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## **ADHA Research on Display!**

Rebecca S Wilder, RDH, BS, MS

*Rebecca S. Wilder is an associate professor at the University of North Carolina Chapel Hill School of Dentistry and Director of the Master of Science Degree Program in Dental Hygiene Education. She is the current editor-in-chief of the Journal of Dental Hygiene.*



One of the most exciting aspects of the ADHA Annual Session is the presentation of research posters by our current members and student members. This year was no exception. In this issue of the *Journal of Dental Hygiene* you will find 23 abstracts that were presented by our researchers in dental hygiene. For many years, those of us involved in oral health research have been pushing for investigations that will increase our visibility and promote the National Dental Hygiene Research Agenda. All professional groups have their own body of knowledge so for dental hygiene to be considered a true profession, we too, must have our own research. The research poster session at ADHA is one platform for displaying our research.

I am particularly proud to say that my institution contributed to the presentations at ADHA Annual Session. For several years, I have had at least 1-2 graduate students who have presented their research (based on their thesis topics) at the research poster session. This year is no exception. In addition to the 2 students who presented from the University of North Carolina at Chapel Hill, we had representation from the following graduate programs in dental hygiene: Texas A&M Health Science Center Baylor College of Dentistry; University of Missouri-Kansas City; Idaho State University; University of Tennessee Health Science Center; Old Dominion University; and the University of Maryland, Baltimore.

In addition to the graduate students who presented, we have numerous faculty members from across the country who are involved in exciting investigations that will improve the way we teach or practice dental hygiene-all in an effort to improve the oral care of the public. I wish to highlight the efforts of institutions such as The Ohio State University College of Dentistry Dental Hygiene, Western Kentucky University, Massachusetts College of Pharmacy and Health Sciences, University of New England, New York University College of Dentistry, and Armstrong Atlantic State University.

Another exciting part of this issue of JDH is the publication of the winning paper of the ADHA/Sigma Phi Alpha Journalism Award Competition. The award is intended to honor a student who has written a review or original research paper that contributes to the dental hygiene body of knowledge and is of the quality to be published in the *Journal of Dental Hygiene*. Students enrolled or within 6 months post graduation from a baccalaureate, degree completion BS program, masters, or doctoral level program were eligible to apply. All of the papers were to be linked to the National Dental Hygiene Research Agenda. The recipient of the award received \$1000 and had her paper published in the *Journal of Dental Hygiene*. The winner of this year's competition is Amy Neussl, RDH, BS, a 2007 graduate of the baccalaureate program at the University of Bridgeport, Fones School of Dental Hygiene. Amy's article is titled, "Mouthguards in the American Hockey League." We would like to commend Amy for her paper and hope to see more from her in the future. Also, a special thanks to Johnson & Johnson for their support of the Journalism Award. Honorable mention was extended to Elizabeth Onik, RDH, BSDH, a 2007 graduate of the Master of Higher Education Administration program in the Graduate School of Education at the University of Pittsburgh, for her manuscript, "Missing Persons: African Americans in Dental Hygiene".

As we start this new academic year, I want to acknowledge all of the educators and administrators across the country who are teaching in our 280+ programs. The students who participated in the research poster presentations did not do it alone. I know from experience the amount of time and energy it takes to mentor and develop a student to be able to conduct research, present it at a national meeting and then proceed to publish the work in a professional journal. We have a wonderfully dedicated group of academicians in dental hygiene who are not only improving the knowledge base of our dental hygiene students but they are also contributing to the dental hygiene body of knowledge with their own scientific investigations.

Finally, I want to extend a special tribute to Katie Barge, our manager and staff editor in the Communications Division at ADHA. When I began my tenure as editor of the JDH in January 2006, Katie was there to organize the process and keep me on task. I was immediately impressed with her maturity and skill-even though she was barely out of college! Katie will begin a new adventure in her life soon. In October, Katie and her husband, Chad, will set out for The Kingdom of Tonga where they will spend 2 years working as Peace Corp volunteers. I have no doubt that she will exert the same skill, maturity, and fun as she has at ADHA. Thank you, Katie, for your dedication to the ADHA and the *Journal of Dental Hygiene*. We will miss you!

Have a great fall!

**Rebecca Wilder, RDH, BS, MS**

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## Upfront

Eugenia Jefferson

*Eugenia Jefferson is staff editor of the Journal of Dental Hygiene and staff writer for Access*

### **Chewing gum might reduce dental caries**

According to researchers, chewing gum could be a dental-protective agent against caries. Researchers at the Department of Dental Public Health Sciences, Northwest/Alaska Center to Reduce Oral Health Disparities, University of Washington emphasized the substance xylitol. The authors researched different types of substances found in chewing gum such as calcium, bicarbonate, carbamide, chlorhexidine, fluoride, and xylitol.

They reviewed and selected clinical investigations and previous reviews using the substances found in chewing gum the previous substances and on their effects on reducing caries. They searched the MEDLINE database using various keywords such as "dental caries" and "oral health" to see if their hypothesis of whether chewing gum is an effective agent in carie prevention match with the substances. The authors found discovered that all of the substances found in gum could be used to strengthen and improve oral health. "These substances exhibit properties that are protective of the oral environment and mediate common oral diseases," the authors said.

The review found a difference of opinion regarding the suitability of recommending chewing gum for caries prevention in children. It is questionable whether advocating chewing gum for dental caries is suitable. Some argue that giving it to young school children would create more choking hazards. and the lack specific dosage recommendations. However, the authors believe that chewing gum could be an effective agent to reduce tooth decay and should be reconsideredommended for children.

According to the study, chewing gum is stimulates saliva flow which cleanses food debris and plaque from teeth. It reduces the chances of gingivitis and periodontitis. In addition, Streptococcus mutans levels and tooth decay decrease.

### **Study shows graphic health warning pictures might be helpful for cessation**

Showing graphic health warning pictures of mouth and throat cancer might be an effective way to stop smokers from smoking, according to an article in the Australian Dental Journal. A study at the University of Padjadjaran in Bandung, Indonesia, aimed to investigate whether showing graphic health warnings would increase the demand for smoking cessation advice in dental practices.

The researchers surveyed 800 dental patients, out of them 152 smoked. A separate survey was given to the patient's dentists. They were asked questions about smoking practices and attitudes toward cessation in the dental practice. The majority of dentists and patients remember seeing graphic health warnings of mouth and throats cancer on television.

After viewing the graphic images, half of the patients reported that they planned to quit within six months. According to the study, 47.7% of them agreed that the graphic warnings made them more likely to quit. Researchers found that the

graphics seemed to increase the patients' awareness and their intention to stop smoking. Dentists were positive towards cessation activities, but believed their patients lacked the motivation to quit smoking.

"Forty percent of smokers would try to quit if asked by their dentists, but only 28.4% preferred a dentists for cessation advice," said the authors. Even though the pictures were effective in awareness, the demand cessation advice among patients was low. "In general, dentists found no change in demand for smoking cessation advice since the launch of the National Tobacco Campaign in 2006," stated the authors.

### **ADHA seeks abstracts for Annual Session**

American Dental Hygienists' Association is looking for clinician, healthcare providers, educators, researchers and graduate students who have conducted research on an oral health related topic. Abstracts are being solicited for research on oral health and dental hygiene related topics at the Center for Lifelong Learning at Annual Session in Washington, D.C. on June 17-23, 2009.

The posters should pertain to the ADHA National Dental Hygiene Research Agenda. Topics should include the following: health promotion / disease prevention, health services research, professional education and development, clinical dental hygiene care, occupational health and safety.

Additional information can be found at <http://www.adha.org/research/nra.htm>. For the complete call announcement, guidelines for abstract submission and selection criteria, visit: [www.adha.org/research](http://www.adha.org/research).

All abstracts must be submitted by February 18, 2009.

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## **Review of: Tooth Whitening: Indications and Outcomes of Nightguard Vital Bleaching**

Joan Gibson-Howell, RDH, MSED, EdD

*Reviewed by Joan Gibson-Howell. Gibson-Howell is an Assistant Professor at The Ohio State University College of Dentistry, Dental Hygiene. She teaches dental radiology, dental materials lab, oral anatomy lab, and an on-line clinical teaching methodology course. She is also faculty advisor for the degree completion practicum program.*

### **Tooth Whitening: Indications and Outcomes of Nightguard Vital Bleaching**

**Haywood, Van B**

**Quintessence Books Publishing Co**

**Hanover Park, IL, 2007**

**144 pages**

**ISBN: 978-0-867-15450-4**

**\$98.00**

As stated in the preface of this book, the author's goal is to "provide clinicians and patients with valuable information about the benefits and safety of using nightguard vital bleaching with a dentist-prescribed home whitening treatment using a custom -fitted tray." Although this technique has been used since the late 1960s, it was shared by word of mouth and was never published. Dr. Haywood, along with other colleagues, pursued research in this area of esthetic dentistry at the University of North Carolina-Chapel Hill and since 1989, has published their results in the literature.

This book includes a variety of topics including the importance of a proper examination, correct diagnosis, and treatment of various types of tooth staining. In addition, Dr. Haywood addresses important issues such as treatment options, combining whitening with restorative treatment, design of the custom-fitted tray, treatment of sensitivity, and caries control. At the end of this text, there are three appendices with useful information for the practitioner. Appendix A provides text with numerous photographs of the technique for fabricating bleaching trays, Appendix B is a useful bleaching analysis form for practitioners, and Appendix C contains a comprehensive list of recommended readings.

For practitioners, the text is succinct yet thorough and utilizes the corresponding clinical color photographs to clearly depict the topics. Because a picture 'speaks a thousand words,' practitioners will truly benefit from the excellent clinical color photographs of pre and post treatment. All sections and all topics in this book are clearly depicted in both words and clinical photographs in the form of patient cases. For example, chapter 1 includes an extensive section on 'how to discuss bleaching with patients.' With this concern in mind, the author addresses various topics such as dark canines, existing restorations, visible roots, worn teeth and existing defects and includes exceptional photographs of each condition. The author also addresses special populations such as the elderly, children, patients with sensitivity, and patients who are pregnant with both text and again outstanding clinical photographs of each situation. The readings also provide clear instructions so that clinicians can easily explain the benefits and safety of nightguard vital whitening to patients.

Because the text is written in such an understandable way, it is also a valuable resource for the dental patient who is thinking about whitening their teeth or is providing guidance to a friend or other family member. For example, all chapters include many patient cases that illustrate a variety of unique patient situations with whitening. Chapter 2 includes patient cases about stains of genetic origin, age-related, and nicotine stains. Because whitening is a desirable treatment for many patients, it is important that they are clearly informed of the advantages and the limitations of whitening. This book is an excellent resource to assist the patient in asking relevant questions of the practitioner and make an informed decision about whether nightguard vital tooth whitening is a treatment they want to pursue.

As previously discussed, the value of this book to both practitioner and patient is that it includes such outstanding pre treatment situations and post treatment results with the outstanding clinical color photographs. This feature is clearly a superb quality of this text and lends to the excellence of the author and publisher.

