sidelining this other most important group. In view of the present study results, there is an urgent need to take measures in this regard and conduct oral health awareness programs for the teachers as well.

## Conclusion

The findings of the present study indicate that oral health knowledge was lacking among the primary school teachers of rural Mangalore, although practices were satisfactory. Teachers require training programs, in which a half day workshop/symposium on oral health aspects could be beneficial. Coordination between the school authorities, parents, dental care providers and funding agencies is required to implement a teacher's training program in between the school's academic schedule. Dental hygienists in India and elsewhere can exchange lobbying efforts towards this educational experience. A dental hygienist should always be a part of the team providing school dental health programs, so that the importance of oral hygiene is highlighted.

## Recommendations

Based on the results of this study, the author recommend the following:

- To create awareness among teachers regarding oral hygiene so that they stimulate the development of resources to make dental care available to all children
- When conducting school dental health programs, dental professionals should also plan out a separate lecture/demonstration of oral hygiene measures to school teachers so as to increase their awareness about oral hygiene
- Guidelines for teachers in monitoring and supervising tooth brushing drills should be developed
- Incorporation of a chapter on oral hygiene in the school curriculum would be helpful, so that the children are taught about the importance of oral hygiene at an early age

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## Dental Fluorosis and Lumbar Spine Bone Mineral Density in Adults, ages 20 to 49 years: Results from the 2003 to 2004 National Health and Nutrition Examination Survey

R. Constance Wiener, MA, DMD, PhD; Usha Sambamoorthi, PhD

### Introduction

Osteoporosis, a systemic disease of reduced bone mineral density (BMD) and potential fractures, is responsible for \$10 to \$18 billion in annual U.S. fracture-related costs.<sup>1</sup> In 1994, the World Health Organization (WHO) provided criteria for osteoporosis in postmenopausal white women as BMD of 2.5 or more standard deviations below young average BMD.<sup>2,3</sup> A deviation of 2.5 standard deviations from the BMD of the average young white woman was significantly related to the future lifetime risk of any fractures, and was therefore used as the criteria.<sup>4</sup> The concern of low BMD is morbidity and mortality from spontaneous fractures or falls. A study of 163,979 participants showed that those with osteoporosis had a fracture risk ratio of 4.03 (95% CI 3.59, 4.53) and those with osteopenia (-1 to -2.5 standard deviations below young average BMD) had a fracture risk ratio of 1.80 (95% CI 1.49, 2.18) compared with those with normal BMD.<sup>5</sup> Similar results occurred when humerus, forearm and wrist fractures were considered.<sup>6</sup>

Biomarkers or other predictors would be beneficial in identifying those at risk for fracture to target them for early intervention. Periodontal disease was studied as an indicator, but at best was a weak factor.<sup>7</sup> Techniques, such as quantitative ultrasound, have also been proposed.<sup>8</sup> Recently, the use of dental panoramic radiography to evaluate inferior mandibular cortical BMD has been proposed for low BMD screening.<sup>9,10</sup>

Bone strength partially depends upon the hydroxyapatite crystal, the crystal also present in teeth. Its structure is modified by various metals (lead, arsenic) and halide anions such as fluoride. At thera-

### Abstract

**Purpose:** Osteoporosis is an urgent public health concern. Many factors influence bone mineral density (BMD), a criterion used to diagnose osteoporosis. The purpose of this study was to determine if dental fluorosis may be a marker for osteoporosis. The association between dental fluorosis and BMD at the lumbar spine was examined.

**Methods:** Using a cross-sectional design with 1,805 adults, ages 20 to 49 years, from the 2003 to 2004 National Health and Nutrition Examination Survey, an analysis of the association between dental fluorosis and BMD was performed, using chi-square and multivariable logistic regression. Other variables included predisposing factors (gender, age and race/ethnicity), enabling factors (marital status, education, poverty status and health insurance) and lifestyle/behavioral factors (perceived health status, smoking, alcohol intake, physical activity and body mass index).

**Results:** Overall, 13.5% had fluorosis; 6.8% with fluorosis and 9.8% without fluorosis had low lumbar spine BMD. Multivariable analysis found there was not a statistically significant association between fluorosis and lumbar spine BMD (adjusted odds ratio=0.82; 95% CI (0.43, 1.56)).

**Conclusion:** Dental fluorosis and lumbar spine BMD were not found to be associated in a sample of adults.

**Keywords:** fluorosis, osteoporosis, osteopenia, lumbar spine, bone mineral density, NHANES

This study supports the NDHRA priority area, **Clinical Dental Hygiene Care:** Investigate the links between oral and systemic health.

peutic levels during development, small amounts of fluoride replace the hydroxyl-group and form fluorapatite, which is caries-resistant in teeth.<sup>11</sup> Although this pre-eruptive effect is now considered to be minor, compared to fluoride's topical effect, it led to the 1945 decision to fluoridate the water supply of Grand Rapids, Michigan.<sup>12</sup> The result, a reported (and later contested) 56% decrease in caries 15 years later, led to nationwide community water fluoridation (CWF) and dramatic reductions in caries.<sup>12</sup> CWF, one of the top 10 public health achievements of the twentieth century, was identified as the "most socially equitable way to prevent caries, [with the] greatest effect on the socially disadvantaged children who have the



most decay."<sup>13</sup> CWF has been present in some sites for over 67 years.

Research involving fluoride as a medication to increase BMD was also conducted. A randomly controlled study of 202 postmenopausal women with osteoporosis and fracture history indicated that fluoride (75 mg/day) increased cancellous bone (lumbar spine, femoral neck, etc.) but decreased cortical BMD (radii).<sup>14</sup> The study showed no difference in spinal fractures, but identified an unexpected increase in non-spinal fractures.<sup>14</sup> Other studies showed no difference between the groups in fractures at either site.<sup>15-17</sup> A meta-analysis of 11 studies indicated an increase in lumbar spine BMD, with no significant difference in fractures.<sup>18</sup>

In developing children, excessive fluoride (greater than 1 mg/day or 1 ppm) will mottle teeth (dental fluorosis)<sup>19</sup> and may result in osteosclerosis, osteoporosis and osteomalacia, or a combination of the conditions.<sup>11</sup> Sources of excess fluoride include high naturally occurring levels of fluoride in wells, springs, etc., dietary fluoride supplements prescribed or taken inappropriately, and excessive ingestion of fluoride toothpaste and similar products. The American Academy of Pediatric Dentists recommends a smear of fluoridated toothpaste for children under age 2 years, and the American Dental Association recommends seeking dentist/physician advice for the use of fluoridated toothpaste for children under age 2 years. It is important for dental hygienists to know about community water fluoridation, and other sources of an individual patient's potential fluoride exposure and educate patients with young children about current recommendations.

The purpose of this study was to determine if dental fluorosis is associated (co-occurs) with low BMD in an adult sample. The conceptual framework was the Ecosocial Theory,<sup>20</sup> that there are many predisposing, enabling, health risk factors involved in the development of diseases and conditions, such as low BMD.

## Methods and Materials

This study analyzed data from the National Health and Nutrition Examination Survey (NHANES) for years 2003 to 2004. The NHANES protocols are presented in detail elsewhere.<sup>21</sup> In summary, the NHANES is a U.S. federal, on-going program in which the nation's health and nutrition status are evaluated with questionnaires, clinical examinations and laboratory tests of participating non-institutionalized civilian adults and children. The survey follows epidemiological principles in selecting participants in which selections are multistage, prob-

abilistic and stratified based on counties, blocks, households and individuals within the households. To provide for race/ethnicity analyses, the survey is designed to oversample non-Hispanic Blacks and Mexican Americans.

The study included adults who participated in BMD analysis and fluorosis evaluation, ages 20 to 49 years. Skeletal mass and BMD become consistent after bone growth stops. Children, having the potential of inconsistent BMD, were excluded to age 20 based upon the Centers for Disease Control's stature-for-age charts which indicate growth in stature continues from birth to age 20 years.<sup>22</sup> Fluorosis data were only available to age 49 years. Participants were excluded if there were missing data on fluorosis, or had highly variable imputed lumbar spine BMD data.

BMD data were collected using dual-energy x-ray absorptiometry with a Hologic QDR-4500A fan-beam densitometer (Hologic, Inc., Bedford, Mass.). Participants were excluded from the BMD examination if they were pregnant, if they self-reported having had radiographic contrast medium within the previous 7 days, a nuclear medicine study within the previous 3 days and if their physical size could not be handled by the instrumentation (a height over 6'5" or a weight above 300 pounds).

The lumbar spine BMD values were chosen based on previous research. The most clinically relevant site for younger patients to assess is the lumbar spine as epidemiologic evidence indicates the greatest risk of any fracture in women in the first 15 to 20 post-menopausal years are vertebral fractures.<sup>4</sup> Secondly, sensitivity and specificity for osteoporosis and osteopenia at other sites have been calculated assuming a low t-score at the spine or femoral neck as the criterion for a correct diagnosis.<sup>23</sup> Thirdly, spinal fractures are associated with increased mortality, therefore prevention of the first such fracture is important.<sup>24</sup> Originally, the definitions of osteoporosis (a BMD t-score below -2.5) and of osteopenia (a BMD t-scores between -1.0 and -2.5) were intended for epidemiological purposes.<sup>3,4,25</sup> Using the definition of osteopenia as the definition of low BMD, the lumbar spine BMD was dichotomized into a normal category and low BMD category using a t-score cut-point of 1 standard deviation of the normal mean ( $\leq 0.880$  g/cm<sup>2</sup>) as used in previous research.<sup>3,25</sup> There were 38,280 participants, 1,440 missing/excluded/highly imputed values, 5,280 with imputed values and 31,175 with no imputed values.

Dental fluorosis data were collected for participants aged 6 to 49 years using the Dean's Index.<sup>21</sup> A score of 0 indicated a normal tooth, 1 indicated very

mild fluorosis, 2 indicated mild fluorosis, 3 indicated moderate fluorosis, 4 indicated severe fluorosis and 5 indicated questionable fluorosis. For an evaluation of fluorosis, the contralateral tooth also had to have a fluorosis diagnosis. If a tooth were crowned, missing, not fully erupted, or if one-half or more of the visible enamel was replaced with a restoration, or covered with an orthodontic band, or destroyed by caries, the tooth was evaluated as "cannot be assessed."<sup>21</sup> Fluorosis was categorized into 3 categories: no/questionable fluorosis, the presence of fluorosis (Dean Indices of 1 to 4) and cannot be assessed.<sup>21</sup> The person level score was determined by the NHANES definition in which the score for the 2 teeth most affected by fluorosis are determined and if they are not equivalent, the lesser score is used.<sup>21</sup> The no/questionable and presence of fluorosis categories were based upon previous research using similar cutpoints (dichotomized presence of fluorosis/no fluorosis) although the other studies used the Thylstrup and Fejerskov Index<sup>26,27</sup> or Tooth Surface Index of Fluorosis.<sup>28</sup> There were 8,847 participants with dental evaluations. Trained, licensed dentists and trained recorders conducted the evaluations in mobile examination centers. They underwent intense training, monitoring and calibration. Interrater correlation was expected to be high, otherwise retraining of examiners occurred.<sup>21</sup>

The sample size with both available BMD and fluorosis values was 1,805. An economic model recommends using a WHO intervention algorithm when low BMD occurs with advancing age, low femoral neck BMD, low body mass index (BMI), personal history of prior fragility fracture, rheumatoid arthritis, other putative causes of secondary osteoporosis (such as inflammatory bowel disease), parental history of hip fracture, 3 months or more systemic corticosteroid use, 3 or more ounces of alcohol daily, and cigarette smoking.<sup>29</sup> As a result of the recommendation, predisposing factors (age, gender, race/ethnicity); enabling factors (education, poverty status, health insurance, marital status) and life-style/behavioral factors (perceived health status, smoking status, alcohol intake, physical activity, body mass index) were included in the analyses.

Bivariate association between fluorosis and low BMD were tested using the chi-square test. Logistic regression models were used to evaluate the association between fluorosis and lumbar spine BMD using 4 model specifications. The first model contained only the fluorosis variable. The second model additionally included predisposing factors of gender, race/ethnicity and age in years. The third multivariable model added the enabling factors of marital status, education, poverty status and health insurance. The fourth multivariable model included self-

reported health status, alcohol use, smoking status, moderate exercise and BMI.

Valid data decreased with age as there were more pacemakers, stents, hip replacements and obesity with age.<sup>21</sup> Therefore, the missing data could not be treated as a random subset of the data file.<sup>21</sup> NHANES resolved the problem of bias due to non-random invalid and missing data with multiple imputations so that the use of the data sets would provide complete data and ensure an accurate standard error of the estimate.<sup>21</sup> The imputations were based on critical weight and waist circumference data. A subset of highly imputed values was created if weight and waist circumference were not available. The data in this study did not include the subset of highly imputed values.

Imputed BMD data had 5 imputed values for each individual. We analyzed the data with several combinations of the imputed values. The analyses were consistent across all 5 imputed values. The results presented are from 1 of the analyses.

## Results

Table I presents the characteristics of participants. The study population was 51.4% male, predominantly Non-Hispanic White (69.1%), educated at above high school (58.7%), and between 40 and 49 years (37.6%). Most participants were moderate users of alcohol (35.5%), non-smokers (51.9%) and were married (61.6%). There were 74.8% who had health insurance and 61.8% who exercised moderately. There was an equal distribution of normal/underweight, overweight and obese participants. There were 90.4% with normal lumbar spine BMD and 13.5% had fluorosis.

Table I summarizes the characteristics of adult participants with low lumbar spine BMD. For ease of reading, the table does not include adult participants with normal lumbar spine BMD. Overall, there was not a statistical difference between those with fluorosis and those who did not have fluorosis who also had low lumbar spine BMD (6.8% and 9.8%, respectively).

Statistically significant group differences in low lumbar spine BMD were noted by gender, age, education, health status, race/ethnicity and exercise. A higher percentage of men (12.5%) than women (6.6%) had low lumbar spine BMD. There were 15.3% of Mexican Americans, 9.6% of Non-Hispanic Whites and 4.4% of Non-Hispanic Blacks who had low lumbar spine BMD.

Table II presents 4 logistic regression models with

Table I: Description of Sample Characteristics and Number and Weighted Percent with Low Lumbar Spine Bone Mineral Density National Health and Nutrition Examination Survey, 2003 to 2004

	Total		With Low BMD		Significance
	n	wt%	n	wt%	
All	1,805	100.0	181	9.6	
Fluorosis					
• Fluorosis	259	13.5	18	6.8	0.253
• Normal	564	33.2	55	9.8	
• Cannot be assessed	982	53.3	108	10.2	
Gender					
• Women	839	48.6	55	6.6	0.001
• Men	966	51.4	126	12.5	
Race/Ethnicity					
• Non-Hispanic White	878	69.1	84	9.6	0.031
• Non-Hispanic Black	423	11.8	20	4.4	
• Hispanic	351	9.4	59	15.3	
• Other	153	9.7	18	10.1	
Age in years					
20 to 29	606	29.8	41	6.7	0.010
30 to 39	568	32.6	56	9.2	
40 to 49	631	37.6	84	12.2	
Marital status					
• Married	1,034	61.6	108	10	0.522
• Not married	769	38.4	72	8.7	
Education					
• Less than High School	378	14.6	65	15.3	0.008
• High School	483	26.7	40	9.0	
• Above High School	944	58.7	76	8.4	
Poverty Status					
• Poor	476	20.9	60	12.0	0.486
• Low Income	305	14.2	30	8.4	
• Middle Income	486	30.8	46	8.7	
• High Income	451	34.0	39	10.1	
Health Insurance					
• Insured	1,228	74.8	123	9.7	0.582
• Not insured	558	25.2	57	9.4	

either odds ratios (OR) or adjusted odds ratios (AOR) and corresponding 95% confidence intervals (CI) of low lumbar spine BMD. Model 1 included the single variable fluorosis and model 2 included predisposing variables (gender, race/ethnicity, and age). Enabling variables were added in model 3 (education, poverty status, health insurance and marital status), and lifestyle/behavioral variables were added in model 4 (self-perceived health status, alcohol use, smoking status, moderate exercise, BMI). There was no statistically significant association between fluorosis and low lumbar spine BMD in any of the models.