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## **Review of: Mosby's Review for the NBDE, Part I and Mosby's Review for the NBDE, Part II**

Patricia A Frese, RDH, MEd

*Reviewed by Patricia A. Frese, RDH, MEd, professor, University of Cincinnati, Raymond Walters College, Department of Dental Hygiene, Cincinnati, Ohio.*

### **Mosby's Review for the NBDE, Part I**

**Dowd, F Editor**

**Mosby Elsevier**

**St Louis, MO, 2007**

**416 pages, 171 illustrations, indexed, soft cover**

**ISBN: 978-0-323-02564-5**

**\$59.95**

### **Mosby's Review for the NBDE, Part II**

**Dowd, F Editor**

**Mosby Elsevier**

**St Louis, MO, 2007**

**448 pages, 300 illustrations, indexed, soft cover**

**ISBN: 978-0-323-02565-2**

**\$59.95**

These texts are designed to prepare dental students for the 2 National Board Exams. The first exam is generally taken after 2 years of dental school followed by the second exam closer to graduation. They accomplish this goal and are another study aid for dental hygiene students preparing to take the National Board for Dental Hygiene.

Each of the texts provides a preface with information on test preparation and resources for additional reading. The chapters are presented in the order the subjects appear on the dental exam. The first text covers the basic sciences while the second text focuses on the dental specialties. The chapters are presented in an easy-to-read outline format allowing the reader immediate access to important details. Each chapter begins with a general content outline and concludes with review questions. Multiple tables, diagrams, and photographs aid the reader's understanding of the content. The texts conclude with a practice test. The questions mimic the style of questions on the exam. Questions are provided as stand-alone multiple choice, testlet and case-based questions. Answers and rationale are provided for all the questions.

The second text comes with a companion CD which contains 387 additional questions and 5 extensive cases with 20 questions each. Using the CD in the Study Mode displays questions section - by - section allowing the user to follow the subjects in order or choose a particular subject tofor study. The correct answer and rationale are provided at the end of each question. In the Test Mode, the user can simulate a testing situation. Questions are randomly generated and a timer appears at the bottom for pacing. At the end of the session, a result table is generated and a review section comparing chosen answers to correct answers with rationale is displayed. In the Case Study Mode, the user can choose from 5 extensive case studies. After reviewing the case, the user can answer the 20 questions and is given immediate feedback with rationale.

These review texts are a worthwhile investment for the dental student preparing for the National Board and as an adjunct for the dental hygiene student.

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## **Review of: Prevention in Clinical Oral Health Care**

Mary Danusis Cooper, LDH, MSED, Professor

*Indiana University-Purdue University Fort Wayne, Indiana.*

### **Prevention in Clinical Oral Health Care**

**David Cappelli and Connie C. Mobley**

**Mosby Elsevier**

**St. Louis, Missouri, 2008**

**312 pages, Illustrated, Indexed**

**ISBN: 978-0-323-02564-5**

**\$56.95**

This new soft cover text does not address new issues associated with the importance of oral health, but reinforces the overall promotion of oral health and its impact on every patient. Every dental office should "introduce, apply, and communicate prevention" to those at risk for dental disease. Whether the patient is at risk for dental caries, periodontal disease, or oral cancer, education is the key in preventing these diseases. In recent years, more and more studies reveal the oral-systemic link, therefore placing an increased emphasis on the direct correlation of overall health and prevention of diseases.

Addressed in this text is the concept of the risk for diseases and the choices involved in preventing these diseases. In order to address all aspects of prevention, the text is divided into 4 sections. Each section focuses on the different avenues of preventive dentistry, but with the end result being the same--providing the reader with the knowledge on how to promote oral health and prevent disease. Before preventive measures can be implemented, the oral health care provider must have an understanding of the epidemiology and biology of diseases and this is the basis for section 1. After reading section 1, the reader will have a complete understanding of the epidemiology/biology of dental caries, periodontal disease, and oral cancer.

In the second section, the risk factors for dental caries, periodontal disease, and oral cancers are assessed. Also included in this section is a chapter on the synergism between pharmacology and oral health. This chapter delves into the adverse effects drugs have on the oral cavity. Of particular interest are the tables listing drugs--OTC and prescription--associated with dysgeusia (taste alterations) and xerostomia. Also in addition, the section on the effects herbal supplements can have on the soft tissue and teeth is of interest, confirming the need to have all medications, including herbal medications and nutritional supplements listed on the medical history.

Section 3 provides information on the "critical link between assessment strategies and the development of customized patient treatment plan to achieve optimum oral health." Because I have strong interest in nutrition, I particularly found the information presented in the nutritional risk assessment chapter of value. Again, several precise and easy-to-review tables provide the reader with information that usually is not evaluated or addressed with the patient in clinical practice. Nutrition

is the key to overall health. Many nutritional deficiencies can be detected intra- and extraorally. The health care provider should be acquainted with these physical findings and be able to make sound recommendations to help the patient with noted nutritional deficiencies. Also in this section, the authors address how to work with a fearful and phobic patient as well as those from diverse cultural backgrounds and social norms. The importance of providing the best possible care to all patients is emphasized.

Finally, the last section focuses on the practical aspects of prevention to help keep all individuals healthy and free from disease. From a different angle, the importance of good nutrition is revisited. Common conditions in the U.S. are addressed including diabetes, osteoporosis, cardiovascular diseases, and obesity and how these conditions can have an affect on oral health. The chapters on prevention strategies of dental caries and periodontal disease discuss tobacco cessation, chemotherapeutic agents for plaque and caries control, mechanical strategies for removing plaque, as well as pit and fissure sealants to name a few. Preventive strategies for special populations are also addressed in this section proving the need for care for this growing and diverse population.

Overall, this text offers valuable information for the dental health care provider, whether it is used as a reference in clinical practice or by a student in dental hygiene school. Strengths include up-to-date research based information along with valuable tables for reference and review. Each chapter begins with an outline of the content that will be discussed, learning objectives, and key terms. The glossary at the end of the text provides a complete review of terms. The inclusion of color photos would have made this textbook more complete; however, it is understood that cost is a factor here.

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## **Review of: Periodontology for the Dental Hygienist, 3rd Edition**

Sue P Humphrey, RDH, MSED

*Reviewed by Sue P. Humphrey, RDH, MSED, Associate Professor in the Peiodontology Division at the University of Kentucky College of Dentistry, Lexington, Kentucky.*

### **Periodontology for the Dental Hygienist**

#### **Third Edition**

**Dorothy A. Perry, RDH, Phd and Phyllis L. Beemsterboer, RDH, MS, EdD**

**Saunders, 2007**

**St. Louis, Mo.**

**504 pages, 473 illustrations, indexed, softcover, CD-ROM study guide**

**ISBN: 978-1-4160-0175-1**

**\$61.95**

In this third edition of *Periodontology for the Dental Hygienist*, a comprehensive review of all aspects of periodontology is offered for dental hygiene students and practitioners. The goal of the text, as stated by the authors, is for use as a learning tool for the dental hygienist to be confident in applying a comprehensive understanding of disease and treatment in daily clinical practice. An ancillary CD-ROM is provided with each text for self-paced and guided student study options, offering case studies and answers to study questions embedded in each chapter with rationale to support correct answers. The book includes 473 illustrations, many of which are color clinical photos, providing enhancement to support presented material.

This most recent edition of *Periodontology for the Dental Hygienist* is organized into 5 parts. Included in the first part is a historical perspective on dental hygiene and periodontology, an overview of periodontal anatomic characteristics and host response, as well as epidemiology and microbiology of periodontal diseases. The second section covers the foundations of periodontal therapy. This second part includes chapters on calculus and other disease-associated factors, gingival diseases and periodontal diseases. The third part of the text is organized to cover assessment of periodontal diseases with chapters on clinical assessment, treatment planning for the periodontal patient, and occlusion and temporomandibular disorders. Treatment for periodontal diseases is the subject of the fourth section of the text, including chapters on plaque and disease control, nonsurgical therapy, periodontal surgery, dental implants, periodontal emergencies and systemic factors influencing periodontal disease. And the final part of the text is directed toward results of periodontal therapy, focusing on periodontal maintenance, prevention and prognosis after periodontal therapy.

The format of each chapter is presented in a sound educational approach beginning with learning outcomes and key terms. At the conclusion of each chapter are summary points, study questions in both multiple choice and short answer format, and listed references. Definitions are clearly stated, with key terms highlighted. Each chapter is replete with illustrations, clinical photos, and graphics. New to this edition is the collection of evidence-based support for presented concepts and

modalities. A common thread of referencing dental plaque to plaque biofilm is an illustration of the authors intent to link contemporary terminology and research with established foundational terminology and knowledge.

The depth and breadth of the information in the third edition of *Periodontology for the Dental Hygienist* is impressive. The information was found to be technically and factually correct. While no single source can cover all necessary information for practice, this text would serve as an excellent required text for any periodontology course in dental hygiene programs as well as an updated reference for practicing dental hygienists.

In the next edition, the reviewer would like to see inclusion or development of the topics listed below for the enhancement of a currently excellent text:

- More complete cross-referencing of topics from chapter-to-chapter within the text, especially for the novice dental hygiene student
- More development of the abbreviated section on host response, linking this to oral findings and tissue response
- Clinical application of risk assessment categories for caries and periodontal disease
- Discussion of oral bisphosphonate-induced osteonecrosis and potential clinical findings and risk
- More development of the use of xylitol and remineralization modalities in caries prevention and intervention
- Inclusion of fluoride varnish and its approved uses
- Development of the discussion of nutrition linking particular oral findings with possible nutrient deficiencies

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## **Cetylpyridinium Chloride Mouth rinse on Gingivitis and Plaque**

Joanna Asadoorian, AAS(DH), BScD(DH), MSc and Karen B Williams, RDH, PhD

*Karen B. Williams, RDH, PhD, is a professor and director of the Clinical Research Center at the University of Missouri-Kansas City. She received her certificate in dental hygiene and BS in education at The Ohio State University, her MS in dental hygiene education at the University of Missouri-Kansas City, and PhD in evaluation, measurement and statistics at the University of Kansas. Dr. Williams has been active in clinical dental hygiene for over 35 years and in clinical research for 23 years. Her areas of specialization include research design and statistics, educational methods, dental product efficacy, health outcomes research, and clinical dental hygiene. She is a research consultant for numerous dental manufacturers. Dr. Williams has presented papers and continuing education programs throughout the United States and internationally. Joanna Asadoorian is an Associate Professor at the School of Dental Hygiene, Faculty of Dentistry, and University of Manitoba. Joanna obtained her Associate degree in Applied Science in Dental Hygiene at Erie Community College in New York State and subsequently completed her B.Sc.D. in dental hygiene and M.Sc. degree at the University of Toronto. Joanna's primary research interests have surrounded quality assurance and continuing competency programming of health care professionals. Through this research, Joanna has conducted investigations in practitioner self-assessment, clinical reflection and behaviour change, and, more recently, she has been examining personal oral health care behaviour implementation. Joanna is currently pursuing her doctorate degree focusing her research in health care provider clinical decision-making. Joanna is active with service to both Canadian and American Dental Hygienists' Associations, and she disseminates her research findings nationally and internationally through publications and delivering presentations throughout the year.*

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.

### **A 6-month clinical trial to study the effects of a cetylpyridinium chloride mouth rinse on gingivitis and plaque. Am J Dent 2005;18 (special issue):9A-14A.**

**Mankodi S, Bauroth K, Witt JJ, Bsoul S, He T, Gibb R, Dunavent J, Hamilton A**

Dental Products Testing Inc, West Palm Beach, Florida, USA

#### ***Abstract***

**Purpose.** To evaluate the effects of a novel mouth rinse containing 0.07% high bioavailable cetylpyridinium chloride (Crest Pro-Health Rinse) on the development of gingivitis and plaque versus a placebo control over a period of 6 months.

**Methods.** This was a randomized, 6-month, placebo-controlled, parallel groups, double-blind, single center clinical trial. One hundred thirty-nine generally healthy adults with mild-to-moderate gingivitis were enrolled in the study. Subjects were given Modified Gingival Index (MGI), Gingival Bleeding Index (GBI) and Modified Quigley-Hein Plaque Index (MQH) examinations followed by a dental prophylaxis. Subjects were then randomly assigned to either the cetylpyridinium chloride (CPC) rinse or placebo rinse and instructed to begin rinsing twice a day with 20 ml of their assigned mouth rinse

for 30 seconds after brushing their teeth. Subjects were assessed for MGI, GBI and MQH scores after 3 and 6 months of product use. Oral hard and soft tissue examinations were also performed at all visits.

**Results.** One hundred twenty-four subjects were evaluable at Month 3 and 119 at Month 6. After 6 months, subjects rinsing with the CPC rinse showed 15.4% less gingival inflammation, 33.3% less gingival bleeding, and 15.8% less plaque relative to the placebo group. All reductions were highly statistically significantly different ( $P < 0.01$ ). Results were similar at 3 months. Both treatments were well-tolerated.

**Clinical Significance.** This study demonstrates that the Crest Pro-Health's 0.07% CPC mouthrinse provided significant antiplaque and antigingivitis benefits when used twice daily for 6 months as an adjunct to tooth brushing.

### **Commentary**

Chemical plaque control as an adjunct to normal oral hygiene has been the subject of numerous research studies over the past 2 decades. Chlorhexidine gluconate oral rinse (CHG) is considered the gold standard for reducing plaque and gingival inflammation; however, it has well-documented side effects such as dental staining, increase in calculus formation and transient altered taste acuity. These side effects generally preclude long-term use. In addition, CHG rinses are generally formulated with an alcohol-based vehicle of 11.9%. Essential oil mouth rinses (EO) also have been shown to possess anti-plaque and antigingivitis effects, but without the unfavourable side effects common to CHG. EO rinses have the highest alcohol content of any oral rinses at 27.9%. Because of the alcohol content, both CHG and EO are contraindicated for individuals with xerostomia or past history of alcohol dependency. Recently, a cetylpyridinium chloride oral rinse (CPC) was formulated as an alcohol-free alternative to other anti-plaque and anti-gingivitis oral rinses. This study experimentally compared the antiplaque and antigingivitis effectiveness of CPC, 0.07% in a bioavailable matrix (Crest® PRO-HEALTH™ Rinse) to an alcohol-free placebo-control oral rinse over 6 months. This was a well-designed trial incorporating many study features recommended by the American Dental Association Council on Scientific Affairs. One-hundred and thirty-nine study subjects were randomly assigned to either the CPC or placebo-control oral rinse groups, and were instructed to brush normally and rinse twice daily with their assigned rinse. The study was conducted as a double-blind trial with neither study subjects nor examiners aware of which subjects received which oral rinse. In order to qualify for participation, subjects had to have mild gingival inflammation and a plaque score of at least 1.5 on the Modified Quigley-Hein Plaque Index (MQH). Comparison of subject characteristics at baseline showed that the experimental and placebo groups were equivalent with respect to age, gender, ethnicity, smoking status, and levels of oral health parameters. Subjects were recalled for assessment of plaque and gingivitis at 3 and 6-month intervals. A total of 124 subjects were available for the month 3 and 6 visits. At both 3 and 6-month time points, the CPC group demonstrated statistically significantly lower plaque (MQH) and gingival measures (MGI and Gingival Bleeding Index-GBI) compared to placebo. The difference between active and placebo group scores at 6 months were: 15.4% for gingivitis scores; 33.3% for bleeding scores; and 15.8% for plaque scores. The ADA Guidelines for Acceptance of Chemotherapeutic Products for Control of Gingivitis have set the minimal standard required for gingivitis reduction between the active therapy and the control at 15%. Given this standard, the CPC mouth rinse demonstrated acceptable gingivitis reduction. While it is not possible to compare the effectiveness of CPC to the gold-standard CHG in this study, previous research has demonstrated reductions in gingivitis ranging from 18-80%, depending on the sample selected for the study. In the current study, baseline bleeding scores were modest (12.2% and 11.4%, for placebo and experimental, respectively) suggesting that subjects did possess a mild level of gingival inflammation. Previous research has shown that the greater the level of gingivitis, the greater reductions can be expected with chemotherapy agents. Whether CPC would demonstrate greater effectiveness in individuals with moderate or severe gingivitis remains to be seen. The current study suggests that for subjects with mild gingival inflammation, CPC can be more effective than placebo at reducing plaque, gingival bleeding and gingival index scores. Future studies are needed to determine the relative effectiveness of CPC on subjects with higher levels of gingival inflammation, as well as to substantiate the therapeutic effect of CPC oral rinses. These preliminary results are promising, especially for individuals for whom alcohol rinses are contraindicated.

**Comparison of the effects of cetylpyridinium chloride with an essential oil mouth rinse on dental plaque and gingivitis - a 6-month randomized controlled clinical trial. J Clin Periodontol. 2007 Aug; 34(8):658-67**

**Albert-Kiszely A, Pjetursson BE, Salvi GE, Witt J, Hamilton A, Persson GR, Lang NP**

School of Dental Medicine, University of Berne, Berne, Switzerland

**Abstract**

**Objective.** To compare the effects of an experimental mouth rinse containing 0.07% cetylpyridinium chloride (CPC) (Crest Pro-Health) with those provided by a commercially available mouth rinse containing essential oils (EOs) (Listerine) on dental plaque accumulation and prevention of gingivitis in an unsupervised 6-month randomized clinical trial.

**Material and Methods.** This double-blind, 6-month, parallel group, positively controlled study involved 151 subjects balanced and randomly assigned to either positive control (EO) or experimental (CPC) mouth rinse treatment groups. At baseline, subjects received a dental prophylaxis procedure and began unsupervised rinsing twice a day with 20 ml of their assigned mouthwash for 30 s after brushing their teeth for 1 min. Subjects were assessed for gingivitis and gingival bleeding by the Gingival index (GI) of L oe & Silness (1963) and plaque by the Silness & L oe (1964) Plaque index at baseline and after 3 and 6 months of rinsing. At 3 and 6 months, oral soft tissue health was assessed. Microbiological samples were also taken for community profiling by the DNA checkerboard method.

**Results.** Results show that after 3 and 6 months of rinsing, there were no significant differences ( $p=0.05$ ) between the experimental (CPC) and the positive control mouth rinse treatment groups for overall gingivitis status, gingival bleeding, and plaque accumulation. At 6 months, the covariant (baseline) adjusted mean GI and bleeding sites percentages for the CPC and the EO rinses were 0.52 and 0.53 and 8.7 and 9.3, respectively. Both mouth rinses were well-tolerated by the subjects. Microbiological community profiles were similar for the two treatment groups. Statistically, a significant greater reduction in bleeding sites was observed for the CPC rinse versus the EO rinse.

**Conclusion.** The essential findings of this study indicated that there was no statistically significant difference in the anti-plaque and anti-gingivitis benefits between the experimental CPC mouth rinse and the positive control EO mouth rinse over a 6-month period.

**Commentary**

This study examined the effect of unsupervised use of a CPC rinse (Crest® PRO-HEALTH™ Rinse) compared to an ADA approved EO mouth rinse (LISTERINE®) following a professionally delivered supragingival polishing. Since all subjects received a dental prophylaxis prior to initiating oral rinse use at home, the primary intent was to determine if the CPC and EO products differentially reduced gingivitis, plaque reaccumulation and shift in microbial composition. The study design did not include a placebo comparison group, thus the only comparisons possible were between the two active mouth rinses. The study population started with 151 subjects and, of those, 127 completed the 6-month study. The authors appropriately evaluated the characteristics of those individuals who dropped out of the study to those who completed the study and determined that the drop out of 24 subjects did not create a bias in results. Multiple statistical analyses were conducted to compare between groups at each time interval and compare within group over time. An intent-to-treat, analysis of covariance (ANCOVA) statistical procedure was used to compare GI scores for both 'site level' and 'subject averaged' data for the 3 month comparisons and 6 month comparisons while controlling for any potential baseline differences. Results showed no statistically significant differences between the CPC and EO groups at 3 months and 6 months for GI scores; however, both groups improved comparably from baseline. Similarly, for % sites with bleeding, there was a statistically significant difference favoring the CPC rinse. Baseline levels of gingival inflammation were relatively low for both groups, with average bleeding on probing of 14.6 and 13.3%, for CPC and EO, respectively. After 6 months of oral rinse use, the adjusted average bleeding on probing was 6.0 and 7.4 for CPC and EO. This difference was statistically significant; however, the authors were quick to point out that the difference was small, and not clinically meaningful. Plaque reaccumulation scores followed a similar trajectory as GI scores, decreasing from baseline in both groups, but with no differences between oral rinse groups at the 3 month and 6 month time intervals. Additionally, neither oral rinse was

effective at significantly reducing subgingival periodontal pathogens at either 3 or 6 months, despite the fact that all subjects received supragingival polishing at baseline. Assessment of 40 periodontal organisms was achieved at baseline, 3 month and 6 months using checkerboard DNA-DNA hybridization. Of interest, 50% of sites in both oral rinse groups harboured *P. gingivalis* at baseline, but did not show a statistically significant change over the study period. This is not terribly surprising as previous studies have shown that oral rinses have limited capacity for reaching subgingivally, and are not present for sufficient periods of time to achieve effectiveness against pathogens.