The odds ratio for fluorosis and low lumbar spine bone mineral density was 0.65 in the unadjusted model. The adjusted odds ratio for low lumbar mineral density became 0.68, 0.71 and 0.69 with the

addition of predisposing variables, enabling variables and lifestyle/behavioral variables, respectively. In evaluating a type of non-response analysis, we considered the participants whose teeth could not be assessed due to missing teeth, crowns, partial eruption of teeth, restorations obscuring one-half or more of the visible enamel, coverage with an orthodontic band, or destroyed by caries. In these analyses, there was no significant difference in lumbar spine BMD with the reference group in any of the models.

## Discussion

The findings on overall prevalence of fluorosis (13.5%) are consistent with existing studies. There is a wide range of values reported in other stud-

Table I: Description of Sample Characteristics and Number and Weighted Percent with Low Lumbar Spine Bone Mineral Density National Health and Nutrition Examination Survey, 2003 to 2004 (continued)

	Total		With Low BMD		Significance
	n	wt%	n	wt%	
All	1,805	100.0	181	9.6	
<b>Health Status</b>					
• Excellent	226	14.2	16	7.1	0.015
• Very good	589	38.3	37	7.1	
• Good	643	35.3	77	11.5	
• Fair/Poor	274	12.2	41	12.8	
<b>Alcohol Use</b>					
• Heavy	622	34.0	66	9.4	0.119
• Moderate	580	35.5	49	8.7	
• None	430	21.5	41	8.6	
• Missing	173	9.0	25	16.2	
<b>Smoking Status</b>					
• Current Smoker	573	31.4	64	11.4	0.233
• Former Smoker	272	16.7	31	10.3	
• Never Smoker	960	51.9	86	8.3	
<b>Exercise</b>					
• Yes	1,028	61.8	81	8.3	0.004
• No	777	38.2	100	11.7	
<b>Body mass index</b>					
• Underweight/Normal	647	37.3	75	10.7	0.091
• Overweight	584	32.5	63	9.9	
• Obese	564	30.2	41	7.6	

Based on 1,805 non-institutionalized civilian men and not-pregnant women aged between 20-49 years, who had fluorosis and bone mineral density screenings. Weighted percentages were obtained to control for complex sample design, therefore division of individual cell sizes by the total sample will not reflect weighted percentages. Significant group differences were tested by Chi-square statistics.

\*\*\* $p < 0.001$ ; \*\* $0.001 \leq p < 0.01$ ; \* $0.01 \leq p < 0.05$

Wt %: weighted percent; N: number of participants

ies for fluorosis. One study of persons aged 6 to 39, reported fluorosis prevalence at 23%.<sup>30</sup> Another, for children from Kindergarten to grade 5, reported fluorosis at 44%.<sup>31</sup> One study reported fluorosis at 23.0% for maxillary central incisors when fluoride intake was 0.04 to 0.06 mg F/kg.<sup>32</sup> Finally, another reported fluorosis at 51% with CWF fluoridated at 1 ppm.<sup>33</sup> A literature review indicated that although the 1945 fluorosis prevalence estimate for Grand Rapids was 10%, 10 to 17 years later, the prevalence was 7 to 16%, and has been increasing with increasing availability of multiple sources of fluoride (toothpaste, mouth rinses, prescribed fluoride)--ranging from 7.7% to 69% in areas of CWF and from 2.9% to 42% in non-fluoridated communities.<sup>19</sup>

In this study, no significant association of fluorosis and low lumbar spine BMD were found. Though not at a statistically significant level, fluorosis had a protective effect (AOR 0.78 in model 1 and 0.81 in model 2 and 0.82 in model 3). While therapeutic levels of fluoride have drastically reduced caries, increasing amounts of fluoride ingestion has become

a public health concern in terms of dental fluorosis, resulting in the Health and Human Services 2011 recommendation to lower CWF to 0.7ppm.<sup>34</sup>

There are many individuals in the public who remain skeptical about fluoride and its systemic effects. Fluoride exposure has been a controversial national discussion and requires scientific examination to inform the debate. The first wave of the U.S. population potentially exposed to a lifetime of community water fluoridation is approaching middle age and older, and life-time effects may be examined. This study adds to the literature in that we found no association of dental fluorosis and lumbar spine BMD.

This study has several strengths. It uses data from a large, nationally representative study with laboratory measures of BMD, clinical evaluations of fluorosis, and availability of comprehensive information on many variables that can affect presence of osteoporosis. There were some limitations present in the study. As a cross sectional study, causal state-

ments cannot be inferred. Highly imputed lumbar spine data were not used, and this study used self-reported indicators potentiating selection bias and non-differential misclassification bias. Missing teeth, crowned or veneered teeth, not fully erupted teeth, or teeth with more than one-half or more of the visible enamel replaced with a restoration, or covered with an orthodontic band, or destroyed by caries had to be evaluated as cannot be assessed, which resulted in a large category of participants. Nevertheless, their BMD was not significantly different from the referent. Despite these limitations, our study was able to examine the association between fluorosis and low lumbar spine BMD. This study did not reveal a statistically significant association between fluorosis and lumbar spine BMD, was not present in the sample of adults aged 20 to 49.

Dental hygienists routinely provide topical fluoride treatments (which do not cause fluorosis) to their patients. It is a time in which they are often queried about the safety and efficacy of fluoride. The questions provides an opportunity for dental hygienist to discuss the benefits of fluoride, the distinction between topical and systemic fluoride, and they may use the results of this study to indicate continued support of the safety of fluoride, in therapeutic levels, in terms of its effect on bone mineral density.

## Conclusion

Dental hygienists, in presenting oral hygiene instruction, provide patients with anticipatory guidance information to help avoid dental fluorosis in the

Table II: Odds Ratios and Adjusted Odds Ratios for Fluorosis from Logistic Regression on Low Lumbar Spine Bone Mineral Density National Health and Nutrition Examination Survey, 2003 to 2004

	Odds Ratio	95% Confidence Interval	Significance
MODEL 1			
Fluorosis			
• Yes	0.65	[0.37 , 1.15]	0.2737
• Cannot be assessed	1.09	[0.77 , 1.54]	0.4640
• No (Reference Group)	-	-	-
	Adjusted Odds Ratio	95% Confidence Interval	Significance
MODEL 2			
Fluorosis			
• Yes	0.68	[0.36 , 1.30]	0.4240
• Cannot be assessed	0.98	[0.70 , 1.38]	0.8707
• No (Reference Group)	-	-	-
MODEL 3			
Fluorosis			
• Yes	0.71	[0.37 , 1.36]	0.5114
• Cannot be assessed	0.93	[0.66 , 1.32]	0.8568
• No (Reference Group)	-	-	-
MODEL 4			
Fluorosis			
• Yes	0.69	[0.35 , 1.37]	0.5127
• Cannot be assessed	0.88	[0.61 , 1.28]	0.7113
• No (Reference Group)	-	-	-

1,805 non-institutionalized civilian men and not-pregnant women aged 20 to 49 years. Model 2 adjusted for fluorosis (present, absent), gender (male, female), race/ethnicity (Non-Hispanic Whites, Non-Hispanic Blacks, Mexican Americans, others), and age (20 to 29, 30 to 39, 40 to 49 years). Model 3 additionally adjusted for marital status (married, not married), education (less than high school, high school, above high school), poverty status (poor, low income, middle income, high income), and health insurance (insured, not insured). Model 4 additionally adjusted for health status (excellent, very good, good, fair/poor), alcohol use (heavy, moderate, none), smoking status (current, former, never), moderate exercise (yes, no), body mass index (normal/underweight, overweight, obese).

permanent dentition of their children, particularly the maxillary anterior teeth. Hard tissue formation occurs between ages 3 months to 7 years for the maxillary anterior teeth. Dental hygienists continue to remind adults to secure toothpaste tubes from very young children, and to prevent child access to prescribed fluoride tablets or gels. Dental hygienists inform patients with children that the American Academy of Pediatric Dentists recommends a smear of fluoridated toothpaste for children under age 2 years, and the American Dental Association recommends seeking dentist/physician advice for the use of fluoridated toothpaste for children under age 2 years. When queried about the safety of fluoride and bones, dental hygienists may report that this study of adults ages 20 to 49 did not show an association of fluorosis and low BMD.

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# CLL Poster Session

## **A Comparison of School Dental Examination Data in Illinois: Beneficial for Public Health Programming and Surveillance**

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(Southern Illinois University Carbondale)

**Purpose:** In most states, local oral health data is not readily available for agencies to utilize to justify public health programming. Illinois requires dental examinations for entry into kindergarten, second and sixth grades employing the Association of State and Territorial Dental Director's basic screening survey format. The purpose of the study was to document access to care and other oral health issues in the southernmost 16 counties in Illinois by comparing the Southern Illinois results of school dental examination data with statewide dental examination data.

**Methods:** A retrospective review of existing data was conducted from results of 2011 Illinois school dental examinations. The statewide data was accessed from the report of dental compliance and dental health status compiled by the Illinois State Board of Education (ISBE) Division of Data Analysis and Progress Reporting. Dental exam data for schools from the lower 16 counties was accessed for the same year from the ISBE website and transferred to Excel spreadsheets. Descriptive results for the various components of the dental examinations reported from the lower 16 counties were compared to statewide data.

**Results:** Compliance for dental examinations for the state was 77.8% (n=454,282) and in the southern 16 counties was 78.4% (n=11,204). A larger proportion of Southern Illinois children required waivers for dental examinations (2.56%, 288) representing significant access to care barriers. Children requiring waivers for the remainder of the state was 0.71% (2,862). Sealant use in Southern Illinois school children was comparable to statewide use, and even higher than statewide in sixth grade children. Results for untreated decay were higher by approximately 8% for all 3 grades of Southern Illinois children compared to statewide data. There was little difference in treatment urgency between the 2 groups. The "unknown" category of data (neither "yes" nor "no" was marked on the form) was much higher for all of the oral health indicators among Southern Illinois children than the rest of the state.

**Conclusions:** In an age of increased competition for scarce resources, health data drives public health programming. Information gained from the mandatory school dental examinations is valuable for documenting oral health status, access to care and unmet dental needs in states' low access areas. Results from this study can be used to leverage resources for the implementation of public health programs. Calibration exercises for dental providers can be justified from the results as better data collection can result in better surveillance.

**Funding Source:** SIUC-Undergraduate Assistant award.

## **Formative and Summative Clinical Assessment: The Student Perspective**

\*Kristeen R. Perry, RDH, BSDH; Linda D. Boyd, RDH, RD, EdD  
(Massachusetts College of Pharmacy and Health Sciences University/Forsyth School of Dental Hygiene)

**Purpose:** The purpose of this study was to explore dental hygiene students' perspectives on the method of daily clinical grading versus formative feedback and summative (comprehensive patient case competency, CPCC) assessment which is used in other health care disciplines.

**Significance:** A literature search revealed a limited number of studies of clinical assessment methods used to assess student competency. The most common methods discussed were daily clinical grading and fulfillment of patient requirements. However, it remains unclear this is an effective approach for ensuring competency.

**Methods:** Based on the literature a BSDH program developed a method of formative and summative assessment (CPCC) for clinical curriculum. A survey was developed to gather student perspectives on the change from daily clinical grading to formative/summative assessment. The survey was distributed to a convenience sample of dental hygiene students (n=48) at the end of fall and spring semesters, anonymous, and conducted in an online survey tool.

**Results:** The response rate was 100% (n=48).



Responses to the following statements were as follows: "I felt like formative feedback allowed for more collaboration with clinical faculty than the daily grading format," 98% (n=47) agreed/strongly agreed. "Formative feedback encourages me to ask questions to enhance my learning," 98% (n=47) agreed/strongly agreed. When asked about summative assessment in the form of patient care competency (CPCC), 98% agreed/strongly agreed; "Summative CPCCs were an appropriate method to evaluate my abilities to provide evidence-based dental hygiene care." The main advantage cited: "I feel like formative feedback opened more doors for questions and hands-on help from clinical instructors and there was less pressure so it was easier to ask faculty questions regarding patient care and know what's expected of you before being graded." Overall, 83% (n=40) preferred the formative/summative assessment versus 15% who preferred daily grading.

**Discussion:** Upon initial implementation of the change in grading format students felt uncomfortable asking questions because they were used to "losing points" in the daily clinical grading system. Students quickly came to value the opportunity to ask questions to learn and improve their patient care skills prior to summative assessment.

**Conclusion:** Based on student comments daily grading makes them reluctant to ask questions which is a necessary part of learning. Finding a balance between creating a safe environment where students can learn and assessing competence to ensure graduates can provide quality care is challenging, but this small study suggests formative and summative assessment system may facilitate student learning.

### **Supplemental Instruction through Distance Education: An Innovative Hybrid Project Using Wimba Online and Tablet Technology**

\*Carrie L. Hanson, RDH, MA  
(University of Missouri-Kansas City, School of Dentistry)

**Problem Statement:** It is critically important dental educators strive to increase admissions of diverse candidates to both dental and dental hygiene school in order to more closely mirror the rapidly changing demographics of our nation.

**Purpose:** The purpose of the Admission Enhancement Program (AEP) is to assist culturally diverse candidates to enrich their application and subsequent admission to dental school.

**Methods:** The UMKC School of Dentistry (UMKC-SOD) partnered with the UMKC Center for Academic Development (CAD) and Supplemental Instruction (SI) to pilot the AEP. A total of 12 candidates were admitted to the 8 week hybrid summer program. The program utilized both on-site enrichment experiences at the SOD and online distance education. Shadowing a dental student, hands-on lab activities and career exploration seminar activities were among the onsite enrichment experiences students were given. A central focus was to strengthen foundational knowledge in math, chemistry, organic chemistry and biology in preparation for the Dental Admission Test (DAT). Topics were presented as 2 week online modules. Daily interactive sessions between UMKC AEP students and SI Leaders were delivered through distance education. Students benefited from 24/7 (asynchronous) access to academic content and remained "in touch" with UMKC faculty, staff and each other, no matter where they lived. The peer-led SI sessions were held in a live (synchronous) online classroom. Readings, concepts, homework assignments, issues of confusion and complex problems were reviewed and aided by writing tablet technology to deepen engagement and learning of materials. This innovative program represents UMKC's effort to utilize internationally recognized SI learning strategies through distance delivery, and the opportunity to use state-of-the-art tablet technology to enhance instruction in math and science.

**Results:** Students completed a survey at the conclusion of the AEP which incorporated all programmatic details. Outcomes suggest students and SI Leaders viewed the online SI format and the tablet technology favorably (45.5% to 81.8%). Additionally, 85.7% of students were accepted to dental school. All students indicated the AEP helped them learn new skills for dental school preparation. Year two of the AEP reviewed all outcomes data and implemented changes to enhance the goals and mission of the program.

**Conclusions:** This project has the potential to stimulate others in the academic community to consider online SI instruction and writing tablet technology to enhance learning skills and could be a model applied to dental hygiene to aid in increasing diversity in those programs.

Funding for this project was provided by the Missouri Legislature.