Overall, the results suggest that the anti-plaque and anti-gingivitis effectiveness of the CPC is comparable to that achieved by EO rinses in a population of individuals with mild gingivitis. The results of this study, as with the previous study, can be inferred to individuals with mild gingivitis and who are relatively young (mean age of 39.5 years) and healthy. As 76% of subjects were non-smokers, it is unknown whether similar results would be obtained in a population of individuals who smoke. The primary intent of this study was to assess the relative effectiveness of a CPC oral rinse compared to an EO rinse; however, the absence of a placebo control group makes it difficult to determine how much of the reduction in PI and GI is attributable to the active ingredients rather than increased attention to oral health. In the past, there have been numerous studies demonstrating the effectiveness of EO rinses to reduce plaque and gingivitis better than controls. These studies met the requirements of the ADA Guidelines for Acceptance of Chemotherapeutic Products for Control of Gingivitis and subsequently lead to the ADA seal for EO rinses as anti-plaque and anti-gingivitis products. As the observed reductions for the EO rinse group from baseline are within the range previously reported, the equivalence of clinical data between the EO and CPC groups suggests potential utility for the CPC product. More long-term trials comparing CPC to positive controls (EO and CHG) and negative controls (placebo) in samples with various levels of gingival disease are needed to provide the firm evidence needed to establish CPC as a therapeutic product.

## **The Bottom Line**

The market is inundated with new oral rinses claiming to prevent or reduce plaque and gingivitis and improve dental aesthetics. Clients expect dental hygienists to provide direction in product selection and hygienists need to be aware of the state of evidence related to chemotherapeutic control of plaque and gingivitis. These two studies present preliminary evidence regarding the effectiveness of CPC for the reduction of plaque and gingivitis. CPC is thought to exert antimicrobial activity by disrupting the cell membrane of microbial organisms that then results in an alteration of cellular metabolism, cell growth and ultimately, cell death. The need for alcohol-free oral rinses that can effectively reduce dental plaque and gingival inflammation, especially in developing countries where polypharmacy-induced xerostomia is increasing, makes the results of these studies promising. Collectively, evidence from these two trials gives preliminary support for recommending these rinses, especially to individuals with mild gingivitis. However, dental hygienists are cautioned about extending this evidence to populations with more severe diseases. Making good evidence-based clinical decisions relies on clinicians' critical evaluation of the applicability of research findings (from a well-defined study population) to patients with various levels of gingival and periodontal disease. It is also prudent for dental hygienists to make recommendations considering the body of evidence available on any given topic. These two studies present preliminary findings on the effectiveness of CPC oral rinses for mild gingivitis. Clearly as more evidence is generated, clinicians will need to reconsider whether these recommendations remain timely.

Given the findings from these two studies, the following conclusions and recommendations can be made to dental hygiene clinicians:

- The CPC oral rinse (Crest® Pro Health Rinse) demonstrated 15.4% reductions in gingivitis and 15.8% for plaque scores at 6 months compared to a placebo control in populations with mild gingivitis;
- The CPC oral rinse also demonstrated comparable results in reducing plaque and gingivitis when compared to EO in subjects with mild gingivitis;
- In order for CPC to receive the ADA seal of acceptance for gingivitis, two long term studies showing gingivitis reductions of at least 15% are necessary providing that the study design meets ADA guidelines including the incorporation of negative controls. One of these studies meets those requirements;

- When interpreting study results, in addition to demonstrating statistically significant differences between groups (control and treatment), it is important to consider whether change from baseline in the outcome measure (i.e. plaque score, gingivitis score) is demonstrated between groups over time and is clinically meaningful.

## **Summary**

Preliminary evidence has demonstrated a reduction in gingivitis scores of at least 15% between placebo controls and CPC oral rinse (Crest® Pro Health Rinse). While this is indeed promising, additional studies are needed to determine whether CPC would achieve similar levels of disease and plaque reduction, especially for individuals with more severe gingivitis and/or periodontitis. For those patients for whom alcohol-containing mouth rinses are contraindicated, CPC oral rinse may be a viable adjunct to the traditional home care regimen. Finally, dental hygienists should monitor the literature in this area closely as new research will likely be published on CPC effectiveness and increase the evidence base for making good clinical recommendations.

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## Survey of Diabetes Knowledge and Practices of Dental Hygienists

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**Background.** *Increasing incidence of diabetes in the United States and risk for more severe periodontal disease in individuals with poorly controlled diabetes make it essential to provide access to education to prepare oral health providers to care for this population.*

**Objective.** *The purpose of this survey was to assess the dental hygienist's diabetes knowledge, beliefs concerning the disease, and clinical practices to identify professional continuing education needs. analysis of variance with repeated measures was used to determine if significant differences existed in the amount of muscle activity generated with each fulcrum.*

**Methods.** *A 5-part survey was constructed using the American Diabetes Association 2007 Clinical Practice Guidelines and the American Association of Periodontology Commissioned Review of diabetes and periodontal disease. Invitations to participate were disseminated electronically to American Dental Hygienists' Association (ADHA) members. A convenience sample of dental hygienists (n=392) representing 48 states participated.*

**Results.** *The majority of the respondents were female (99%), ages 41 to 60 (60.1%), and in practice more than 16 years (58.3%). Major deficits in knowledge were associated with the patient's hemoglobin A1c (HbA1c) value and implications for diabetes control (50%). The survey responses indicated confusion about the current classifications of diabetes with 70% of respondents using classifications that are no longer recognized. Seventy-five to 90% of participants were unfamiliar with the impact of various types of diabetes medications on dental care.*

**Conclusions.** *Dental hygienists in this survey demonstrated a need for enhancing knowledge about diabetes as it applies to clinical patient care. The areas of greatest need included the American Diabetes Association Clinical Practice Guidelines for standards of care, diagnosis of diabetes mellitus, medications, and best practices for interacting with other health professionals when caring for people with diabetes.*

**Keywords:** diabetes mellitus, dental hygienist, allied health personnel, continuing education

### Introduction

The most recent data from the Centers for Disease Control and Prevention (CDC) indicated that 18.2 million Americans were diagnosed with diabetes in 2002.<sup>1</sup> The CDC estimates that another 5.2 million people have undiagnosed diabetes.<sup>1</sup>

In addition to those with diagnosed and undiagnosed diabetes mellitus, estimates released in June of 2005 by the CDC suggest that an additional 41 million people may have pre-diabetes, which places them at increased risk of developing diabetes.<sup>2</sup>

Given the epidemic proportion of diabetes, it is critical for all health professionals to be well- educated about diabetes.<sup>3</sup> Dental hygienists are well-positioned to provide patients with diabetes prevention information, support the need for good glycemic control, and facilitate referral to other health care providers.

## **Background**

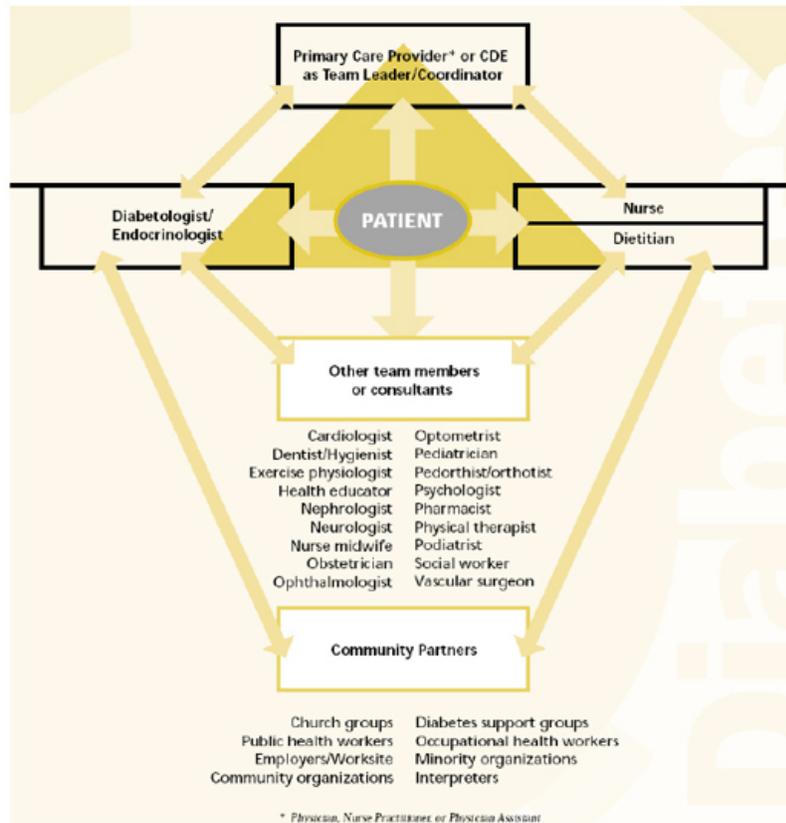
Approximately 70% of the population visit a dental office at least annually, providing an opportunity for dental professionals to assist in diabetes prevention and management.<sup>4</sup> Few studies have been conducted to identify oral health findings predictive of a risk for prediabetes or diabetes. However, a controlled, cross-sectional study of individuals with diabetes and those without found a statistically significant increased severity of periodontal disease ( $p=0.006$ ), degree of xerostomia ( $p=0.0003$ ), and presence of white spot carious lesions ( $p=0.02$ ) in those with diabetes.<sup>5</sup>

Although it seems clear that people with diabetes are at increased risk for periodontal disease, the impact of managing periodontitis on a patient's glycemic control is less clear.<sup>6</sup> Research has been done in an attempt to determine if nonsurgical periodontal therapy to treat and manage periodontal disease impacts glycemic control in individuals with diabetes. The results have been inconclusive with some studies demonstrating improvement in glycemic control,<sup>7-9</sup> and others finding no significant difference.<sup>10-13</sup>

Given the increasing prevalence of diabetes it is critical that dental professionals become better prepared to actively work with other health care providers in diabetes prevention and management.<sup>10</sup> Research to investigate the professional education needs of dental practitioners about diabetes is lacking. Nevertheless, the National Diabetes Education Program has developed an educational activity for 4 health care disciplines to facilitate collaboration and ensure that a consistent message is provided to clients with diabetes.<sup>14</sup> The health care providers targeted by the information are optometrists, podiatrists, dental professionals, and pharmacists.<sup>14</sup> This educational activity is a good beginning, but more evidence is needed to identify the educational needs of dental hygienists to ensure adequate support for provision of care for patients with diabetes.

In addition to enhancing education for dental professionals, dental professionals must be incorporated into the multidisciplinary health care team for prevention and management of diabetes for a lifetime, as shown in Figure 1.<sup>15</sup> An interdisciplinary team elevates the role of the dental professional from a peripheral contributor of care to one of greater importance. Dental professionals must become proactive with policy makers and the other members of the health care team to gain support for being an integral member of the team.<sup>15</sup> As a member of a multidisciplinary team, the dental professional should also recommend regular follow up with the primary care provider, annual eye exams and foot exams, as well as flu vaccinations.<sup>14</sup> The purpose of the survey was to assess the dental hygienist's diabetes knowledge, beliefs concerning the disease, and clinical practices of dental hygienists. The information gathered will assist with designing continuing professional education to meet the needs of dental hygienists to enhance their ability to effectively support patients' diabetes prevention and management while achieving and maintaining optimal oral health.