## Smiles for a Lifetime: Direct Access to Preventive Care for Head Start Children

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Jo Ann Catalfo, MS  
(Ann Arbor Public Schools Preschool & Family Center)  
\*Charlotte J. Wyche, RDH, MS;  
(State of Michigan Oral Health Program and University of Michigan School of Dentistry)

During the 2004/05 school year, only 55% of preschool children registered in Washtenaw County Head Start (WCHS) received a required dental exam and preventive care. Of those children, 46% were identified as needing follow-up care. However, fewer than half received treatment. In 2006, WCHS received a grant to hire an Oral Health Coordinator (OHC). Subsequent discussions between the OHC and a dental hygienist friend initiated the idea of a fluoride varnish program.

The Smiles for a Lifetime program, implemented during the 2007 to 2008 school year, offered free dental screening and fluoride varnish application to all children enrolled in all 6 WCHS sites across the county. Program objectives included: 2 on-site visits (at the start and end of each school year), application of fluoride varnish and "flashlight" screening exam, and a referral for needed treatment and support to establish a dental home. One or more staff members or teachers at each WCHS site discussed need for follow-up care with each child's parent/guardian to assure that a dental home was identified and treatment was received.

Key aspects of program implementation include the use of Michigan's PA 161 (direct access) law and development of dedicated RDH teams. A second visit to classrooms in April allowed teams to identify children who had not yet received care for needs noted during the first screening in October.

Relationship building and engagement of administration, staff and teachers at each WCHS site were important components of the success of the program. Teacher support was identified as key to increasing the return of positive permission forms as well as providing assurance that needed follow-up care was discussed with a parent/caregiver. Providing information and reassurance to local dentists was important to avoid misunderstanding of the goals and scope of the program.

Program data indicate that the Smiles for a Lifetime program provided more than 5,000 oral screenings and fluoride varnish applications between 2007

and 2012. An increased number of positive permission slips returned after the first year of the program indicate success in increasing the number and percent of WCHS children who received fluoride varnish. Compliance with referral is difficult to assess, but anecdotal evidence indicates that twice-yearly interaction with RDH teams increased awareness and encouraged staff to provide follow-up for the more than 500 children identified as needing restorative care.

Funding Source: Year 1 funding: Washtenaw District.

## Knowledge and Attitudes Towards People With HIV and Willingness to Conduct Rapid HIV Testing: A National Survey of U.S. Dental Hygienists

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(New York College of Technology)  
\*Winnie Furnari, RDH, BS, MS, FAADH;  
(New York University College of Dentistry)

**Problem Statement:** In the U.S., an estimated 21% of people living with HIV/AIDS do not know their positive status. Expanding rapid HIV testing in the dental setting may increase the number of individuals aware of their HIV status and can begin medical care and social support services.

**Purpose:** Expanded rapid HIV testing initiatives are needed outside the routine medical setting. The dental setting is a logical choice since almost two thirds of Americans see a dental provider each year. This study aimed to determine knowledge of HIV, attitudes toward people living with HIV and willingness to conduct rapid HIV testing among dental hygienists.

**Methods:** Practicing dental hygienists were recruited to complete a cross-sectional survey. The survey included 13 questions assessing knowledge and attitudes. Surveys were administered online using Campus Labs, and were collected from September to December 2011.

**Results:** Subjects were first assessed in terms of mean knowledge test score. Individuals who answered 75% or more of the questions correctly were placed into a category of "high test scorers," while those who answered less than 75% of the test questions correctly were placed into the "low score" group. Associations between groups were tested using a chi-square statistic for categorical variables and a t-test for continuous variables. Attitudes were measured as scores on a 3 point Likert scale, and

were analyzed as categorical variables. Age, gender and race-adjusted odds ratios and their 95% confidence intervals were estimated using unconditional logistic regression models. Statistical significance was assessed using a 2-sided test at the  $\alpha=0.05$  level for all studies.

**Conclusions:** Increased knowledge about HIV is associated with an increased comfort level in working with medically compromised patients, and in counseling about sexual HIV prevention methods. This study demonstrates a majority of the high scoring knowledge group indicated that they would be willing to conduct HIV rapid tests.

Those with high test scores were more likely than those with low test scores to feel comfortable counseling about sexual HIV prevention. The groups did not differ in their willingness to be trained to perform HIV testing. This indicates a need to offer supplemental access to HIV education and training in dental hygiene curriculum and post-graduate continuing education. The study supports the NDHRA priority area, Health Services Research. It was approved by the Long Island University Institutional Review Board.

Funding for this project was through Long Island University Health and Wellness Institute.

### **The Dental/Mental Connection – Dental Care as Integral to Mental Health Care**

\*Patricia E. Doyle, RDH, BS, FADPD  
(University of Washington, UW Oral Health Collaborative)

The 2 goals of this program are to illustrate the critical relationship of oral health care service delivery to mental health care patient outcomes and to deliver relevant education and training to mental health case managers, their clients and dental professionals to develop mutual awareness and the ability to advocate successfully for oral health care service delivery to mental health clients.

While oral health problems occur more frequently among mental health clients than the general population, access to oral health care for this demographic is far more problematic. This program is important because it presents a practical model for building understanding and trust among mental health patients, case managers and dental professionals for the purpose of increasing oral health care service delivery to mental health clients, and it documents the success achieved by integrating service delivery for dental and mental health care.

Mental health clients in the program are people with chronic or severe persistent mental illnesses who receive disability support and are served in community mental health systems.

The model has 3 elements: client-centered intake and assessment, coordination of initial and ongoing oral health care, and creative approaches to resource development. It takes a 1:1 approach to clients, emphasizing the need for respect of individual life circumstances as the foundation for successful treatment.

Program training presents education about these issues and explores successful resolutions. Issues include:

- Oral pathology, including gum disease, tooth decay, and dental treatment needs
- Psychotropic medications
- Smoking, substance abuse, and other habits
- Dental fears and phobias
- Special management considerations
- Financial barriers
- Education and training focusing on the interrelation of dental and mental health

The program is not site dependent and can be easily replicated. Training for mental health case managers, clients and dental professionals can be delivered in person or online. Pre- and post-training questionnaires measure changes in participants' oral health awareness and understanding.

A dental hygienist who volunteered 1 day/week saw about 30 new patients a year and coordinated 150 appointments. Thirty-four percent completed their treatment plans which included preventive, restorative, and surgical services. This is a small program that offers dental hygienists the opportunity to make a big difference in the lives of people who are mentally ill.

### **ADHA Hyposalivation with Xerostomia Screening Tool Project**

\*Margaret J. Fehrenbach, RDH, MS  
(Self-employed, Dental Hygiene Education Consulting)

**Problem Statement:** The number of xerostomia cases has increased greatly over time because people are taking an increased number of medications; there are more than 400 prescription and non-prescription medications associated with xerostomia. Other factors are also involved. In the absence of the protective factors of saliva, a patient becomes

more susceptible to oral disease such as caries, candidiasis and periodontal disease, all of which can result in significant oral care concerns. Thus the major concern for dental health care providers is to assess hyposalivation with xerostomia. A hyposalivation with xerostomia screening tool was created for the dental hygienist in dental practice by funding from an Unrestricted Educational Grant provided by GlaxoSmithKline, and utilizes American Dental Hygienists' Association (ADHA) Standards for Clinical Dental Hygiene Practice regarding the assessment, etiology and management of conditions. The screening tool generates an overall susceptibility to hyposalivation with xerostomia, using a simple grading scale ranging from low to moderate to high risk. Using the assessment and diagnosis clinical parameters, the tool comes to a conclusion or dental hygiene evaluation of risk for hyposalivation with xerostomia that allows for planning and implementation of interventions per risk level of the patient by the dental hygienist and rest of the dental team. The tool was presented to the ADHA members via an article in Access magazine.

**Purpose:** The validation of the screening tool in a clinical setting.

**Proposed Method:** One effective way to obtain objective measurements of quantitative changes in saliva is by collecting saliva. A total of 100 participants in a selected clinical setting with the primary symptom of xerostomia would be used in the study. Each participant would first be evaluated using the developed tool by a dental hygienist to determine the participant's risk level for hyposalivation. After the evaluation, first unstimulated saliva would be collected and then stimulated saliva, with both being weighed. Later the participant's salivary flow rate for both the unstimulated and stimulated flow is calculated by dividing the amount (weight) of collected saliva by the duration of the collection period (5 minutes). Both the responses to the tool and salivary flow rates for each participant would undergo data analysis in comparison to known values to determine the validity of the tool to adequately evaluate the risk level for hyposalivation.

**Funding Source:** GSK (future funding not appropriated at this time).

### **Palliative Oral Care: Perceptions of Long-Term Care Certified Nursing Assistants**

\*Joyce Y. Sumi, RDH, BS, MS; Margaret Walsh, BS, MS, MA, EdD; Kristin Hoeft, MPH; Jane Forrest, RDH, EdD; Susan Hyde, DDS, MPH, PhD (University of Southern California)

**Background:** Oral care deficiencies continue to occur in long-term care (LTC) institutions despite governmental standards. Reported low priorities of oral care among LTC nurses and limited interdisciplinary utilization of dental professionals contribute to diminished optimal oral health. Certified Nursing Assistants (CNAs), primarily responsible for providing palliative oral care (POC) to LTC residents with life-limiting illnesses, critically need sound oral care knowledge and training to ensure patients' quality of life. Further investigation to understand CNAs' role in POC of institutionalized populations is necessary, as studies have indicated differences between CNAs' reported oral care and actual practices.

**Objectives:** This qualitative study explored the perceptions and barriers of LTC CNAs who provide POC and situated those experiences within a health-promotion planning model.

**Methods:** Digitally recorded, semi-structured interviews conducted with 10 LTC CNAs obtained POC knowledge and attitudes that were supplemented with field observations.

**Results:** CNAs perceived themselves as primarily responsible POC yet were deficient in that knowledge. Subsequently, personal dental experiences became their preeminent source of information. Absent were evidence-based guidelines, efficacious oversight and interdisciplinary communication to between dentistry and nursing leaving CNAs to self-monitor quality of oral care.

**Conclusion:** The lack of POC accountability and effectual interdisciplinary collaboration underscores the need for new models to address this multi-dimensional problem. Although increased oversight and training for CNAs can initiate POC improvements, augmented geriatric oral health education for dental and medical professionals is essential to improve achieving optimal oral health for all LTC residents.

## **Video Assisted Psychomotor Skill Development in Dental Hygiene Education (VAPS)**

\*Laurel L. Risom RDH, MPH; \*Karen Sue Williams, RDH, MS; \*Sandra A. Stramoski RDH, MSDH; \*Kristin Minihan-Anderson RDH, MSDH; Kateri Klesyk RDH, BSDH (Fones School of Dental Hygiene, University of Bridgeport, Bridgeport CT)

**Problem Statement:** Dental Hygiene education is challenged with the problem of psychomotor skill development, knowledge retention and transference of the new skill into practice. Successful dental hygiene instrumentation skills require practice time on typodont models beyond the clinical setting without the oversight and feedback of instructors. This may lead to incorrect technique development.

**Purpose:** The purpose of this study was to investigate the effectiveness of instructional instrumentation videos for first year dental hygiene student performance during clinical learning. Effectiveness was measured by instructors evaluating each student using a scored assessment for 11 dental hygiene instruments. The null hypothesis: there is no statistically significant difference in initial instructor assessment scores between students who have been provided instrumentation videos and students who have not.

**Methodology:** This randomized control trial involved 52 (n=52) first year dental hygiene students; 26 students were assigned to each group, experimental and control. Instructional instrumentation videos were created and made available to the experimental group only via the University's Learning Management System. The control group received identical lecture content and demonstrations but did not view the videos prior to the assessments. The experimental group had access to the videos for 72 hours following lecture. A total of 5 calibrated instructors, blinded to group selection, utilized 17 criteria to assess student effectiveness related to the use of 11 instruments. Criteria included grasp, fulcrum, positioning, activation and mirror use. Students also completed pre- and post-assessment surveys indicating prior dental hygiene instrumentation use, student learning style, utilization of videos during practice, frequency of video viewing and the perceived benefits of video use. IRB approval was granted from the University of Bridgeport. Data was analyzed at a significance level of  $p \leq 0.05$  utilizing SPSS Statistics version 20. Mann-Whitney U and Chi-square tests were applied to demonstrate differences between variables.

**Results:** The experimental group demonstrated

a statistically significant improvement with four of the 17 criteria, for 4 of the 11 instruments assessed when compared to the control group. Three of the 4 instruments demonstrating statistically significant improvement were assessment instruments. Post-assessment surveys indicated over 85% of students agreed the videos helped with dental hygiene fundamentals, typodont practice and instrumentation technique.

**Conclusion:** Instructional instrumentation videos can be a valuable tool to aid student psychomotor skill development in dental hygiene clinical education. Further research is warranted.

## **Innovative Internship Opportunities in a Baccalaureate Degree DH Curriculum**

\*Eva M. Lupovici, RDH, MS; Rosemary Hays, RDH, MS; Cheryl Westphal-Theile, RDH, EdD (New York University College of Dentistry)

The baccalaureate degree dental hygiene curriculum is designed to pursue an area of focus, which is enhanced by Internship in Dental Hygiene Program Course. The purpose of these assignments is for the student to further develop interprofessional educational experiences, innovation, reflection, while assessing their future professional goals. The internship opportunities include areas of focus in Corporate, Research, Nursing, Education, Public Health, Geriatrics and Law/Ethics.

The students choose their assignment site, which is arranged through collaboration of the dental hygiene program with institutions, government agencies and private corporations.

Students enroll in the internship courses in their fourth year of curriculum. The following are the educational experiences where students can participate.

One internship is at a major pharmaceutical company, the students have the opportunity to learn about research, dental product development, manufacturing and marketing strategies.

Interprofessional educational experiences are achieved at the Colleges' Nursing Faculty Practice. In corroboration with Nurse Practitioners, the student participates in a pilot program on interdisciplinary learning model for nursing, dental and hygiene students. This experience engages students and faculty to develop strategies to promote greater interdisciplinary alliances in offering comprehensive holistic patient's care all in 1 location.

Another internship is with the Colleges' Patient Advocate. The student has the opportunity to learn about laws governing student and licensed dental practitioners, and ethical issues of conflict resolution.

The research Internship is at the College's Research Center. Students participate in various funded projects; where they learn about research protocol, grant writing and processes of conducting research.

A student whose interest is public health is achieved at the Veteran's Administration Hospital dental clinic, where they provide dental hygiene services to medically and mentally compromised patients. Students interested in the public health and the older adult can complete the internship at a Naturally Occurring Retirement Community (NORC). They work as a team member with a nutritionist, nurse and social worker to provide onsite care and lectures to meet the concerns of the older adult patient.

Students interested in pursuing education are assigned to dental clinics at the College to teach the undergraduate dental hygiene students under faculty supervision.

At the completion of each semester, the students share their internship experiences on the Blackboard Course site. The students expressed satisfaction with their chosen site, with the teaching internship most valued. All students stated that their internship empowered them to assess and reflect on their future professional goals, through innovative educational experiences.

### **Education Strategies for Integrating Evidence Based Principles in a Two Year Dental Hygiene Program**

\*Mary Therese Keating-Biltucci, RDH, MA; Beth Kettell, MLS; Alice Wilson, MLS and Pam Czaja, MLS (University of Rochester)

**Problem Statement:** The dental education environment fosters passive learning instead of critical thinking and lifelong learning skills.

**Purpose:** The purpose of this research was to investigate education strategies that support critical thinking and lifelong learning by utilizing the principles of evidence based learning in a dental hygiene 2 year curriculum.

**Methods:** A qualitative approach that adheres to

well established criteria of critical incident technique (CIT) was utilized as the research method. A total of 4 lesson plans (assessments) were developed to produce data collected from 3 critical incidents. These assessments reflected the students' comprehension of the teaching objectives.

**Results:** Dental hygiene students exhibited an increased level of comprehension in assessments 1 and 3. The n and descriptive statistics was used for the pre and post assessments. Research results used a p-value of <0.05 as the cut-off for statistical significance. Assessments 1 and 3 were both significant with p-values of 0.018 and 0.000, respectively. Dental hygiene student's in a 2 year college program exhibited skills when accessing the web for general information. Students also applied some critical thinking skills in the case study lesson and assessment. Students fared poorly when attempting to access and use scientific information instead of information available to the public.

**Conclusions:** These results suggest that while dental hygiene students are capable of utilizing evidence based theories they may lack the knowledge integral to practice this concept as a student and in their professional lives. Dental hygiene students require evidence based learning principles integrated into their curriculum beginning in their first semester of a 2 year program so they become familiar with the principles. Comprehension and utilization of evidence based practice will be a familiar concept if the principles are applied to dental specific courses such as community dentistry, clinical dental hygiene, dental therapeutics and periodontics.

### **Blood Glucose Testing in Dental Practices: A Community-Based Feasibility Study**

A. Barasch; G. H. Gilbert; M. S. Litaker; R. Palmore; W. Wright; M. M. Safford; \*Sarah Verville Basile, RDH, MPH (The National Dental Practice-Based Research Network Collaborative Group)

**Problem Statement:** Diabetes prevalence has increased significantly. Optimal glycemic control is found in only 35% of diabetes patients (NHANES 1999 to 2000). Diabetes prevalence continues to increase suggesting additional methods are needed for screening patients at risk for the disease as well as those who are undiagnosed or whose disease is poorly managed.

**Purpose:** The purpose of this study was to assess the feasibility of blood glucose screening in dental practices in the National Dental Practice-Based Research Network (NationalDentalPBRN) and was

comprised of community dental practices across 5 regions: Alabama/Mississippi, Florida/Georgia, Minnesota, Permanente Dental Associates in cooperation with Kaiser Permanente NW Research Foundation, and Scandinavia (Denmark, Norway, Sweden).

**Methods:** Dental practitioners and/or staff were trained in how to use a handheld glucometer (Free-Style Freedom Lite, Abbott Diabetes Care). Consecutive patients  $\geq 19$  years of age with one or more risk factor for diabetes were enrolled until 15 qualified and consented in each practice. Barriers and benefits to glucose testing in dental practice were reported using patient and dentist/staff questionnaires.

**Results:** Dental practitioners and staff ( $n=67$ ) in community-based dental practice settings ( $n=28$ ) enrolled patients ( $n=498$ ) into the study according to National Dental PBRN developed protocol. Most dentists considered glucose testing necessary (93%), agreed that testing was beneficial (85%), and agreed that testing may help identify patients at risk for periodontal disease (75%). Among dentist identified barriers to use, 22% perceived testing as time-consuming (58% disagreed), 5% expressed cost would be a barrier (51% disagreed) and 5% thought that testing will open practices to liability (72% disagreed). Among patient-respondents, most (83%) thought glucose testing in dental practice was a good idea (2% disagreed). Also, most patients (85%) reported that testing was easy (2% disagreed) and 62% said the test made them more likely to recommend other patients to the practice because glucose testing was conducted.

**Conclusion:** Glucose testing was generally well-received by both patients and dental practitioners and their staff. Results should dispel beliefs that glucose testing is time consuming, cost-prohibitive, and poorly accepted by dental patients.

Funding for this project was provided by NIDCR: DE-16746, DE-16747, U19-DE022516.

### **Patient Awareness of Xylitol**

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\*Brigette R. Cooper, MS, RDH;  
Krystal A. Bode, BS, RDH and  
Linda M. Froehlich, BS, RDH  
(MN State University, Mankato)

**Purpose:** Tooth decay continues to be a significant problem in the population. Research has demonstrated how daily use of xylitol gum is an effective way to stop the production of acid causing tooth decay. Little research has examined the awareness

and knowledge of xylitol in the general public. This study examined dental patients' knowledge of xylitol as it relates to prevention of tooth decay and overall health.

**Methods:** Surveys were distributed to a convenience sample of dental patients at a Midwest University Dental Hygiene clinic ( $n=39$ ) and a general practice dental office ( $n=11$ ). Researchers designed a knowledge score from 10 true/false items about xylitol based on the literature. Participants indicated their level of agreement regarding 8 various oral health beliefs related to xylitol and tooth decay. Frequencies and Pearson correlations between the oral health beliefs were examined. Relationships between knowledge and age groups were examined through an ANOVA test. Participants were grouped according to education levels with no college degree ( $n=23$ ) or a 2 year degree or higher ( $n=24$ ). Income levels were grouped according to less than \$50,000 ( $n=23$ ) or greater than 50,000 ( $n=22$ ). Knowledge scores according to education level and income level were examined with t-tests.

**Results:** Of those surveyed, 82% of participants were Caucasian with 85.1% between the ages of 25 and 54. The average knowledge score regarding xylitol was 5 correct out of 10 true/false items. Most participants were aware that xylitol is not readily available (70.2%) and that xylitol can reverse the initial stages of decay (68.1%). Most participants (61.7%) were unaware that xylitol can help regulate blood glucose levels for diabetics. Results revealed that there were no significant differences between the knowledge scores and participants' age ( $p=0.90$ ), education ( $p=1.0$ ), or income level ( $p=0.46$ ). There was a significant correlation ( $p=0.01$ ) between participants' value of oral health and the knowledge score ( $r=0.36$ ). Despite the lack of knowledge, 79.6% of participants were willing to administer and monitor the use of xylitol for their children to reduce the chance of tooth decay.

**Conclusion:** The findings in this study suggest that dental patients are largely unaware of xylitol and its potential benefits, regardless of age, education level, or income level. Further research should be conducted with a larger random sample to validate these findings. Increased knowledge among dental patients is needed to increase the use of xylitol to prevent dental decay. Dental hygienists can play a key role in educating patients about the benefits of xylitol.

## **Comparison of Critical Thinking in a Traditional Master's Degree Program and an Innovative Bridge Program for Associate Degree Dental Hygienists**

Linda D. Boyd, RDH, RD, EdD; Dianne S. Chadbourne, RDH, MDH; \*Lori Rainchuso, RDH, MS (Forsyth School of Dental Hygiene, Massachusetts College of Pharmacy & Health Sciences)

**Problem:** Self-perceived barriers to success among dental hygiene graduate students, prior to their entry into graduate level course work, is a belief that an extended absence from academia and fear of graduate courses being too difficult will prevent them from successful completion of their degree program.

**Purpose:** The purpose of this study was to evaluate and compare the critical thinking skills of students entering a newly designed online Associates Degree (AD) to Masters (MS) Bridge program and an established online MS program.

**Methods:** The Health Sciences Reasoning Test (HRST), a validated assessment of critical thinking skills of health science students, was administered to all entering AD to MS (n= 15) and MS students (n=7). AD to MS students repeated the test after completing the bridge portion of the program and at their point of entry into the MS curriculum. IRB approval was obtained for use of the HRST with all graduate students for the purposes of this study. The HRST is composed of 5 subscales with each subscale score tallied to create an overall performance score for each student's critical thinking skills. The scale for the HRST overall scores are interpreted as follows: 25 strong skills, 15 to 24 competent skills, 14 and below fundamental weakness in skills, and 10 or lower extremely weak skills.

**Results:** The mean HSRT score for the AD to MS students at entry into the program was 20 with an individual high score of 26 and low of 15. The mean HSRT score for the MS students at entry into the program was 17, with an individual high score of 24 and low of 12. The mean HSRT score for the AD to MS students after completing the bridge program was 22 with an individual high score of 25 and low of 14.

**Conclusions:** Outcomes of the mean HRST scores for AD to MS students showed improvement from the point of entry to the midpoint of the program. MS students' scores fell below those of the AD to MS students and may indicate students entering the AD to MS programs have critical thinking skills equal to or better than entering MS students. Further study

needs to be conducted to include a larger pool of participants before conclusions can be drawn.

## **Increasing Access to Oral Healthcare Services to Underserved Children Through a Collaborative School-Based Program Using Expanded Scope of Practice Dental Hygienists and Dental Hygiene Students**

Cynthia C. Gadbury-Amyot, MSDH, EdD and \*Melanie Simmer-Beck, RDH, MSDH (University of Missouri-Kansas City)

**Purpose:** To describe how collaboration between a university, a school district, an expanded scope of practice dental hygienist (ECP-RDH) and local dentists in a community has resulted in the delivery of comprehensive preventive and restorative oral health care to unserved and underserved children on site at their elementary schools.

**Statement of the Problem:** Accessing oral health care is a growing problem for children in the U.S. Promising oral health care workforce innovations are improving access to preventive oral health care. However, in most instances, these innovations do not have outcomes data that illustrate impact on access to care.

**Study Significance:** A change in the dental practice act allowing dental hygienists direct patient access provided the opportunity for this unique collaboration, where a dental hygiene faculty member with an ECP-RDH supervises dental hygiene students in the children's elementary schools using portable dental equipment to provide comprehensive preventive oral health care services. Restorative services are provided by dentists in the local community. This study will provide 4 years of robust outcomes data that demonstrate the impact this model had on improving access to oral health care.

**Methodology:** This study is a descriptive, retrospective, review of the electronic patient record from 2008 to 2012.

**Results:** Since its inception in 2008, 960 children have been provided comprehensive preventive oral health care services including prophylaxis, radiographs, fluoride varnish and sealants. A total of 292 (n=292) children were provided preventive oral health care services 2 or more times indicating the presence of a dental home. The decay rate remained decay free in 21%, decreased in 40%, increased in 27% and did not change in 11% of the children who used this model as a dental home. While urgent needs have been addressed by community dentists on a volunteer basis this has not



solved the need for comprehensive restorative care. As of Fall 2012 a partnership with a federally qualified health center has resulted in the provision of place-based restorative care.

**Conclusion:** A change in the dental practice act allowing children direct access to dental hygienists combined with a school-based, place-based approach to care has resulted in the provision of preventive and restorative oral health care to children who have not been able to access the predominantly private practice, fee-for-service dental model in the U.S. Future research should examine how the provision of place based restorative care impacts the children's state of oral health

Funding for the project was provided by the REACH Healthcare Foundation"

NDHRA: Health Services Research.

### **Dental Hygiene Service-Learning in Belize**

\*Brigette R. Cooper, MS, RDH; \*Angela L. Monson, PhD, RDH  
(Minnesota State University, Mankato)

**Purpose:** The purpose of this program was to provide preventive oral health services to underserved children in Belize. Program goals were to treat children who do not have regular access to oral health care, to provide students the opportunity to participate in a culturally diverse outreach program, and to increase student's competency in providing oral health services for children.

**Significance:** Integrating service-learning into dental hygiene curricula fosters graduates who are better prepared to work effectively among diverse populations and have the opportunity to learn beyond what could be achieved in the classroom.

**Approach:** Dental hygiene faculty at Minnesota State University, Mankato collaborated with dentists in Belize to establish a service-learning rotation in San Pedro, Belize, located on the island of Ambergris Caye. During their final semester in the program, senior dental hygiene students participated in this optional, 7 day study abroad experience. Prior to departure, the students acquired knowledge concerning the culture of Belize, health care standards and protocols, and what the anticipated experience providing oral health care in Belize would involve. A total of 6 students, 2 dental hygiene faculty and 3 dentists volunteered at 2 clinics in San Pedro to provide oral health care for children ages 5 to 13. Treatment included prophylaxes, radiographs, seal-

ants, fluoride varnishes and oral hygiene instructions. They also organized a massive school fluoride varnish campaign, led by one of the volunteer dentists. While in Belize, students were immersed in the Belizean culture as they explored the island, participated in community events, and traveled to the mainland of Belize to see the Mayan ruins and small villages in the rain forest.

**Evaluation:** Students wrote daily reflection papers to evaluate their accomplishments, reflect on their day providing oral health care and document their cultural experiences during travel. Reflections were positive, indicating greater confidence in their dental hygiene skills, awareness of cultural diversity and a desire to be involved in outreach projects as they begin their professional careers. We believe service learning enhances dental hygiene education and is an important part of the curriculum.

Partial funding for this project provided for by Minnesota State University, Mankato.

### **Inter-Rater Reliability of the Mallampati Classification for Patients in a Dental Hygiene Clinic**

\*Diane P. Kandray, RDH, MEd; Mary L. Yacovone, RRT, MEd; Debbie Juruaz, DDS; G. Andy Chang, PhD  
(Youngstown State University, Ohio)

**Purpose:** Obstructive sleep apnea (OSA) is a condition characterized by a partial or complete closure of the airway resulting in repeated episodes of breathing cessation during sleep. There are a number of methods to screen and evaluate patients for sleep disorders like OSA. Dental professionals can contribute to the identification of risk factors for OSA by screening patients for physical characteristics associated with OSA. The Mallampati classification is one assessment used by anesthesiologist to identify the size and shape of the oropharynx which can be an indicator of OSA. There is little data to demonstrate the use of the Mallampati classification by dental hygienists in the clinical setting. The purpose of this study was to assess the inter-rater reliability between dental hygiene students and a supervising dentist using the Mallampati classification to evaluate and classify the pharyngeal soft tissues.

**Methods:** A sample of 234 patients volunteered for the study. The dentist and dental hygiene students were trained by a licensed respiratory therapist on the proper method to determine Mallampati classification. The dentist and the dental hygiene students were instructed to sit the patient upright in the dental chair, and to use the dental light to

look into the patients open mouth without phonation. The students were given a diagram of the Mallampati classification and were instructed to place a check mark next to the appropriate image that corresponded to the patients' oropharynx opening. The clinic dentist performed the same exam with the same recording criteria on a separate but identical form.

**Results:** Quantitative research methods were used to evaluate the inter-rater reliability between dental hygiene students and the clinical dentist in performing the Mallampati classification. The data was analyzed using adjusted McNemar test for non-independent data, Kappa score and percentage of agreement with 95% bootstrap confidence interval. There was an agreement between the dental hygiene student and the dentist in the majority of the independent assessments with a p-value=0.498 from the adjusted McNemar test. Inter-rater agreement measured by Cohen's Kappa coefficient is 0.54 with a 95% bootstrap confidence interval of (0.42, 0.64). The percentage agreement is around 77% with a 95% confidence interval of (72%, 82).

**Conclusion:** It was concluded that dental hygiene students can evaluate and classify the pharyngeal soft tissues comparable to a supervising dentist in the clinical dental hygiene setting. Future research should be explored to study dental professionals' important role in the recognition of risk factors for OSA.

### **Accessing Dental Hygiene Services in Price County, WI: An Ongoing Investigation of Quality of Life and Quality of Care**

\*Jodi Olmsted, RDH, PhD  
(University of Wisconsin-Stevens Point)

**Problem Statement:** Little research exists documenting Quality of Care (QoC) and Quality of Life (QoL) for individuals accessing dental services through public health departments when dental hygienists are using a consultative/referral model. Using a consultative/referral model is one way of addressing the issues of declining funding, access to care and workforce development for improving oral health of families with economic disparities and cultural differences.

**Purpose:** The purpose of this research was documenting quality of life and quality of care measures for families receiving care from dental hygienists within public health departments, and considering if oral health for families with economic disparities and cultural differences improved.

**Methods:** A longitudinal, descriptive analysis was conducted. Data existed for analyzing how the Quality of Care (QoC) provided by the dental hygienist offering educational and preventive services through the local public health department impacted/improved the Quality of Life (QoL) for individuals served. A consultative and referral model is used, working with community dental providers. Evidence based practices and descriptive, statistical evidence gathered allowed for conducting a descriptive, longitudinal analysis of these programs.