**Figure 1. Typical Multidisciplinary Team in Diabetes Care**



Centers for Disease Control and Prevention. Team Care: Comprehensive Lifetime Management for Diabetes. Atlanta, Georgia: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, 2001.

## Methods

### *Measurements*

A 5-part survey was constructed using the American Diabetes Association 2007 Clinical Practice Guidelines for standards of care and diagnosis of diabetes mellitus along with an American Association of Periodontology Commissioned Review of diabetes and periodontal disease.<sup>6,16,17</sup> Survey questions addressed 1) knowledge about oral health and diabetes (58 items); 2) beliefs about addressing diabetes in the dental office (13 items); 3) current practices in providing care to patients with diabetes (18 items); 4) barriers to addressing diabetes in the dental office (10 items); and 5) preferences for topics and modalities for continuing professional education (2 items). The survey ended with a mechanism for respondents to provide open-ended comments.

The survey content was evaluated by diabetes and oral health experts prior to piloting with a small sample of dental hygienists. An initial pilot of the survey (n=36) identified issues with the response options for the questions regarding current practices in reviewing a patient's medical history. This issue was resolved prior to opening the survey to potential respondents nationally.

**Participants**

An invitation to participate in the survey was disseminated electronically via a mailing list of dental hygienists as well as via a newsletter sent to members of the American Dental Hygienists' Association (ADHA). The mailing list included dental hygienists who contacted Idaho State University for information about the graduate dental hygiene program between August 2005 and October 2007. The electronic newsletter for the ADHA is disseminated nationally. A convenience sample of dental hygienists (n=392) with representation from 48 states completed the survey. Overall 501 potential respondents accessed the electronic survey with a completion rate of 78%.

**Results**

A summary of demographic characteristics (Table I) indicated the majority of the respondents were female (99%), between the ages of 41 and 60 (60.1%), in a private practice setting (54.6%), and had been in practice more than 16 years (58.3%).

**Table I. Characteristics of Survey Respondents**

<b>Demographics Variables</b>	<b>Respondents (n)</b>	<b>Respondents (%)</b>
<b>Gender</b>		
Male	4	1
Female	387	99
<b>Age</b>		
<30 yrs	51	13.0
31-40 yrs	75	19.2
41-50 yrs	96	24.6
51-60 yrs	139	35.5
>61 yrs	28	7.2
Missing data	2	.5
<b>Area of Practice(Check all that apply)</b>		
Private practice	256	54.6
Specialty practice	38	8.1
Educator	85	18.1
Public or Community Health	51	10.9
Other	38	8.1
Missing data	1	.2
<b>Yrs in Professional Practice</b>		
<2 yrs	60	15.4
2-5 yrs	34	8.7
6-10 yrs	29	7.4
11-15 yrs	36	9.2
>16 yrs	228	58.3
Missing data	4	1.0

Table II provides an overview of the survey respondents' personal experience with diabetes along with educational preparation for caring for patients with diabetes. Slightly more than one-third of dental hygienists (40%) reported having diabetes themselves or in the immediate family. A majority of respondents spend 10 or fewer hours per week (70%) providing care for patients with diabetes. About 75% of participants had 4 or fewer hours of diabetes education in their entry-level dental hygiene program. The dental hygienists were fairly evenly divided between those who had engaged in 4 or less hours (49.6%) and those who had completed more than 4 hours of continuing professional education related to diabetes since graduation from their professional programs.

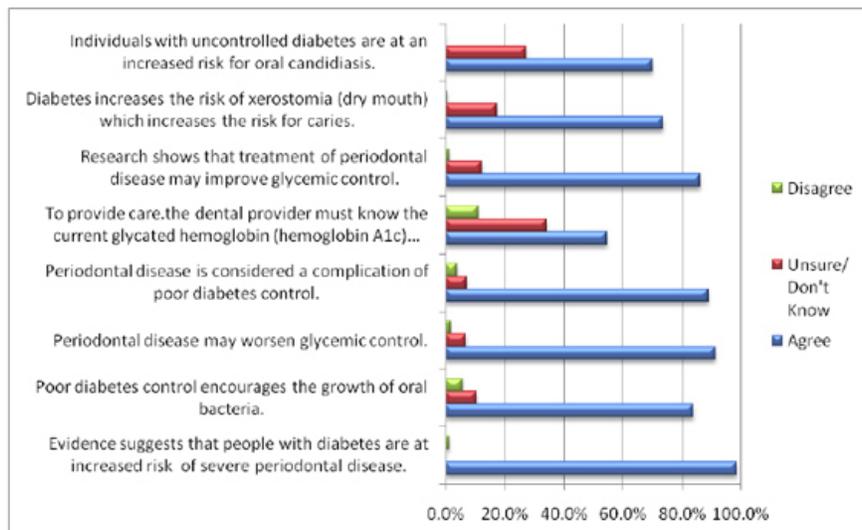
Table II. Previous Diabetes Experience and/or Education of Respondents

	Respondents (n)	Respondents (%)
<i>Do you or someone in your immediate family have diabetes?</i>		
Yes	156	39.9
No	235	60.1
<i>Approximately how many hours/week do you provide care to clients with diabetes?</i>		
<5 hrs	155	39.6
5-10 hrs	119	30.4
11-20 hrs	43	11.0
21-30 hrs	34	8.7
31-40 hrs	29	7.4
Missing data	11	2.8
<i>Approximately how many hours of education about diabetes did you receive during your professional training?</i>		
<1 hr	93	23.8
1-4 hrs	177	45.3
5-10 hrs	68	17.4
>10 hrs	47	12.0
Missing data	6	1.5
<i>Approximately how many hours of continuing education about oral health and diabetes have you had since graduation from your professional program?</i>		
< 1 hr	81	20.7
1-4 hr	113	28.9
5-10 hrs	90	23.0
>10 hrs	104	26.6
Missing data	3	.8

### Diabetes and Oral Health Knowledge

A Likert-type scale (strongly agree = 1 and strongly disagree = 5) was used to assess the oral health and diabetes knowledge of the respondents. A majority of respondents agreed (*strongly agree* and *agree* were combined for analysis) with most of the questions related to oral health and diabetes (Figure 2). Dental hygienists responding to the survey tended to be unsure or didn't know about requesting a patient's glycated hemoglobin (hemoglobin A1c) value (34.4%) or risk for candidiasis in the person with uncontrolled diabetes (27.2%).

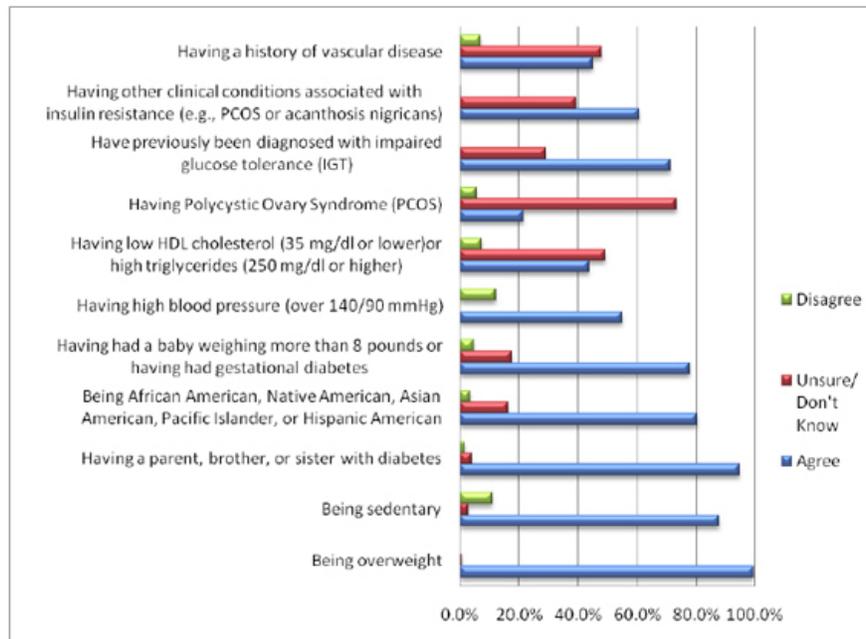
Figure 2. Knowledge about Diabetes and Oral Health



A majority of respondents indicated knowledge (*strongly agree* or *agree*) about the following risk factors for diabetes: being overweight (99.5%), having a family member with diabetes (94.5%), a history of gestational diabetes or giving birth to a baby more than 8 pounds (77.9%), sedentary (76.3%), and previous diagnosis with impaired glucose tolerance (71.1%).

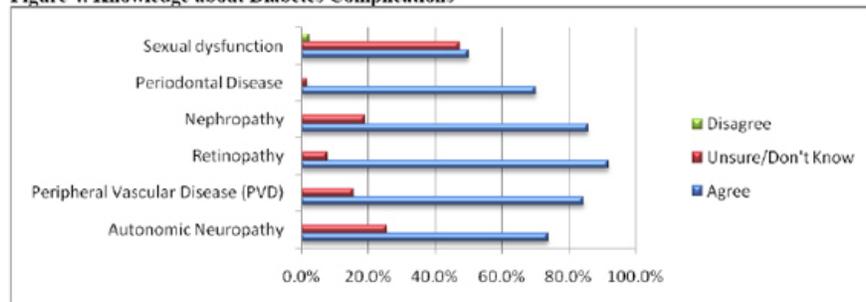
Dental hygienists reported not knowing or being unsure about the following risk factors: polycystic ovary syndrome (PCOS) (73.3%), low HDL cholesterol or high triglycerides (49.1%), and history of vascular disease (47.9%) (Figure 3).

Figure 3. Knowledge about Risk Factors for Diabetes



Respondents to the survey generally knew the complications associated with poorly controlled diabetes (Figure 4). The complications that dental hygienists were most likely to be unsure of were sexual dysfunction (47.6%), autonomic neuropathy (25.8%), and nephropathy (19.1%). When asked about the Expert Committee on Diagnosis and Classification of Diabetes classifications, results indicated that 86% thought Type 1, Type 2, and gestational diabetes were the current classifications, while about 70% thought noninsulin dependent diabetes mellitus (NIDDM) and insulin dependent diabetes mellitus (IDDM) were the current designations. More than 55% of dental hygienists were *unsure* or *didn't know* about the other specific types of diabetes associated with medications, genetics, etc.