**Results:** From 2005 to 2011, 3,633 oral health education sessions were provided, 2,216 fluoride assessments were conducted and 1,786 (61%) children received systemic fluoride supplements. A total of 1,667 children were eligible for a weekly topical mouth rinse program, with 1,258 (75%) participating, and 3,028 (83%) children received fluoride varnish. A total of 59 minorities received care, and 30 to 35% of clients served were either Medicaid or Badger Care recipients. Data documenting QoC and QoL was analyzed for described communities. Initial QoL data was ranked in the bottom half of state, while 70% of original determinant data was also ranked in the bottom half of reported metrics. Improvement in QoL measures were noted through improved health outcomes and determinant metrics. QoL measures are annually re-normed statewide, requiring further study.

**Conclusions:** Data describes how QoC and QoL measures for individuals with economic disparities and cultural differences are affected in the service communities studied. This analysis describes positive impacts made, and efficacy of using a consultative/referral model when care required is outside the scope of dental hygiene practice.

**Funding Source:** Northern Wisconsin Association of Health Education Centers (NAHEC).

### **The Need for Improved Health Professionals' Education in the Treatment of Persons with Developmental Disabilities**

\*Gino R. Garza, RDH, BSDH; M. Cunningham; K. Perez; V. Agado; C. Yeung; C. Nguyen  
(University of Texas Health Science Center at San Antonio)

**Problem Statement:** Health professionals' education lacks specific training in providing care for patients with developmental disabilities (DD). It is important for health professionals to have communication and hands-on skills necessary to treat patients with DD.

**Purpose:** The purpose of this study was to identify patient satisfaction with the quality of health care received from medical and dental professionals.

**Methods:** This pilot study focused on the health care transition experience of young adults with developmental disabilities and their family members to gain new insights into their medical and dental needs. A mixed research design was used to identify a convenience sample of 15 in which descriptive and qualitative data were gathered in a structured 45 minute interview. This pilot study was approved by the University of Texas Health Science Center San Antonio Institutional Review Board, May 6, 2009, approval number HSC2009033H.

**Results:** Patients most commonly reported (33%) that their general physician was not prepared to treat those with DD. Other results include the patients' perception that their general dentist was not prepared to treat patients with DD (27%), patients reporting being very dissatisfied with the quality of dental care they have received (13%) and patients reporting being very dissatisfied with the quality of medical care they have received (13%). Furthermore, families often felt segregated during appointments and treatment planning. Lastly, patients would like doctors to "explain, listen and answer questions, take more time, make sentences shorter" when communicating.

**Conclusions:** Health professionals lack training specific to interacting with young adults with developmental disabilities. Training of new health professionals should focus on "patient and family centered care". Licensed healthcare professionals should attend continuing education courses designed to educate professionals on treatment and communication of patients with DD.

Funding for this project was provided by the South Texas Area Health Education Center.

### **Dental Anatomy: Analysis of Teaching Methods in Dental Hygiene**

\*Alcinda K. Trickett Shockey, RDH, DHSc; Cathryn L. Frere, RDH, MSEd (West Virginia University)

**Problem Statement:** The subject matter of Dental Anatomy within the dental hygiene curriculum historically has been a very difficult subject for successful student completion. Dental anatomy instruction methods have traditionally been lecture and laboratory. Changes in student safety and the addition of innovative teaching tools have been encouraged for

improved student success.

**Hypothesis:** With a seemingly increased use of technology, what types of teaching methods are dental anatomy instructors employing for dental hygiene student success? Have traditional lecture and laboratory methods been replaced?

**Purpose:** The purpose of this study was to assess an understanding of instructor teaching methods used for student learning enhancement within dental hygiene curriculum systems.

**Methods:** Using an on-line tool to survey teaching methods used in dental anatomy for dental hygiene students, all post-secondary dental hygiene schools in the U.S., with encouragement for the assigned dental anatomy instructors' participation preferred, were surveyed after securing WVU IRB approval on file. The results of those surveys were gathered and analyzed (n=108). A simple crosstab data analysis was conducted.

**Results:** With the majority of DH schools surveyed provide an associate degree (AS/AA,AAS=76.6%, BSDH=19.6%, BA=0.9%, MSDH=2.8%); the use traditional lecture for dental anatomy didactic is preferred by instructors for all types of schools (94.2%) with the use of text and atlas usage being the second most preferred method (89.4%). Audio-visual (79.8%) and models (79.8%) were reported as the next highest followed by interactive multi-media (64.4%) and extracted human teeth (34.6%). Self-instructional text (27.9%) was the least preferred method. Laboratory teaching methods were varied. Permanent dentition models (92.0%) and labeling of drawings and diagrams (88.6%) were the most preferred with deciduous dentition models (73.9%) and study guides (70.5%) being the next preferred. The use group discussions (65.9%) and extracted human teeth (60.2%) are used with skull observation (51.1%), self-study (44.3%) and self-instructional packages (33.0%). 19.3% carve the entire tooth and 11.4% use add-on technique carving with 10.2% reported using entire crown carving and extracted tooth scaling methods. Interestingly, the participants reported using a combination of many methods during laboratory experiences.

**Conclusions:** Dental anatomy is taught in dental hygiene programs throughout the U.S. and is an essential part of the curriculum. Various teaching methods are used by instructors to meet students' learning styles to encourage student success. Although new teaching methods with new technology are available, a combination of various teaching methods is used by instructors to assure continued student success.

## **Evaluation of the Plaque Removal Efficacy of a Water Flosser Compared to String Floss in Adults After a Single Use**

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**Statement of Problem:** The ability of a water flosser to remove plaque is still questioned by some dental professionals especially when compared to string floss.

**Purpose:** The objective of this study was to compare the plaque removal efficacy of a water flosser to string floss combined with a manual toothbrush after a single use. This study adds to the body of evidence of using a water flosser and either a power or manual toothbrush as the optimal regimen compared to the current standard of brushing and flossing. This study supports the NDHRA category of Health Promotion/Disease Prevention.

**Methods:** Seventy adult subjects participated in this randomized, single use, single blind, parallel clinical study. Subjects were assigned to 1 of 2 groups: water flosser plus a manual toothbrush (WF), or unflavored waxed string floss plus a manual toothbrush (SF). Each participant brushed for 2 minutes using the Bass technique. The WF group added 500 ml of warm water to the reservoir and followed manufacturer instructions using the classic jet tip. The SF group used waxed string floss between each tooth following standard flossing technique. Scores were recorded for whole mouth, marginal, approximal, facial, and lingual regions for each subject using the Rustogi Modification Navy Plaque Index. The primary comparison evaluated the mean change between the groups, utilizing a between independent groups one-way analysis of variance. Data was summarized using descriptive statistics (mean, median, minimum, maximum and standard deviation) by treatment group and overall. All statistical tests were conducted using a significance level of  $\alpha=0.05$ . Study and forms were approved by the Institutional BRCL (IRB), Mississauga, Ontario, Canada.

**Results:** The WF group had a 74.4% reduction in whole mouth plaque and 81.6% for approximal plaque compared to 57.7% and 63.4% for the SF

group respectively ( $p<0.001$ ). The differences between the groups showed the Water Flosser was 29% more effective than string floss for overall plaque removal and 29% for approximal surfaces ( $p<0.001$ ). The WF group was more effective in removing plaque from the marginal, lingual, and facial regions; 33%, 39% and 24% respectively ( $p<0.001$ ) than SWR group.

**Conclusion:** In this study the water flosser and manual toothbrush group demonstrated significantly better plaque removal scores for all tooth surfaces than the manual brush and string floss group as measured by the RMNPI after a single use.

**Funding Source:** Water Pik, Inc.

## **Dental Hygienists' and Dentists' Clinical and Teledentistry Screening for Dental Caries in Urban Children**

\*Susan J. Daniel, RDH, MS, PhD  
(University of Tennessee Health Science Center)

**Problem Statement:** Early screening for dental caries in ages 2 to 5 is a critical first step in prevention and treatment. Teledentistry has been identified as an effective and efficient means of increasing access to care for screening, referral and treatment.

**Purpose:** The purpose of this study was to determine whether or not there was a difference in dental hygienists' and dentists' screening for dental caries with either clinical or teledentistry methods.

**Methods:** A convenience sample of 82 children 4 to 7 years of age was selected for the study. Two clinical examiners (i.e., dental hygienist and dentist) and 2 teledentistry examiners (i.e. dental hygienist and dentist) screened for dental caries and existing restorations. The clinical dentist's screenings were standard of care for the UTHSC, Urban Smiles mobile program. Each professional's findings were recorded on separate charts. Photographs of each child's teeth were obtained using the iPhone 4S, images were stored in an album by participant number, uploaded to the cloud for retrieval, checked for quality and uploaded to a course in Black Board accessible by the 2 teledentistry examiners. The teledentistry examiners screened images, and charted caries and restorations. Each child's 4 charts were converted to a decayed filled surfaces (DFS) score.

**Results:** A total of 78 children met inclusion criteria. Among the examiners, the teledentistry dentist had the highest DFS scores. Spearman's correlation

between the 2 clinical examiners was 0.99. Spearman's correlations in other group relationships with the clinical dentist were between 0.75 and 0.81. No difference was found between the teledentistry dental hygienist and the clinical dentist ( $p > 0.10$ ).

Conclusions: Use of teledentistry for dental caries screening could increase early access to care for young children.

### **Constructing a Collaborative Model to Improve Access to Oral Health in Yamhill County**

\*Lori Killen Aus, RDHEP, MA

Purpose/Goals: To increase access to preventive oral health care in Yamhill County, Oregon by serving the needs of the uninsured and under-insured while reducing the number of Emergency Department (ED) visits related to oral infections and pain.

Significance: An Oral Health Survey conducted from November 2011 to January 2012 in Yamhill County revealed that only 34% of the convenience sample ( $n=59$ ) had a dental visit in the past year, citing cost as the number 1 barrier. Approximately 27% were without any form of dental insurance. Some had dental insurance that cover extractions only, offering no preventive services. Local hospital ED report significantly high numbers of individuals seeking urgent care for dental related problems. Approach/Key Features: Love INC (In the Name of Christ) is a national non-profit, faith based organization. A volunteer base of providers was established of Expanded Practice Dental Hygienists (EPDH), Dental Hygienists, Dental Assistants, Receptionists, Dentists and various specialists. A-dec, a local manufacturer of dental equipment, donated mobile dental units and Newberg church of Christ offered space to establish a dental clinic. Materials and supplies are acquired through donations from local dental offices and vendors. Equipment maintenance and repair is provided by Dental Service and Repair, Inc. and Newberg Providence Medical Center donated grant monies enabling the purchase of an autoclave. Two EPDH clinics are currently held each month with dental hygiene students from Mt. Hood Community College participating through volunteer clinic rotations. EPDHs provide oral cancer screenings, periodontal screenings, patient education, radiographs, preventive periodontal therapies, fluoride varnish and a restorative triage report that is sent to collaborating dental offices for free treatment to the Love INC client.

Evaluation: Although it is too soon to see reduc-

tions in ED cases, the clinic has treated 2 patients who were referred by physicians for quadrant periodontal therapy: 1 to prepare for cardiac surgery, and one as an un-controlled type 1 diabetic case ( $HbA1c=11$ ). Both received the treatment they could not afford with successful outcomes. The Love INC dental clinic represents a group of volunteer professionals demonstrating community concern and social responsibility. In 2012, 142 volunteer dental health professionals were able to provide 203 under-served individuals with dental care, an increase from 139 who received care in 2011. Since opening the clinic in 2010, Love INC has provided over \$153,000 in dental care to individuals in need. The Love INC dental clinic has demonstrated an innovative and effective model for access to public health care.

### **Effectiveness of Computer-Assisted Guidance for Tobacco Dependence in Dental Offices: A Randomized Clinical Trial**

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Introduction: Tobacco use is an etiologic factor for multiple diseases, including periodontal disease and oral cancers. Current evidence suggests dental providers ask about tobacco use but don't assist the patient in tobacco cessation. Approaches that involve screening for drug use, brief intervention and referral to treatment (SBIRT) provide a promising, practical solution. This project examines whether dentists and hygienists will assess interest in quitting, deliver a brief tobacco intervention and refer to a tobacco quitline more frequently when provided with computer assisted guidance compared to a control group.

**Methods:** This study is a blocked, group-randomized trial in which the HPDG dental clinics are the unit of randomization and patients nested within each randomized clinic represent the lowest level unit of observation. All clinics assess tobacco use including type and amount, dependency questions and interest in quitting. The intervention clinics included the intervention that provided suggested scripts for the provider to use based on dependency, prior attempts and interest in quitting. Primary outcomes were patient reports of the provider assessing interest in quitting, delivering a brief intervention and referring to a quitline. The outcome measure came from a random sample of smokers surveyed by phone 1 to 3 days after the dental appointment. Electronic data recorded by providers in the electronic dental record was also examined.

**Results:** Dental providers assessed interest in quitting (control 71% vs. intervention 89%,  $p=0.0001$ ), discussed specific strategies for quitting (control 25% vs. intervention 48%,  $p=0.003$ ) and referred the patient to a tobacco quitline (control 17% vs. intervention 39%,  $p=0.007$ ).

**Conclusion:** Computer tools embedded within electronic health records can effectively assist providers in the delivery of tobacco interventions. This tool was developed with user-centered design principles increasing the likelihood of adoption by providers. This approach holds promise for translating current evidence into daily clinical practice.

Funding provided by the National Institutes of Health: National Institute of Dental and Craniofacial Research.

### **Interprofessional Health Care for Disabled Populations**

Loren Fisher; Deanna McGregor; Carrie Hall; Marlena Cobb; Jessica Hanson; Melanie Taverna; Veronica Young, PharmD, MPH; J. Tysinger, PhD; \*Carol Nguyen, RDH, MS (University of Texas Health Science Center San Antonio)

**Problem and Significance:** Disability impacts 22% of Americans this accounts for more than 54 million people. It has been estimated that more than 90% of children born with chronic or disabling conditions will live longer than 20 years, meaning that more and more children with developmental disabilities (DD) will need to transition from pediatric care to the adult health care system. To effectively meet the needs of this population health professionals must collaborate to improve patient outcomes. The purpose of the study was to detect disparities that

young adults with DD experience during health care transition (HCT) and identify potential methods to improve health outcomes through interprofessional collaboration.

**Methods:** A mixed study design was used to describe a convenience sample of 15 participants. Frequency and descriptive statistics were used to evaluate quantitative results. Qualitative epistemologies used Adult Learning Theory and Social Capital Theories to guide interprofessional network. Participants were young consenting adults with DD who completed a high school transition program. Interprofessional fellows from the UT Health Science Center San Antonio Medical School, College of Pharmacy and School of Health Professions gathered data in a single 45 minute face-to-face structured interview. Two person teams gathered, transcribed and categorized data in nodes using NiVo 9. Major themes identified were disparities and barriers to care. This study was approved by the Institutional Review Board, May 6, 2011, approval HSC2009033H.

**Results:** To improve utilization of services 9 participants expressed a need for increased collaborations to coordinate health services. Seven reported a need for a health advocate to navigate the health care system. Ten participants in this study lacked autonomy to make health decisions and lacked health literacy to use and apply health information.

**Conclusion:** As our dynamic healthcare system evolves educators need to incorporate interprofessional education during clinical training to improve health outcomes and maximize health service utilization. This project was funded through Southwest Border AHEC.

This project was funded through Southwest Border AHEC.

### **Outcomes Assessment of Expanded Practice Dental Hygienists in Oregon**

\*Amy E. Coplen, RDH, MS; Kathryn P. Bell, RDH, MS (Pacific University, Hillsboro, OR)

**Problem Statement:** Currently the dental hygiene practice model in Oregon includes the Expanded Practice Dental Hygienist (EPDH). This allows hygienists to provide care to populations that have limited access to care without the direct supervision of a dentist. The impact of EPDH practitioners is yet undocumented.

**Purpose:** The purpose of this study is to conduct

an outcomes assessment of EPDH practitioners in order to quantify the impact on the access to care crisis in Oregon.

**Methods:** A 16 question anonymous survey was developed and approved by the IRB at the Pacific University. The survey was delivered via mail to all EPDHs in Oregon (n=181) in November 2011. A second mailing was sent to non-respondents. Descriptive statistics and were used to analyze the data in SPSS. Variables analyzed include: demographic characteristics of the sample, geographic areas/settings where care is provided, and numbers of services provided.

**Results:** The response rate for the survey of EPDH holders was 39% (n=71). Approximately 40% (n=39) of the respondents were currently using their EPP to provide care to limited access patients with an additional 21% (n=15) planning to start their own expanded practice. The majority of practicing EPDHs provide care in residential care facilities and in school settings. Of the current practicing EPDHs, they practice independently 9.3 hours per week on average with independent practice comprising on average 22% of their total annual income. Of practicing EPDHs 72% report using portable equipment, 40% advertising for the services they provide and 41% express difficulty obtaining supplies. Of the EPDHs 47% reported never getting reimbursement from insurance companies for their services. Total services provided in an average month from all EPDHs were: 254 adult prophylaxis, 1,003 child prophylaxis, 106 adult fluorides, 901 child fluorides, 1,994 fluoride varnishes, 56 SRPs >4 teeth, 24 SRPs 1 to 3 teeth, 83 periodontal maintenance, 45 full mouth debridement, 3 FMX, 885 sealants, 19 soft relines, 1,744 oral hygiene instruction and 162 comprehensive periodontal evaluations.

**Conclusion:** EPDHs are making a difference by providing preventive care to underserved populations in Oregon. This is the first study to attempt to quantify the impact of EPDHs. Although several limited access areas have been approved by the Oregon Dental Board, to date only a few settings have been utilized. Additional ways to continue expanding the care provided by EPDH practitioners should be explored. Increasing the ability for EPDH practitioners to get reimbursed by insurance companies should also become a priority.

**Funding Source:** Faculty Development Grant, Pacific University.

## Preparing Baccalaureate Dental Hygiene Students for Expanded Practice Upon Graduation

\*Kathryn P. Bell, RDH, MS; Amy E. Coplen, RDH, MS  
(Pacific University, Hillsboro, OR)

**Problem Statement:** Oregon is among several states allowing dental hygienists to provide services to limited access patients without the supervision of a dentist if they hold an expanded practice permit (EPP). Currently two pathways exist to obtain an EPP. The second pathway allows applicants with at least 500 hours of supervised practice in "limited access" settings to apply for an EPP. Pacific University dental hygiene students meet this requirement through clinical practice and external rotations during their course of study. Thus, students are able to apply for an EPP upon graduation. To date, perceived barriers to practicing using the EPP in Oregon have been unreported.

**Purpose:** This study surveys current EPP holders (EPDHs) on perceived barriers to providing service to limited access patients with the purpose of better educating students to begin EPP practice upon graduation.

**Methods:** A 16-item survey was developed, approved by Pacific University's IRB, and pilot tested with current EPDHs. A list of current EPDHs was obtained from the board of dentistry (n=186), and paper surveys were mailed in November 2011 to a sample of 181 recipients (all EPP holders except for pilot testers and 1 of the authors). Responses were collected from 71 (39%). Statistical analysis included descriptive statistics. The survey instrument addressed demographics, utilization of EPP, and perceived barriers to practicing in EPDH capacity.

**Results:** The most frequently identified barriers encountered by practicing EPDHs included insurance reimbursement (33%) and lack of knowledge or acceptance within the dental community (21%). The most frequently identified barriers that kept EPP holders from pursuing EPDH practice were: currently working in a different setting (44%), lack of business knowledge (31%), time (22%) and inability to make a living wage (22%).

**Conclusions:** Additional education may be indicated in dental hygiene programs to help students prepare for independent practice, specifically business management education. Practice management continuing education may also prove helpful for practitioners who are not recent graduates. Next steps: Investigators plan to continue monitoring EP-

DHs through surveys on a biannual basis as well as monitor Pacific University graduates' involvement with limited access populations. In addition, investigators plan to survey dental hygiene programs in other states that have independent practice laws to explore ways they prepare students to provide care in limited access settings.

Funding Source: Faculty Development Grant, Pacific University.

### **The Analysis of Recession Location, Frequency, and Contributing Factors Seen in a Clinical Setting**

\*Joseph W. Evans, DDS; Wendi J. Hulseley, RDH, MPH; Samuel Yerragudla (Western Kentucky University)

**Problem Statement:** Specific areas of the dentition are more prone to recession and could be associated with factors such as age, sex and treatment modalities. It is important for the dental team to understand which sites are more opportunistic to recession and what factors can contribute to this process.

**Purpose:** The purpose of this study was to determine which specific teeth and surfaces are more likely to exhibit recession in a generalized patient pool as well as the correlation of recession to age, gender and orthodontic history. Recent studies have not been conducted to see if changes in recession patterns are occurring.

**Methods:** The investigation utilized a sample size of 1,070 patient records through a retroactive collection process deriving information from the medical/dental history and periodontal charting section of each chart. Charts of all active patients seen over a 3 year period were used for the study with the mean age of the sample being 40.86 years of age. The following items were recorded during data collection: age, gender, individual sites affected by recession for each tooth and previous orthodontic history. Descriptive statistics were used to analyze the data. IRB approval was obtained from Western Kentucky University.

**Results:** Using the linear regression test, the result ( $-4.598 + 0.238 * \text{Age} + 0.991 * \text{gender}$ ) indicated that with the increase in age the chances of recession occurring is 0.238 times more. The mean sample test of 432 males against 638 females resulted in the means of recession of males 6.36 and females 5.31. Using this data with regression analysis, it was determined that males tend to have more

teeth with recession than females 0.991 of the time. The paired t-test sample indicated that recession on anterior teeth is significantly less than posterior teeth ( $t(1,069) = -15.896$ ,  $p\text{-value} < 0.0001$ ). Using the mean sample test, the recession on buccal surfaces (4.96 teeth) is significantly higher than the lingual surfaces (2.05 teeth). Recession was found on teeth 22.26 percent of the time when compared to all teeth present. The tooth and surface most frequently seen with recession is the buccal surface tooth #3 (1,070-781(non recessed teeth)=289 teeth) then the buccal surface tooth #29 (1,070-798=272) followed by the buccal surface tooth #21 (1,070-799=271). The linear regression method ( $6.705 - 3.262 * \text{orthodontic treatment}$ ) was used to deduce that patients undergoing orthodontic treatment have a less number of recessed teeth on average in comparison to those who have not undergone orthodontic treatment.

**Conclusions:** It is essential for the dental team to understand correlating factors associated with recession and to appreciate trends seen with these statistics for clinical communication and enhanced patient education.

### **A Survey of Dental Hygienists in the United Kingdom in 2011**

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In June 2009 Professor Jimmy Steele suggested how a high-quality and flexible dental workforce could help deliver NHS dental care for the future. However, irrespective of these plans for the future, there are questions with regard to the knowledge and skills that dental hygienists and dental hygienist/therapists who have been trained and qualified possess, whether they are using them and if not, why not. Against this background, the aims of this part of the survey were to establish which operative skills dental hygienists and dental hygienist/therapists had been trained in and which they were using.

**Method:** The survey was conducted using a piloted self-reported questionnaire which consisted of 100 questions with sections on: practice profile, as-



assessment, prevention and operative skills, demography, continuing professional education as well as space to write free comments on respondent's opinions as to why certain skills were not utilized. Statistical advice was that a 10% sample of all those GDC registered would be sufficient to achieve an error rate of 5% at 90% confidence level, if there was at least a 66% response rate. The sample was drawn by selecting every tenth name from the resulting list of 561 names. First mailing was sent out May 2011 with follow ups in June and July 2011. The resulting data were entered into an Excel spreadsheet and differences between the responses from dental hygienists and dental hygienist/therapists were statistically tested with the Chi-squared test.

**Results:** A total of 371 of the 561 in the sample (66.1%) had responded. The skill most frequently taught was supragingival scaling (95.1%) with the least being tooth whitening in surgery (25.9%). The most frequently used skill was supragingival scaling (96.2%) and the least were casting impressions (6.2%). Taught skills associated with restorative procedures such as ID blocks (65%), rubber dam(41%) and temporary fillings(81.4%) were more frequently used by dental hygienist/therapists than dental hygienists compared to taught skills of supragingival scaling (95.1%), subgingival debridement (94.9%) and subgingival placement of antibiotics (84.5%) where there was no difference in use by either group. Free comments referred to lack of time for appointments, lack of nurse support and lack of understanding by the dentist as a common theme as to why skills were not used.

**Conclusion:** The results of this study provide an insight into the level of training of, and frequency of use of operative skills of dental hygienists and dental hygienist/therapists in the UK in the summer of 2011.

Funding for this project was provided by P&G.

### **Survey of N.C. Cardiologists' Knowledge, Opinions and Practice Behaviors Regarding Periodontal Disease and Cardiovascular Disease**

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**Objective:** There has been an increase in awareness of the link between oral health and systemic health over the last several years. While questions exist about the relationship of oral disease to car-

diovascular conditions, no published study to date has addressed cardiologists' knowledge and opinions about this area of science.

**Purpose:** To examine North Carolina cardiologists' knowledge, opinions and practice behaviors regarding periodontal disease and cardiovascular disease.

**Methods:** A survey was developed, revised, pilot tested and mailed to 625 licensed, practicing cardiologists' in North Carolina. Three mailings have been conducted with the most recent mailing in January, 2013. Data were analyzed using descriptive statistics.

**Results:** The response rate was 19% (n=119). Respondents were mostly males (86%) and working in private group practice (48%) or academia (32%). A total of 63% were correct on the first sign of periodontal disease, however, only 18% choose the correct answers for the etiology of periodontal disease. Half of cardiologists' surveyed are unsure that treatment of PD can decrease a patient's risk for CVD. A total of 60% of respondents stated that medical students and dental students should be trained to work corroboratively. The majority are interested in learning more about the relationship between CVD and Periodontitis.

**Conclusion:** The majority of cardiologists surveyed are unclear about the etiology of periodontal disease and would like to have more information about the potential oral-systemic link regarding CVD. It is important for educators and administrators in higher education to examine the need for interprofessional education and collaboration between medicine and dentistry.

Funded by the American Dental Hygienists' Association Institute for Oral Health12:201.

### **Game Based Learning and a Oral Health Education Project**

\*Mário Rui Araújo, RDH, BSDH, M. Psych  
(P&G International Board Member)

Since good oral health is essential to good overall health as well as to the prevention of oral disease and unnecessary suffering, oral health education and promotion is a major concern of the Portuguese Oral Health. Mobilizing support for good oral health within the community is essential to have success in improving oral health outcomes. It is often useful to develop community oral health strategies, adding to the normal approaches and new ways on interacting with different target populations to obtain this support.

Statler et al (2002) say that play is a mode of activity that involves imaging new forms of individual and collective identity. Within the special frame of Game Based Learning (GBL) people develop emotionally, socially and cognitively, building skills and establishing ethical principles to guide actions. Games, with no relation to health care can also be employed in order to positively influence patient's treatment compliance (Sharar, 2007). This project aims at identifying the effects of different games on motivation and oral health behavioral changes in view of developing a (currently not available) strategic model to use the potential impact of GBL (e.g. the integration of games in oral health prevention programs and intervention). The project will be directed towards the identification of optimal game-based characteristics for different populations, as a way to acquire oral health habits, motivations and increase perceptions. These effects will be studied through their relationship with the socio-cognitive health behavior for the model appearing Health Action Process Approach (Schwarzer,1992) and also by the change in the oral health behavior using the Hiroshima University Dental Behavioral Inventory (HUDBI) (Portuguese version) evaluated before and after the interventions. Drawing upon the HAPA, the purpose of the present project will be to gain insights on the social cognitive determinants of oral health behaviors. Different kind of materials and strategies will be used: Lego pieces, mobile phones, painting skills, music and VJ's interaction. We will be working with a multiprofessional team, to create a network of skills: dental hygienists, artists, musicians, psychologists, dentists, nurses and so on. In sum, with this project, we want to contribute to the current discussion on the affordances of games-based learning by looking for evidence on the claimed effects of GBL in the pre-intentional motivational phase, given that action self-efficacy is recognized as the major determinant of intention. We expected that a successful relation with the game positively influence players' experienced self-efficacy regarding oral health self-management.

### **General Dentists' Recommendations for Third Molar Removal: A Practice-Based Study**

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(Northwest PRECEDENT)  
Joana Cunha-Cruz, DDS, PhD; Greg J. Huang,  
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Objectives: Recommendations for third molar management are not universal. In the U.S., little is known about general dentists' decision making process for third molar recommendations. This study

investigated reasons given by general dentists for third molar removal or retention and assessed patient adherence to dentists' recommendations. Patient and dentist characteristics associated with dentists' recommendations and patient compliance were investigated.

Methods: Northwest PRECEDENT, a dental practice-based research network, trained 50 general dental practices for participation in this longitudinal study. Baseline data on the reasons for general dentists to recommend third molar removal or retention was collected on 798 patients 16 to 22 years old during a routine examination. Patients' reasons to remove or retain third molars were assessed over 2 years by a periodic survey. Generalized estimating equations logistic regression was used to assess the association of dentist and patient characteristics with both dentist recommendations and patient compliance with third molar removal or retention.

Results: Overall, 59% of all third molars were recommended for removal (1,683 third molars from 469 participants). The reasons most commonly given were to prevent future problems (79%), poor orientation/tooth unlikely to erupt (57%), and need to remove other third molars in the same patient (25%). Harmful conditions like pericoronitis, periodontal concerns, caries, or existing pathology were only reasons in 4%, 4%, 4% and 1%, respectively. The most common reasons for recommending retention of third molars were that dentists considered it too early to decide (73%), tooth had a favorable eruption path (39%), and sufficient space for eruption (26%). Among the participants recommended for third molar retention, 84% complied with this recommendation during follow-up, while 55% complied with dentists' recommendation for removal. Patients who had had orthodontic treatment, those with TMJD pain, and from solo practice dentists were more likely to comply with the dentist recommendation to remove third molars than patients without those characteristics. Having a female dentist was the only factor associated with patients' compliance to retain third molars.

Conclusions: General dentists frequently recommended removal of third molars. The main reasons were to prevent future problems, not due to symptoms or pathology. Compliance with dentists' recommendations for third molars was fair for removal and high for retention.

Funding for this project was through NIDCR grants DE016750 and DE016752.

## **Systematic Review of the Association Between Chronic Obstructive Pulmonary Disease or Pneumonia and Periodontal Disease (1997-2012)**

\*Brooke E. Agado, RDH, MS and  
Denise M. Bowen, RDH, MS  
(Idaho State University)

**Objective:** The purpose of this systematic review was to answer the focused research question: Is there an association between periodontal disease and pneumonia or chronic obstructive pulmonary disease (COPD)?