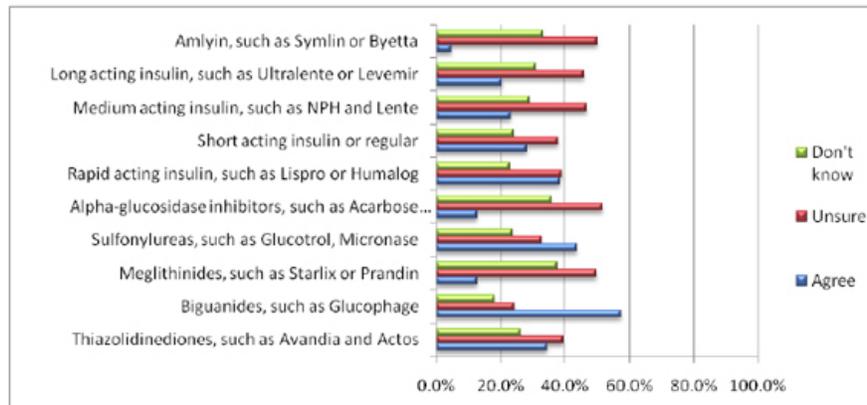
Figure 4. Knowledge about Diabetes Complications



Several questions were asked in regard to knowledge about the standard of care for glycemic control of a person with diabetes. When asked to identify the American Diabetes Association 2007 Clinical Practice Recommendations for fasting blood glucose in those with diabetes, the responses were: 70-110 mg/dl (57.2%), 80-120 mg/dl (36.5%), 90-130 mg/dl (4.8%), and 80-130 mg/dl (1.4%). Responses to the question about the American Diabetes Association recommendation for the number of times a hemoglobin A1C (HbA1c) test should be performed annually in persons who have stable glycemic control were as follows: once per year (45.6%), twice per year (28%), 3 times per year (9.6%), and 4 times per year (15.8%). Respondents indicated the recommendation for the glycated or hemoglobin HbA1c level was less than 6% (26.6%), 7% (45.5%), 8% (19.2%), 9 (1.3%), and 10 (7.5%).

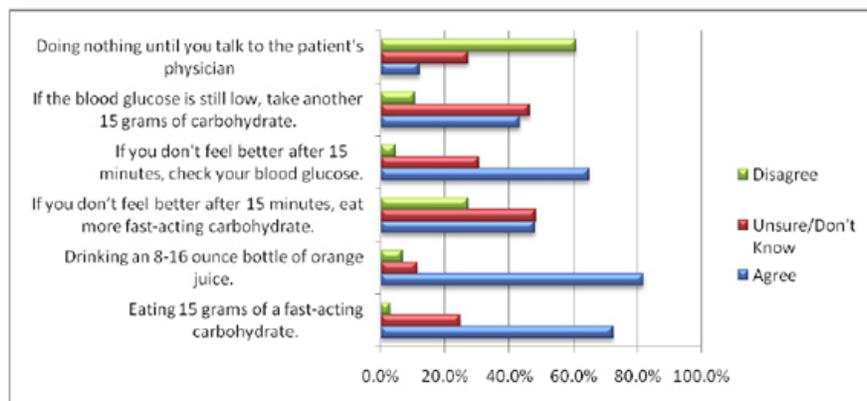
Dental hygienists reported being most familiar with the use of and dental considerations for the following diabetes medications: biguanides, such as Glucophage® or Metformin (57.4%), and sulfonylureas, such as Glucotrol® (44.5%). Over 80% of respondents were not familiar with Meglithinides, such as Starlix® (87.5%), alpha-glucosidase inhibitors, such as Precose® (87.5%), and Amlyin, such as Byetta® ( 83.1%). Sixty to 76% of participants reported being unfamiliar with the use and dental considerations for the various types of insulin (Figure 5).

**Figure 5. Knowledge about Medications Commonly Used to Treat Diabetes**



Respondents generally knew that blood glucose levels below 70 mg/dl (67.5%) indicated hypoglycemia. Another 23.3% indicated that blood glucose below 80 mg/dl suggested hypoglycemia. An additional set of questions addressed the American Diabetes Association Clinical Recommendations for treatment of hypoglycemia (Figure 6). Survey results indicated that the best treatment for hypoglycemia was eating 15 grams of a fast-acting carbohydrate (72.5%) and drinking an 8-16 ounce bottle of orange juice (81.9%). Forty-six to 48% of participants were unsure of what to do if the patient didn't feel better or the blood glucose was still low after 15 minutes. Approximately 39% of respondents would do nothing until talking with the patient's physician.

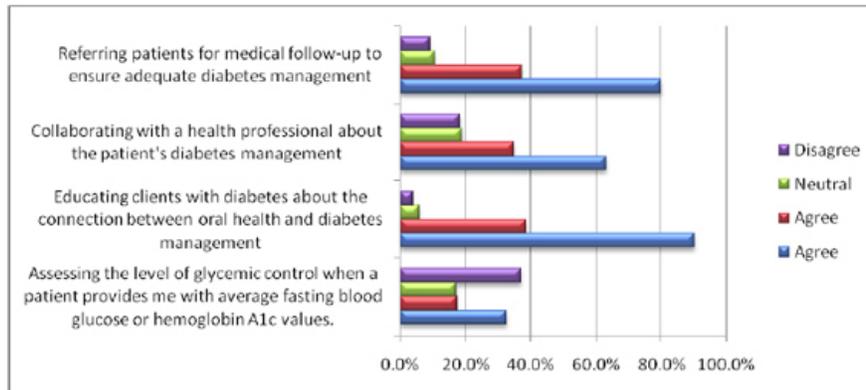
**Figure 6. Knowledge about Management of Hypoglycemia**



**Beliefs about Diabetes in Oral Health Care**

Of the questions that addressed the respondents' beliefs about the aspects of education, assessment and referral of patients that were within the dental hygiene scope of practice, 24.8% of dental hygienists felt that all of these things are within the scope of practice (Figure 7). The aspect most frequently reported as not being within the scope of practice was assessing the glycemic control of clients with diabetes through consultation with the patient's medical professional (54.6%).

**Figure 7. Competence in Assessment Education and Referring Patients with Diabetes**



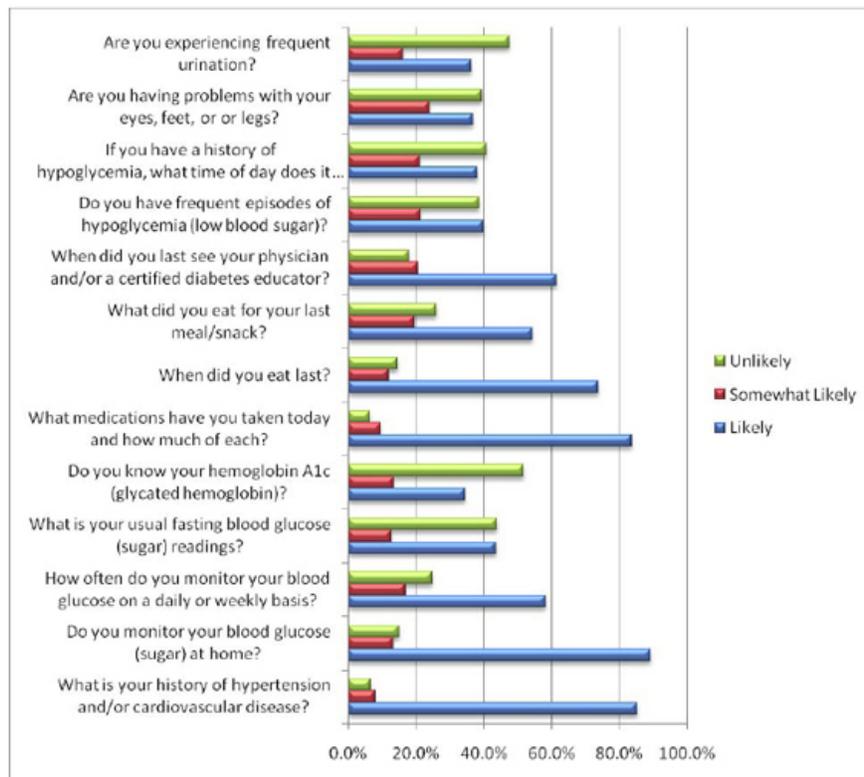
Respondents generally reported feeling competent in educating clients about oral health and diabetes (90.1%), referring patients for medical follow-up (80.1%), and collaborating with a health professional about the patient's diabetes management (63%). Dental hygienists felt least competent in assessing the level of glycemic control when provided with average fasting blood glucose or HbA1c values (50%).

Survey participants agreed that the following should be part of a comprehensive dental examination for patients with diabetes: assessment of diabetes control (83.2%), counseling on prevention of dental disease to enhance diabetes management (97.1%), education about the association between oral infection and glycemic control (97.1%), and referral for medical follow-up as needed (92.1%).

### ***Current Practices for Managing Patients with Diabetes in the Dental Office***

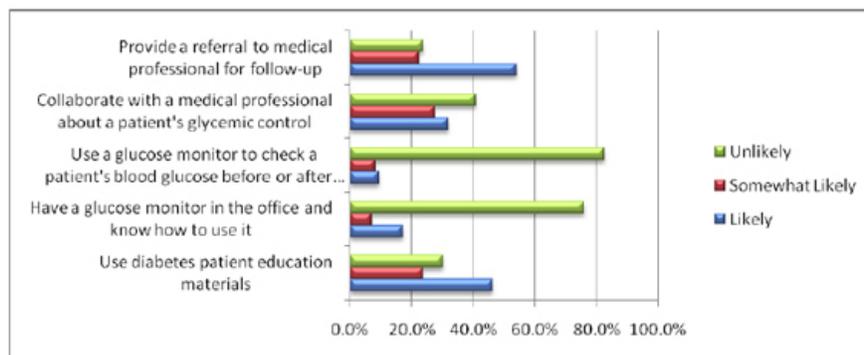
Practices when managing patients in the dental office were explored by determining how likely it was for the respondents to ask patient questions about glycemic control, medications, diet, risk factors, and hypoglycemia when reviewing the medical history (Figure 8). The questions that respondents were *extremely likely* or *likely* to ask their patients with diabetes included: Do you monitor your blood glucose at home? (89.1%); What is your history of hypertension and/or cardiovascular disease? (85.2%); What medications have you taken today and how much of each? (83.7%); and When did you eat last? (73.7%). The questions that dental hygienists were *least likely* to ask patients with diabetes were the following: Do you know your hemoglobin A1c (glycated hemoglobin)? (51.7%); Are you experiencing frequent urination? (47.5%), What is your usual fasting blood glucose reading? (43.8%); If you have a history of hypoglycemia, what time of day does it usually occur and how do you manage it? (40.8%); and Do you have frequent episodes of hypoglycemia? (38.7%).