**Methods:** Databases and keywords searched included: Medline, PubMed, CINAHL and the Cochrane Database of Systematic Reviews on combinations of pneumonia, lung disease, obstructive, OR COPD, and periodontal disease. The literature searches were limited to 1997 (January) to 2012 (December), humans and in English. Inclusion criteria were RCTs/clinical trials, systematic reviews/meta-analysis, and longitudinal, cohort, case control, multicenter and epidemiological studies for links between COPD OR pneumonia and periodontal disease.

**Results and Discussion:** Overall, 126 articles from databases and 12 from reference lists of articles obtained were scrutinized for predetermined inclusion and exclusion criteria. Of these, 24 and 3 (n=27) respectively met the criteria, were analyzed and scored independently by each reviewer to extract evidence. A total of 4 systematic reviews provided fair evidence (Level I – Grade B) of an association between periodontal disease and respiratory diseases (i.e., pneumonia or COPD), 1 additional systematic review (Level I – Grade B) concluded that periodontal disease is a significant and independent risk factor of COPD, 7 studies (counting one that also studied COPD) provided fair evidence (Level II-2 – Grade B) of an association between pneumonia and periodontal disease, including 4 well-designed and controlled studies, 3 studies with research design limitations that affected the strength of the evidence, and 2 studies (counting one that also studied COPD) at lower levels in quality of research design (Level II-3 – Grade C) indicated conflicting results regarding the association of pneumonia and periodontal disease. Ten additional well-designed longitudinal or case control studies (Level II-2 – Grade B) provided fair evidence of an association between periodontal disease and COPD. Three additional studies at lower levels in quality of research design (Level II-3) supported the association between periodontal disease and COPD.

**Conclusion:** A causal association between respira-

tory diseases (pneumonia or COPD) and periodontal diseases remains conjectural. The conclusions reached based on this systematic review indicate there is significant evidence supporting an association of pneumonia and periodontal disease concurring with previous reviews and an association between COPD and periodontal disease.

ADHA National Dental Hygiene Research Agenda: D.3 (D. Clinical Dental Hygiene Care: 3. Investigate the links between oral and systemic health.).

## **Short Term Gingival Health Improvement with Essential Oil Mouthrinse**

\*Christine A. Charles, RDH, BS; ToniAnne Lisante, BA; Ratna Revankar, Ph.D.  
(Johnson & Johnson Consumer and Personal Products Worldwide Division of Johnson & Johnson Consumer Companies, Inc.)

**Problem Statement:** The antiplaque and anti-gingivitis benefit of adding an antimicrobial rinse to tooth brushing has been clinically proven in numerous long term studies. There is very little data for the short term efficacy used in conjunction with mechanical oral hygiene.

**Purpose:** The objective of this SITE-WISE ANALYSIS™ was to evaluate short term efficacy in reducing gingivitis by determining the mean percentage of healthy gingival sites after 4 weeks use of an antimicrobial rinse when added to mechanical oral hygiene.

**Methods:** Subjects with mild to moderate gingivitis were selected to participate in the studies. No initial prophylaxis was provided. Subjects were randomly assigned to treatment groups and were instructed to practice their assigned regimen twice daily. After 4 weeks the Modified Gingival Index (MGI) was determined as at baseline. The MGI was split into 2 categories: scores 0 or 1 (healthy sites) and  $\geq 2$  (unhealthy sites). The mean percentage of healthy sites was plotted by treatment group over time. Data reflecting subjects that completed 4 weeks of treatment from 4 studies were evaluated. The treatment groups evaluated were Brushing (B) or Brushing and flossing (BF) and Brushing and Rinsing (R) or Brushing, flossing and rinsing (BFR) with an essential oil containing mouthrinse. The percentages of healthy sites and unhealthy sites were used in the analysis. No imputations were made for missing data. Descriptive summaries including number of subjects, mean, standard deviation, standard error, median and range are presented. The p-values were calculated using Wilcoxon rank sum tests with a 2-sided 0.05 significance level. The 95% confi-

dence interval and location shift parameter were calculated by using Hodges-Lehmann approach.

Results: Across 4 studies, <3.5% mean percentage healthy sites were found at baseline. In studies designed up to 4 weeks, the 4 week mean percentage healthy sites ranged from 0.8 to 16.1 in the B group and 7.4 to 29.3 in the R group. In the study designed up to 6 months, the 4 week mean percentage healthy sites was 2.1 in the BF group and 4.2 in the BFR group.

Conclusion: The results of this analysis demonstrate that adding LISTERINE® Antiseptic to mechanical oral hygiene improves gingival health in the short term (4 weeks).

Funding for these studies was provided by Johnson & Johnson Consumer and Personal Products Worldwide Division of Johnson & Johnson Consumer Companies, Inc.

### **The National Dental Practice-Based Research Network**

Kimberly S. Johnson, RDH, MDH  
(National Dental Practice-Based Research Network)

Program purpose: ADHA's goal is to broaden dental hygienists' involvement in research. The National Dental Practice-Based Research Network (DPBRN) is an investigative union of practicing dental professionals whose purpose is to provide practitioners with an opportunity to propose or participate in research studies that address day-to-day issues in oral health care. The National PBRN's overall goal is to perform science that is immediately applicable to everyday clinical practice, to foster its movement into everyday clinical practice, and thereby help improve the health of the nation. The National Dental PBRN is an ideal conduit to meet the ADHA's research goals.

Significance of the program: The National DPBRN is committed to maximizing the practicality of conducting research in daily practice across geographically dispersed regions. The studies, to be conducted in participating dental offices with consenting patients, help to expand the profession's evidence base and further refine care. Dental hygienists can now enroll and participate in the network with the prospect of increasing the dental hygiene body of knowledge.

Program's approach: Practitioners are engaged at every step of the research process, generating study

ideas, developing study design, designing data collection forms, feasibility testing, pilot testing, data collection, data analysis, presentations (local, regional and national), and manuscript preparation. Ideas for studies must be of broad interest to practitioners, sufficiently impactful on routine clinical practice and the oral health of the public, and are feasibly conducted in daily clinical practice.

The evaluation plan: As of February 28, 2013, a total of 2,458 persons have enrolled including 484 dental hygienists. Enrollment continues to expand and includes broad national representation of practitioners. Study ideas are being generated, reviewed and prioritized.

Funding for this project through NIDCR.

### **The Dental and Mental Health Connection: Integrating New Dental Workforce Strategies in Minnesota**

Jennifer S. Berge, RDH, REF, MSADT

Mental illnesses are common but often unrecognized and misunderstood. Evidence suggests an association between poor oral health and mental illness. It is estimated that 61% of individuals with severe mental illness have suboptimal oral health. Many factors contribute including lack of awareness of the importance of dental health amongst those living with mental illness, barriers to accessing dental care, the dental practitioner's knowledge of the mental health problem and dental implications and oral side effects of medications used to treat the condition.

According to the National Alliance of Mental Illness (NAMI) organization about 6% of the population or 1 in 17 Americans suffer from a mental illness. It is estimated that mental illness affects 1 in 5 families in the U.S. It usually strikes individuals around adolescence and young adulthood, however, the young and old are considered especially vulnerable.

Oral health, physical health and mental health are linked together. Dental practitioners need to be informed of how mental illness impacts the individual's oral health and be able to manage dental implications caused from the illness. It is important for dental practitioners to integrate with mental health specialists and primary physicians to improve patient outcomes in this special needs population group.

Opportunities to incorporate interdisciplinary

teams are emerging in the health care arena. Mobile dental equipment is being utilized in a community mental health center in Rochester, Minn. Through collaboration, dental professionals, a pharmacist and the mental health specialist team work together in one building, providing dental services and mental health care to those underserved. Dental care has long been an issue for the minority, low-income and homeless populations served by the mental health center. Pairing the 2 providers together has helped hundreds of individuals and families receive dental care.

With the intention to serve those with unmet dental needs, Minnesota recently created a new dental professional known as the advanced dental therapist that is dual licensed whose scope includes that of both a dental hygienist and dental therapist.

Expanding the dental workforce and implementing the services of advanced dental therapists in a non-traditional work setting such as a community mental health center is one way of improving dental access for those that are experiencing a higher prevalence of dental disease.

### **Faculty Practice Programs in Dental Hygiene Educational Settings**

\*Kristin H. Calley, RDH, MS; \*JoAnn Gurenlian, RDH, PhD  
(Idaho State University)

**Problem Statement:** As dental hygiene programs continue to experience reductions in state funding and increasing educational costs, coupled with the ongoing need to provide professional development opportunities and increase clinical research, faculty practice programs may serve as one strategy to address these factors.

**Purpose:** The purpose of this study was to identify characteristics of faculty practice programs housed in U.S. dental hygiene educational institutions to assess operational parameters, fiscal characteristics, benefits and barriers. This study supports the American Dental Hygienists' Association National Dental Hygiene Research Agenda related to access to care and clinical dental hygiene care.

**Methods:** In 2012, a self-designed electronic questionnaire comprised of 31 closed-ended and open-ended items, was sent to 334 dental hygiene education program directors using an online survey engine, Survey Monkey®. The questionnaire contained 2 primary sections. Section I included demographic program items and questions assessing

clinic operations, patient care services and faculty involvement. Section II included fiscal management items. Open-ended questions were available for respondents to express any additional information they believed important. Results were reported using descriptive statistics only.

**Results:** A 53% (n=161) response rate was obtained after 3 mailings. Results revealed that 15.3% (n=25) of the programs either currently had an operating faculty practice (n=21) or previously had a faculty practice within the past 5 years (n=4). The majority of faculty practices were housed on campus in separate clinical facilities for 11 or more years, were funded by the state, operated 5 days per week and provided care primarily to the geriatric population. Maintaining clinical competency for faculty was the primary reason for the faculty practice - faculty participation was optional. The primary barrier of the faculty practice program was the unwillingness of faculty to participate in the program.

**Conclusions:** Faculty practice programs were perceived as a positive experience by program directors. Despite faculty unwillingness to participate, all directors responded they would create a faculty practice again, if given another opportunity to do so. Findings of this study are consistent with prior studies finding limited numbers of dental hygiene programs have a faculty practice, and the main advantage was having opportunities to maintain clinical skills and competency of clinical faculty. This study may provide health care programs with preliminary information when developing new faculty practice programs in their institutional settings.

### **Interprofessional Collaboration to Assess and Care for the Oral Health Needs of Homeless**

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(Metropolitan State University)

**Problem Statement:** Low income Minnesotans, including the homeless, face many barriers to accessing oral health care services.

**Purpose:** The purpose of this study was to assess the perceived oral health needs of clients attending a wellness center for the homeless and use the information to develop a plan to treat those needs.

**Methods:** Clients seeking blood pressure screenings and foot care from nursing students at a wellness center were asked to complete a short written survey regarding their oral health. The survey in-

cluded 5 questions regarding the oral health of the client and his or her family.

Results: Survey information will continue to be collected through the end of April, 2013. Data collected thus far indicates that 47% of those surveyed have not had a dental visit in over a year and 50% had a concern about their dental health.

Conclusions: Homeless Minnesotans have difficulty accessing oral health care services. The survey results collected by Metropolitan State University School of Nursing students prompted a pilot project in collaboration with and the Advanced Dental Therapy Program to deliver prevention, education and other services for homeless individuals.

### **HbA1c Test for Screening Undiagnosed Prediabetes and Type 2 Diabetes in Patients with Chronic Periodontitis During Periodontal Examinations**

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Problem Statement: Bi-directional associations between diabetes and periodontitis suggest using screening protocols in oral health care settings. Although chairside glycosylated hemoglobin (HbA1c) screenings show promise, it is unknown whether using these tests is feasible for identifying undiagnosed diabetes.

Purpose: To assess diabetes screening for patients with periodontitis using validated diabetes risk questionnaires, periodontal findings and chairside HbA1c analyzers during periodontal examinations.

Methods: A correlation research design was employed and approved by Idaho State University's HSC. A purposive sample (n=50) of volunteers was recruited from a periodontal practice. Participants

diagnosed with periodontitis and never diagnosed with diabetes yet reporting  $\geq 1$  diabetes risk factors on a diabetes risk test were examined for periodontal parameters and administered an HbA1c test. Spearman rank correlations assessed relationships between HbA1c values and diabetes risk scores. Pearson's correlations tested relationships between HbA1c values and numbers of missing teeth, percentage of PD $\geq 5$  mm, and percentage of teeth with bleeding on probing (BOP). Independent samples t-tests compared new and maintenance patients' HbA1c values and periodontal measures. Statistical significance was set at 0.05. A 2 week follow-up for participants with elevated HbA1c assessed whether they had contacted their primary health care provider. Cost and time for HbA1c testing were assessed.

Results: A total of 32% (n=16) of participants presented HbA1c values indicating pre-diabetes, 1 presented an HbA1c value indicating diabetes, totaling 34% (n=17). One significant relationship (r=0.269, p=0.030) was found between HbA1c values and percentages of teeth with BOP. No relationships existed between HbA1c values and diabetes risk scores (r=0.060, p=0.340), numbers of missing teeth (r=0.127, p=0.190) or percentage of PD (r=0.124, p=0.196); Further analysis using subgroups of new (n=25) and maintenance patients (n=25) found a significant relationship (r=0.365, p=0.037) between new patients' HbA1c values and percentage of teeth with BOP, yet no significant relationships (r=-0.040, p=-0.426) in maintenance patients. There was a significant difference (t=2.697, df=48, p=0.010) in percent BOP between new and maintenance patients. Of those who presented elevated HbA1c values, 53% (n=9) contacted their primary health care provider within 2 weeks. Cost of each HbA1c was \$9 USD. Mean HbA1c screening time, including related patient education was 19 minutes (SD=6.2).

Conclusions: HbA1c screenings for patients presenting  $\geq 6$  teeth with BOP and diabetes risk factors are available and effective for detecting undiagnosed diabetes. Oral health care providers have opportunities to provide effective diabetes screenings, however, time and costs may be a barrier.

# DENTSPLY/ADHA Graduate Student Clinician's Research Program Posters

## **Attitudes Towards Students Who Plagiarize: A Dental Hygiene Faculty Perspective**

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The purpose of this study was to examine how baccalaureate dental hygiene faculty members address students who plagiarize. The survey instrument consisted of 32 items. An email containing the survey link was sent to 52 baccalaureate dental hygiene program directors in the U.S. Faculty at 30 dental hygiene programs participated in the study. Of the 257 faculty members who received the survey link, 106 completed the survey for a response rate of 41.2%. The faculty thought that plagiarism was a rising concern within their dental hygiene program (54.5%, n=54). The majority of the faculty checked for plagiarism on student class assignment/projects (67.1%, n=53). For those faculty who did not check for plagiarism, 45.8% (n=11) stated it took "too much time to check" and it was "too hard to prove" (16.6%, n=4). The most frequent form of student plagiarism observed by faculty was "copying directly from a source electronically" (78.0%, n=39). Most faculty checked for plagiarism through visual inspection (without technological assistance) (73.0%, n=38). Of the faculty who used plagiarism detection software/services, 44.4% (n=16) always recommended their students use plagiarism detection software/services to detect unintentional plagiarism. For those faculty who caught students plagiarizing, 52.9% (n=27) reported they "always or often" handled the incident within their dental hygiene department. However, 76.5% (n=39) of the faculty did not report the student's violation to an academic review board.

## **Dental Hygiene Student Experiences Using Motivational Interviewing**

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Motivational interviewing is a patient-centered, goal driven counseling method used in a variety of health care settings to encourage behavior changes in pa-

tients. The purpose of this qualitative study was to explore dental hygiene students' experiences using a specific technique of motivational interviewing. This study utilized a convenience sample of 6 senior baccalaureate dental hygiene students. A 2 hour training session was used to teach the participants about motivational interviewing. In particular the training emphasized open-ended questions, affirmations, reflections, and summaries (OARS). These training sessions were given before students worked with patients. The researcher used observation and interviews to assess the participants experience with the concept of motivational interviewing. Several themes supporting previous research were discovered, as well as 3 new themes: reservation, control and focus. The results indicated an overall positive student experience. Further investigation is needed to explore in-depth educational training with motivational interviewing and the student experience.