Figure 8. Current Practices in Medical History Review in the Patient with Diabetes

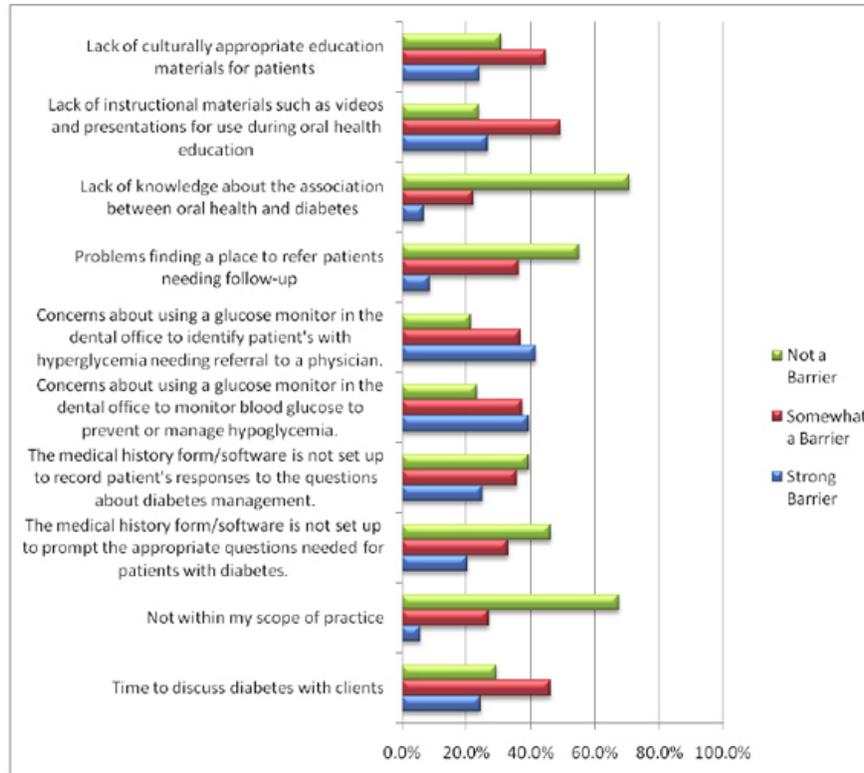


When asked about current practice in assessment, education, and referral of patients with diabetes, respondents were *most likely* to provide referral to a medical professional (54%) and use diabetes patient education materials (46.3%) (Figure 9). The participants were *least likely* to use a glucose monitor to check a patient's blood glucose before or after treatment (82.7%) and have a glucose monitor in the office and know how to use it (75.9%). Only 32% of dental hygienists reported collaboration with medical professionals about a patient's glycemic control. The *strongest barriers* to incorporating diabetes education into patient oral health care included: concerns about using a glucose monitor in the dental office to check blood glucose to prevent or manage hypoglycemia (39.5%) and for identification of patients with hyperglycemia (41.8%) (Figure 10). The items rated as *somewhat of a barrier* were: lack of instructional materials for use during oral health education (49.3%), time to discuss diabetes with clients (46.2%), and lack of culturally appropriate education materials for patients (44.6%).

Figure 9. Current Practice in Assessment, Education and Referring Patients with Diabetes



**Figure 10. Barriers to Incorporating Diabetes into Oral Health Care**



**Professional Education Needs of Dental Hygienists**

The next group of survey questions addressed the perceived educational needs of dental hygienists about diabetes. The first set of questions covered topics of interest for professional continuing education. The continuing education topics of most interest included: an overview of diabetes medications (91.1%) and an update on diabetes along with the current guidelines for the standard of medical care (83.6%). The responses of the participants can be found in Table III. The next set of survey questions explored the delivery modality dental hygienists preferred for the continuing education. Opinions were varied on this question with the majority of people preferring a half-day lecture/participation workshop or self-paced online course (35.3%), followed by a half-day lecture course (28.3), and an interactive online course (27.8%) (Table IV).

**Table III. Continuing Education Needs of Dental Hygienists**

What continuing education topics are of interest to you?	Response (n)	Response (%)
Overview of the medications and diabetes management recommendations	350	91.1%
Overview of diabetes and the guidelines for the standard of medical care	321	83.6%
Strategies for collaborating with health professionals caring for patients with diabetes	295	76.8%
Update on the link between oral health and diabetes	263	68.5%
Basic instruction and practice in using a glucose monitor	255	66.4%
Other (please specify)	21	5.5%

Table IV. Mode for Delivery of Professional Continuing Education for Diabetes

If you are interested in continuing education about diabetes, how would you prefer the information be delivered?	Response (n)	Response (%)
1/2 day lecture/participation workshop	136	35.3%
self-paced online course	136	35.3%
1/2 day lecture course	109	28.3%
interactive online course	107	27.8%
full day lecture/participation workshop	79	20.5%
1-2 hour lecture course	67	17.4%
full day lecture course	59	15.3%
Other (please specify)	9	2.3%

### Qualitative Data

In addition to the quantitative data gathered by the survey, respondents provided comments that may provide further insight into the survey results. The major themes identified in the qualitative data included the value of the survey in identifying the diabetes education needed, importance of being competent in diabetes prevention and management guidelines as health care providers, and importance of educating employers in order to increase the length of appointments as needed to provide comprehensive care to patients with diabetes. The following paragraphs provide excerpts from the respondents' comments.

A number of comments suggested that taking the survey made them realize how much they did not know about diabetes as it relates to oral health (n=10). Example of these comments included the following:

- "This survey makes me realize there is so much to know and that I don't feel prepared enough at this time to provide all the necessary information to my patients. I definitely need to take a CE course devoted specially to diabetes and patient care."
- "Great survey. It got me thinking!"

Other comments expressed the need for oral health care practitioners to be better prepared to address diabetes and oral health as a component of overall health (n=12).

- "As an oral health care provider, it IS our responsibility to speak to our patients about factors affecting their oral health and to provide information to them that can not only improve oral health, but their overall health. After all, WE ARE HEALTH CARE PROVIDERS!"

And finally there were a number of comments suggesting that the dentist needed to be more supportive of exploring the patient's glycemic control before changes would occur in current practices (n=11).

- "The main issue is the DDS. If they don't have the info, if they don't understand the problem, if they don't see the importance, if they don't educate themselves, if they don't feel the need, and if they think the hygienist is there to buff & puff only, then this issue will not see improvement."
- "How to implement a program in the dental practice that the doctors would allow."

### Discussion

Prior to exploration of the findings, it is important to review the limitations of the survey. Lack of random selection of the participants introduces self-selection bias. Those completing the survey may not be representative of all dental hygienists, and, therefore, the results cannot be generalized. Specifically, the demographics of the respondents indicated that the participants had generally been in practice for over 16 years and were in the 41-60 year age range. Therefore, this group of dental hygienists may need more updated information about diabetes prevention and management than more recent graduates of professional programs.

Seventy-five percent of respondents reported 4 or less hours of education about diabetes during their professional career, yet nearly 50% of dental hygienists had pursued 4 or less hours of continuing education about diabetes since graduation. The overall results of the survey seem to suggest that the participants are interested in continuing education on this topic, so increasing the number of diabetes continuing education opportunities as well as variety for the modality of delivery may encourage dental hygienists to increase their diabetes knowledge.

The general diabetes and oral health knowledge of dental hygienists appears to be relatively current based on the survey responses. However, the major deficiency in knowledge for the respondents seemed to be the significance of the patient's glycated hemoglobin (hemoglobin A1c or HbA1c) value. This issue appeared repeatedly in the survey results and is a significant issue since the HbA1c provides information about the patient's long term glycemic control, which in turn may impact the provision of dental care as well as the progression of oral disease.<sup>6,16,17</sup>

Respondents identified a majority of the risk factors (Table V) for diabetes but would benefit from a review of the lesser known risk factors. In particular, 73% of participants did not know polycystic ovary syndrome (PCOS) was a risk factor for diabetes.<sup>17</sup> PCOS is increasingly diagnosed with the current estimates of prevalence being 9-10%.<sup>18,19</sup> PCOS is considered one of the most common endocrine issues in women of child-bearing age with 1 in 15 women being affected.<sup>18,19</sup> Therefore it is incumbent upon dental hygienists to be able to identify PCOS as a possible risk factor for diabetes when reviewing the patient's medical history.

**Table V. Risk Factors and Criteria for Testing for Prediabetes and Diabetes<sup>15</sup>**

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Testing should be considered for all adults who are overweight (BMI  $\geq$  25 kg/m<sup>2</sup>) and have any of the following risk factors:

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- Physical inactivity
  - First degree relative with diabetes
  - Member of high risk ethnic group (e.g. African American, Hispanic/Latino, Native American, Asian American and Pacific Islander)
  - Women who delivers a baby weighing > 9 lbs. or was diagnosed with gestational diabetes
  - Hypertension ( $\geq$  140/90 mmHG or receiving therapy for hypertension)
  - HDL cholesterol <35 mg/dl and/or triglyceride level > 250 mg/dl
  - History of cardiovascular disease (CVD)
  - Polycystic ovary syndrome (PCOS)
  - IGT (Impaired Glucose Tolerance) or IFG (Impaired Fasting Glucose) on a previous OGTT (Oral Glucose Tolerance Test)
  - Clinical conditions associated with insulin resistance (e.g. severe obesity and acanthosis nigricans)
- 

In the absences of risk factors, testing should begin at age 45 years. If results are normal, testing should be repeated at least every 3 years.

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The ability of the dental hygienist to effectively interact with the patient about their diabetes condition and to collaborate with other health professionals is dependent on being familiar with the current classifications for diabetes. The survey responses indicated confusion about the current classifications of diabetes (Table VI) by the Expert Committee on Diagnosis and Classification on Diabetes.<sup>16</sup> This was evidenced by approximately 70% of respondents agreeing with the IDDM and NIDDM classifications, which are no longer used. About 86% of participants agreed with the use of the type 1 and type 2 diabetes classifications. This suggests that either dental hygienists think the old and new classifications are interchangeable or are not aware there has been a change in the classification system for diabetes.

**Table VI. Current Classification of Diabetes**<sup>16</sup>

Classifications	Etiology
Type I Diabetes	B-cell destruction
Type 2 Diabetes	Progressive insulin deficiency often associated with insulin resistance
Other Specific Types of Diabetes	Genetic defects, exocrine defects (such as cystic fibrosis), or drug-induced (e.g. corticosteroids)
Gestational Diabetes	Secondary to pregnancy

In addition to a need for a review of the diabetes classification system, respondents also indicated a need for an update on clinical recommendations for prevention and management of diabetes. Only 18.8% of respondents correctly identified 100-125 mg/dl as being the blood glucose levels used for diagnosis of impaired fasting glucose (IFG).<sup>17</sup> This is of importance for dental health providers because people with IFG and impaired glucose tolerance (IGT) are designated as having prediabetes.<sup>17</sup> Current criteria for diagnosis of prediabetes and diabetes are provided in Table VII. It is not known if people with prediabetes are at increased risk for periodontal disease; however, it is prudent to carefully monitor and maintain oral health to reduce infection and possibly prevent or delay the onset of diabetes.