Keywords: motivational interviewing, open-ended questions, affirmations, reflections, communication, behavior change, dental hygiene education, empathy, dental behaviors

## **Oral Hygiene and Adherence During Orthodontic Treatment in Appalachia**

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Objectives: Orthodontic intervention requires participation by the patient and parents/caregivers. In some cases, orthodontic care is terminated prematurely, either by orthodontists due to poor patient compliance, or by patients or parents/caregivers because of fatigue, disinterest, or other factors. With unique issues affecting oral health in Appalachia, there is a need to identify ones that affect the success of orthodontic treatment. This study was conducted to determine contributing factors in orthodontic adherence, hypothesizing that self-pay patients/families would have the highest completion rates.

Method: A retrospective chart review was conducted in a rural West Virginia private practice, including 278 (56% female) patients, which completed or ter-

minated treatment from 2007 to 2012. Data collected included treatment outcome, payment type, distance traveled, demographics and oral hygiene ratings.

Results: Across all payment types was a 38% successful completion rate. A Chi square test ( $p < 0.0002$ ) revealed differences across groups, with Medicaid/CHIP group ( $n=225$ ) having the lowest success rate (34%). The private insurance group ( $n=19$ ) had a similar completion rate (36%), while self-pay patients ( $n=34$ ) were much more likely to successfully complete orthodontic care (74%). Distance traveled did not differ across groups. Oral hygiene ratings recorded were associated with completion rate.

Conclusions: Significant differences in completion rates related to payment type are noteworthy. Of the patients with public funding, two-thirds did not successfully complete treatment. It is essential that psychosocial interventions be devised, along with encouraging oral health values and requiring appointment adherence to improve orthodontic completion rates in Appalachia.

### **Factors Associated with Clinical Skill Remediation in Dental Hygiene Education Programs**

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Evaluation of students in a clinical environment can be difficult for a variety of reasons including faculty calibration, patient conditions and institutional guidelines. Early identification of skill deficits is critical in order for remediation to begin early in the educational process before deficiencies become complex. Dental hygiene programs must follow standards for student skill progression as set by the Commission on Dental Accreditation (CODA). Clinical skill acquisition is one of the most complex aspects of dental hygiene education. The purpose of this study was to examine the challenges related to formal clinical remediation in dental hygiene programs. A 23 item investigator-designed survey was electronically distributed to 303 entry-level dental hygiene program directors in the United States. A response rate of 36% was achieved. Descriptive statistics and Chi-square analyses were utilized to evaluate relationships between responses and the degree awarded from each institution. Results indicate the majority of programs have clinical remediation policies. The majority of respondents (67.8%) reported identifying students with clinical deficiencies in the pre-clinical semester, and 15.5% of respondents identified students in the second year, second clinical semester. One of the greatest

challenges recognized by respondents (25.2%) was finding time in the curriculum to deliver remediation. These findings indicate respondents are aware of the need for clinical remediation policies in dental hygiene programs but varied as to when in the curriculum the need for remediation was identified.

### **Assessing Critical Thinking Outcomes of Senior Dental Hygiene Students Utilizing Virtual Patient Simulation**

Joanna Allaire, RDH, BSDH, MDH  
University of Tennessee

Dental hygiene, as well as dental, education has been charged with the task of determining which educational practices promote critical thinking, a quality necessary to translate knowledge into sound clinical decision making. The purpose of this pilot study was to determine the effects of virtual patient simulation on critical thinking in dental hygiene students. Virtual patient simulation is an active learning strategy that uses computer based virtual patients to create a simulated patient experience in a controlled environment. Virtual patients are designed to replicate as authentically as possible real-life clinical scenarios.

A pre- and post-test design utilizing the Health Science Reasoning Test evaluated the critical thinking scores of second year dental hygiene students at The University of Texas School of Dentistry Dental Hygiene Program who participated in virtual patients during their senior year. Quantitative data were analyzed using descriptive statistics to compare the data.

A paired t-test was conducted to compare the pretest and posttest scores. There was an observable gain in the critical thinking scores, although the paired t-test did not demonstrate a statistically significant gain in this relatively small sample from pre- to post-test. Analysis included the difference in scores from each individual from pretest to posttest. While the mean difference score was only 0.77, some test takers improved their scores as much as 6 points.

The results of this pilot study may have implications to support the use of virtual patient simulations in dental hygiene education. Further research is needed to validate the findings of this study.



## **Dosimetry Using Three Intraoral Radiologic Device/Collimator Combinations**

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University of North Carolina

Concern with the increase in potential risks associated with dental radiography following the ICRP's 2007 modification of weighting factors for calculating effective dose has renewed interest in the concept and principles of ALARA (As Low As Reasonably Achievable).

Hypothesis: There is no difference in effective dose (E) among 3 collimator modalities.

Methods: Simulated full mouth series (FMX) were exposed on adult (18 projections) and child (12 projections) phantoms using a 6 cm diameter circular collimator, universal rectangular (standard) collimator, and an enhanced rectangular (test) device for both child (with and without thyroid shielding) and adult phantoms. Dosimetry was acquired using optically stimulated luminescence (OSL) dosimeters at 24 anatomical sites in the head/neck region. Exposures were made using 70 kVp, 8 mA (adult: 0.20 and 0.32, child: 0.16 and 0.25). E ( $\mu\text{Sv}$ ) was analyzed using ANOVA and Tukey HSD.

Results: Mean adult E was significantly different ( $p=0.001$ ) among the three modalities: circular (95  $\mu\text{Sv}$ ), test rectangular (76  $\mu\text{Sv}$ ), standard rectangular (59  $\mu\text{Sv}$ ). Child doses were significantly different ( $p=0.0005$ ) between standard rectangular (48  $\mu\text{Sv}$ ) and circular (80  $\mu\text{Sv}$ ) as well as between standard rectangular and test rectangular (70  $\mu\text{Sv}$ ). Child with thyroid shielding resulted in a statistically lower equivalent thyroid dose ( $p=0.004$ ) with the standard (271  $\mu\text{Gy}$ ) as compared to circular (558  $\mu\text{Gy}$ ) and test (519  $\mu\text{Gy}$ ).

Conclusion: Rectangular collimation (standard and test) appeared to significantly reduce dose in the adult exposures. In the child, significant dose reduction was achieved only with the standard rectangular collimator when compared to the circular collimator. Dose differences may be attributed to the size of the rectangular field and thyroid shielding used.

## **Perception of Hearing Loss Associated with Ultrasonic Instrumentation: A Survey**

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University of Minnesota

Objectives: The primary purpose of this study was to determine if there was a relationship between ultrasonic use and dental hygienists' perception of hearing loss.

Methods: This study used a non-experimental survey design to question Minnesota dental hygienists on their work history and ultrasonic practices. A randomized sample of 205 currently registered dental hygienists was obtained from the Minnesota Board of Dentistry. Twenty-eight subjects were excluded, allowing for 177 dental hygienists to receive the descriptive questionnaire.

Results: The response rate was 57.6% allowing 84 surveys to be analyzed. Descriptive statistics indicated a high percentage of female subjects working in a general practice dental office. Two subgroups of subjects were compared: those who indicated they had experienced hearing loss vs. those who did not. Inferential statistics indicated age, use of hearing protection, awareness of hearing loss, and utilization of hearing testing were all statistically significantly different between the 2 subgroups ( $p<0.05$ ). Those who had a perception of hearing loss were older ( $p=0.0173$ ), placed higher importance on using earplugs ( $p=0.0188$ ), on awareness of hearing loss occurring ( $p=0.0301$ ), and on hearing testing ( $p=0.0117$ ).

Conclusions: Results concluded that a significant relationship between perceived hearing loss and ultrasonic use was not found and that employer education and provision of hearing protection may be motivational to dental hygienists in incorporating auditory protective devices into their current protocol. This research will potentially aid in the implementation of annual auditory examinations and use of proper auditory protective devices to be worn by dental hygienists.

## **Impact of Adjuvant Techniques in Oral Cancer Screenings on Motivation to Quit Tobacco Use**

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Idaho State University

The impact of oral cancer (OC) screenings and brief tobacco cessation education with or without adjunctive techniques (ATs) on motivation to quit tobacco use was explored. Subjects ( $n=60$ ) were randomly assigned to positive control (PC) or intervention groups. Participants completed pretests and posttests evaluating motivation to quit. Both groups received standard and AT OC screening and brief tobacco cessation education. The PC group completed posttests before AT. The intervention group completed posttests after AT. There was a significant difference between pre- to post-likely to quit scores in

PC ( $p=0.025$ ) and intervention ( $p=0.014$ ) groups. There was a significant difference in pre- to post-confidence scores across both groups ( $p=0.000$ ) but no significant interaction between groups ( $p=0.090$ ). Screening for OC and brief tobacco cessation education with and without AT improved subjects' likely to quit and confidence scores which have predictive validity for cessation. Professional OC screening with related education are encouraged.

### **Oral Education for Nursing Home Staff: Minimum Data Set 3.0**

Katie Pudwill, RDH, BSDH, MS  
Eastern Washington University

This research study is based on an educational module presented to nursing home staff addressing assessment criteria of the Minimum Data Set 3.0 (MDS) dental section, a tool used by staff to evaluate residents' overall health. Relationships were tested between educating nursing home staff on the dental section and accurate completion of the MDS; between educating staff on correct oral assessment and resulting subsequent referrals for dental treatment; and between dental education and staff perceptions regarding the provision of oral assessment and home care. MDS assessments for nursing home residents ( $n=176$ ) were collected pre- and post-implementation of the educational module, showing an increase in oral conditions identified by nursing staff but a decrease in total assessments completed. Referral rates were collected and statistically significant difference was found using McNemar's test ( $p=0.0018$ ) between the pre-implementation referral rate of 16% and post-implementation referral rate of 30%. Nursing home staff were given pre-implementation and post-implementation Likert surveys. Wilcoxon Signed Rank Test found the education module made them feel more comfortable performing oral assessments ( $p=0.0009$ ) and referring for subsequent dental treatment ( $p=0.0313$ ). These results suggest educating nursing home staff on identification of oral conditions and completing the MDS 3.0 dental section increases their knowledge and perceptions in providing oral assessments. Additionally, referrals to an oral health care provider may increase. Further longitudinal studies may determine best practices for educating nursing home staff to increase their ability to assess the oral cavity and provide appropriate measures to improve oral health of nursing home residents.

### **Impact Crescent Community Health Center's Dental Department on Utilization of Oral Health Care For Low Socioeconomic and Medicaid Populations**

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Clinical setting: Crescent Community Health Center a FQHC, located in Dubuque, Iowa, a population of 57,637, serves a rural tri-state region comprised of Iowa, Illinois and Wisconsin. CCHC recognizes barriers in oral health care lay in socioeconomic status (SES), race, payer type, gender, age and region.

Objectives: FQHCs with a dental component serve populations with the greatest health disparities: ethnic and racial minorities, the uninsured, underinsured, rural residents and Medicaid. However, there are no nationally accepted, oral health measures required by HRSA grantees to report to the Uniform Data System (UDS). The purpose of this study is to report on oral health performance measures recommended by Health Resources and Services Administration's (HRSA), and US Department of Health and Human Services (DHHS) over 5 fiscal years.

Methods: This report used descriptive statistics extrapolated from CCHC's databases HealthPro, and Centricity, analyzed by SPSS to report percentages, and proportion of national dental performance measures from 2007 to 2011.

Results: National performance measure #9, the use of sealants of third graders (aged 8 to 9) over a 5 year period, revealed out of 3,373 procedures, 319 (9.5%) were sealants. Health systems capacity indicator #7b, number of dental visits by Medicaid children (aged 6 to 9); showed Medicaid with 85% ( $n=6207$ ) visits, uninsured 9% ( $n=648$ ) and privately insured 6% ( $n= 421$ ).

Conclusion: Medicaid (aged 6 to 9) received majority of procedures, uninsured and privately insured percentages were significantly smaller. These results show, while CCHCs dental department provides effective access to dental care for Medicaid patients, evidence of low utilization for uninsured populations still exist.

## **Fluorescence Technology Versus Visual and Tactile Examination in the Detection of Oral Lesions: A Pilot Study**

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**Purpose:** The purpose of the study was to compare the effectiveness of the VELscope®, versus traditional (visual and tactile) oral examination in detecting oral lesions in an adult high risk population. **Methods:** A convenience sample of 30 participants (17 cigarette smokers and 13 dual addiction smokers) was enrolled. For the purpose of this study, dual addiction was defined as tobacco plus Hookah. Two trained and calibrated dental hygienists conducted all examinations. Traditional oral cancer examinations were conducted, followed by fluorescence examinations. All subjects received an inspection of the lips, labial mucosa, buccal mucosa, floor of the mouth, dorsal, ventral and lateral sides of the tongue, and hard and soft palate. Both evaluations took place in 1 visit. All participants received oral cancer screening information, recommendations and referrals for tobacco cessation programs and material on the 2 types of examinations provided. **Results:** Thirty subjects, between the ages 18 to 65 were enrolled (23 males and 7 females). The duration of tobacco use was significantly higher in cigarette smokers (14.1 years) than dual addiction smokers (5 years). The average numbers of cigarettes smoked per day were 13.5 compared to 14.2 cigarettes for dual addiction smokers. Neither the traditional oral cancer screening nor the VELscope® examination showed any positive lesions. No lesions were detected; therefore, no referrals were made. **Conclusion:** Study participants were considered high risk based on demographics (current smokers and males). Results support data from the American Cancer Society, which indicates that males smoke more cigarettes than females and that males are at a higher risk of oral cancer. Furthermore, individuals who have dual smoking addictions (Hookah and cigarettes) are on the rise, which increases the oral cancer risk. Results from this study suggests that the traditional visual and tactile oral cancer screening produced comparative results to the VELscope® examination. Neither technique revealed any positive oral lesions.

## **The Licensed Dental Practitioner: A Study of Perceived Need and Public Acceptance**

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University of Bridgeport

**Problem Statement:** Currently, many people are having difficulty affording and/or accessing dental treatment in Vermont. The state faces dental shortages indicated by the 23 dental shortage areas and the lack of affordable oral health care.

**Purpose:** This study sought to identify Vermont's public perception of access to dental care in the state and the proposed need and acceptance of a midlevel dental provider the Licensed Dental Practitioner (LDP). The study focused on variables, such as support for the LDP, types of insurance benefits, types of dental treatment regularly sought, delayed dental treatment due to unaffordability, and the level of difficulty accessing dental treatment at Vermont dental clinics.

**Methods:** A descriptive research design was conducted that included a researcher designed survey. The instrument was distributed to patients at 4 Vermont dental clinics which provide dental or dental hygiene services at no charge or at reduced rates to underserved populations.

**Results:** Two hundred and eighty-seven (287) surveys were returned yielding a 57% response rate. Results revealed that most patients (90.7%) would receive dental services from an LDP. Over half (63.6%) of the respondents stated they have delayed dental treatment due to cost.

**Conclusion:** The figures show strong correlations between people who support the LDP and people who have an access to dental care need. In addition, creating the LDP in the State of Vermont would increase the number of providers trained to treat the underserved and decrease the population's dental disparities.

**Keywords:** Dental Health Profession Shortage Area, Licensed Dental Practitioner, Mid-level provider, Workforce modeling

**NDHRA:** This study supports the NDHRA priority area, Health Services Research: Identify how public policies impact the delivery, utilization, and access to oral health care services.