**Table VII. Criteria for Diagnosis of Prediabetes or Diabetes**<sup>16</sup>

	Prediabetes	Diabetes
<b>FPG</b> Fasting Plasma Glucose (also referred to as IFG-Impaired Fasting Glucose) (Requires an 8 hr. fast and should be repeated on a different day)	100 – 125 mg/dl	≥ 126 mg/dl
<b>Casual plasma glucose</b> (Casual refers to a random glucose value taken at any time)		≥ 200 mg/dl
<b>IGT</b> Impaired Glucose Tolerance (2 hr plasma glucose during OGTT)	140 – 199 mg/dl	≥ 200 mg/dl

The survey responses suggested that only 5% of respondents knew the current clinical practice recommendations for fasting blood glucose (90-130 mg/dl) levels for good glycemic control in adults with diabetes.<sup>16</sup> It is possible that those responding to the question were indicating the normal blood glucose level for a person without diabetes. Twenty-eight percent of respondents knew the current recommendation that an HbA1c test be performed twice per year in those who have stable glycemic control.<sup>16</sup> About 45% of dental hygienists identified the recommendation for the HbA1c goal (<7%) for persons with diabetes.<sup>16</sup> The results of the questions about glycemic control suggest that dental hygienists do not know the current recommendations. This is a concern because this is information that should be routinely gathered from the patient at each dental appointment in order to assess the patient's level of glycemic control, which can impact the ability to heal as well as the risk of more severe periodontal disease.<sup>20</sup> The clinical recommendations for assessing glycemic control are provided in Table VIII.

**Table VIII. Clinical Recommendations for Assessment of Glycemic Control<sup>16</sup>**

	Recommendation	Goals
SMBG (Self-monitoring of blood glucose)	<ul style="list-style-type: none"> <li>• Test 3 or more times/day for those taking multiple insulin injections or using an insulin pump</li> </ul>	
○ Pre-prandial or fasting blood glucose	○ Test first thing in the morning and prior to eating	90-130 mg/dl
○ 2 hour post-prandial blood glucose	○ Test 2 hours after a meal	<180 mg/dl
Hemoglobin A1c	<ul style="list-style-type: none"> <li>• Performed twice annually in those meeting glycemic goals</li> <li>• Performed quarterly in those <u>not</u> meeting glycemic goals</li> </ul>	< 7.0% (recommend non-diabetic range of 4.0-6.0)

A majority of respondents stated a need to learn more about the medications currently being used to manage diabetes. This is not surprising given this is a complex and ever-changing area in diabetes management. Another complexity to the use of diabetes medications is that drugs like metformin and rosiglitazone, previously used to manage diabetes, are now also being used in people with prediabetes to prevent the onset of type 2 diabetes.<sup>21,22</sup> Dental professionals need a basic understanding of diabetes medications to anticipate hypoglycemic episodes. If hypoglycemia occurs, the dental hygienist must know how to manage it quickly to prevent it from escalating to an emergency situation. The survey results incorrectly indicated the best treatment for hypoglycemia was drinking an 8-16 ounce bottle of orange juice (81.9%). The American Diabetes Association recommendation is for 15-20 grams of glucose or a quickly absorbed carbohydrate.<sup>16</sup> Fifteen grams of carbohydrate is equal to approximately ½ cup of orange juice.<sup>23</sup> Overtreating hypoglycemia by administering a large carbohydrate load like that found in 8-16 ounces (1-2 cups) of juice may cause high blood glucose and make it more challenging for the patient to stabilize their blood glucose levels.<sup>24,25</sup>

Most dental hygienists responding to the survey believed that educating, assessing, and referring patients with diabetes was within their scope of practice. However, 55% percent of respondents reported that assessing the glycemic control through consultation with the patient's medical professional was not within their scope of practice. In addition, participants felt least competent in assessing the level of glycemic control when provided with average fasting blood glucose or HbA1c values (50%). It is evident that these respondents need additional diabetes education in order to be able to assess the patient's glycemic control when provided with the fasting blood glucose and HbA1c value. Perhaps the most important information a dental provider should gather from the patient is the HbA1c value because it provides an indication of the long term diabetes control.<sup>16</sup> If the patient does not know this information, ask permission to have that information faxed to the dental office from the patient's primary care physician. Glycemic management should be part of the discussion with the patient as it relates to good oral health. With movement to increase access to oral health care, many state practice acts allow dental hygienists to work with general supervision or unsupervised in alternative practice settings making it critical that the dental hygienist be able to interpret the values used to assess glycemic control.

The survey questions addressing current practices when managing patients with diabetes in the dental office revealed that when reviewing the medical history, the respondents were least likely to ask for fasting blood glucose or HbA1c levels and about any history of hypoglycemia. Patients with type 1 diabetes are at higher risk of hypoglycemia and a history of hypoglycemia is a predictor of future episodes.<sup>26</sup> As discussed earlier, questions about glycemic control are essential to prevent a potential emergency situation with hypoglycemia. Seventy-six percent to 83% of survey participants were not likely to have a glucose monitor in their office or know how to use it. This could be a potential issue in an emergency situation with hypoglycemia since 15 minutes after administering 15-20 grams of carbohydrate, the blood glucose needs to be checked to ensure that it is in the normal range.<sup>26</sup> Even if a patient brings their own glucose monitor from home, they may not be able to check their own blood glucose when they are recovering from a hypoglycemic episode. It is therefore suggested that dental offices have a glucose monitor that the staff is proficient in operating (Table IX). In order to use a glucose monitor in the dental office or clinic, the facility must apply for a CLIA (Clinical Laboratory Improvement Amendments) certificate.<sup>27</sup> Since diagnosis of diabetes is not being conducted, glucose monitoring before or after dental

treatment using a glucometer has been granted a waived status under CLIA.<sup>27</sup> However the waived status requires a biennial fee.<sup>28,29</sup> The form is available through the Centers for Medicare and Medicaid Services, Health and Human Services website [http://www.cms.hhs.gov/clia/01\\_overview.asp](http://www.cms.hhs.gov/clia/01_overview.asp)

**Table IX. Glucose Monitors in the Dental Office**

<b>Rationale for Glucose Monitoring</b>		
<ul style="list-style-type: none"> <li>• Prevention of medical emergency (hypoglycemia)</li> <li>• Identification of hyperglycemia that may impact healing which requires medical referral</li> <li>• Monitoring of a patient recovering from a hypoglycemic event</li> </ul>		
<b>Options for Glucose Monitoring</b>	<b>Advantages</b>	<b>Disadvantages</b>
<ul style="list-style-type: none"> <li>• Patient brings glucose monitor from home</li> <li>• Dental office provides glucose monitor</li> </ul>	<ul style="list-style-type: none"> <li>• Patient knows how to use the monitor and can check their own blood glucose.</li> <li>• No need to apply for waived status under CLIA (Clinical Laboratory Improvement Amendment).</li> <li>• Dental staff can be trained to be proficient with using the glucose monitor.</li> <li>• Staff can easily monitor blood glucose before and after treatment to minimize the possibility of hypoglycemia.</li> <li>• Dental staff can monitor recovery from a hypoglycemic event even if patient is not able to assist.</li> </ul>	<ul style="list-style-type: none"> <li>• Dental staff may not know how to use the monitor if the patient is not able to do so resulting in failure to appropriately manage hypoglycemia.</li> <li>• Must apply and pay a small biennial fee (\$150) for waived status under CLIA.                         <ul style="list-style-type: none"> <li>○ CLIA form available from Centers for Medicare and Medicaid Services, Health and Human Services website <a href="http://www.cms.hhs.gov/clia/01_overview.asp">http://www.cms.hhs.gov/clia/01_overview.asp</a></li> </ul> </li> </ul>

The strongest barrier to incorporating diabetes education identified by survey participants was associated with the use of a glucose monitor. A less significant barrier for about 50% of respondents was the time involved in providing education and lack of educational materials. There are many educational resources available to health professionals on the National Diabetes Education Program website <http://www.ndep.nih.gov> and the American Diabetes Association website <http://www.diabetes.org>. A list of resources for educational materials could be provided on the AHDA website and during professional education courses to provide easy access to dental professionals.

Dental hygienists responding to the survey demonstrated a strong desire to increase their knowledge of diabetes (84-91%) with additional continuing professional education. Opinions on how this education should be delivered were varied with approximately 35% of respondents expressing a preference for a half-day workshop or a self-paced online course.

## Conclusion

Given the increasing incidence of diabetes in the United States and the risk for more severe periodontal disease in individuals with poorly controlled diabetes, it is essential to provide access to regular professional education to prepare oral health providers to care for this population. The sample of dental hygienists in this survey demonstrated a need for enhancing knowledge about diabetes as it applies to clinical patient care. In particular, the areas of greatest need include knowledge about American Diabetes Association Clinical Practice Guidelines for standards of care, diagnosis of diabetes mellitus, and best practices for interacting with other health professionals caring for people with diabetes. As diabetes prevention, diagnosis, management, and treatment continue to advance things like continuous glucose monitoring, insulin pumps, and islet cell transplantation will become more common place and require the dental hygiene educator and clinician to enhance their knowledge about diabetes. Professional education will increase confidence and competence, thereby enhancing the importance of the role of dental hygienists on the multidisciplinary diabetes care team. A variety of educational modalities should be considered to ensure access so that dental hygienists are prepared to support patients with prevention and management of diabetes.

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## Notes

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## Mouthguards in the American Hockey League [AHL]

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**Purpose.** *To examine the orofacial injuries and attitudes toward mouthguards reported by professional ice hockey players of the American Hockey League [AHL].*

**Methods.** *A survey was created and sent to the certified athletic trainers [ATC] of 23 AHL teams. A total of 25 questions were posed regarding age, position, orofacial injury, frequency of prophylaxis by a dental hygienist and methods to clean a mouthguard. The influence and responsibility of professional athletes as role models was also explored.*

**Results.** *A total of 344 surveys of the original 394 surveys [87.3%] were returned. Three hundred twenty-four [82.2%] were acceptable for analysis. All respondents were male, with 74% between the ages of 19 and 25. Almost all players [93.8%] had been advised to wear a mouthguard, with a parent / family member first to advise on their use. Approximately 67.3% of players reported wearing a mouthguard in some capacity. Of those who did not, 31% stopped wearing a mouthguard upon arrival into the AHL. Dental injuries were numerous, occurring within 63.3% of ice hockey players. The most frequently reported injury was chipped teeth. As professional athletes, 88.6% consider themselves role models.*

**Conclusion.** *It is recommended that mouthguards be mandated within the professional arena as the prevalence of orofacial injuries remains a concern within ice hockey. Emphasis should be placed on educating health professionals of all disciplines who interact with athletes, as well as utilizing the promotional power of professional athletes.*

**Keywords:** *AHL, attitudes, ice hockey, mouthguards, orofacial injury*

### Introduction

In light of several national publications, most notably Oral Health in America: The Surgeon General's Report, Healthy People 2010 Goals and Objectives,<sup>1,2</sup> as well as the recommendations of professional organizations<sup>3-12</sup> the wide reaching effects of dental injury have been documented.<sup>1,13</sup> Therefore, this study was conducted to gauge the attitudes, usage and outcomes of mouthguards in professional ice hockey players of the American Hockey League [AHL].

The 2000 Report of the Surgeon General attributes the leading causes of oral and craniofacial injuries to "sports, violence, falls and motor vehicle collisions," and elaborates further, stating "oral-facial injuries can bring disfigurement and dysfunction, greatly diminishing the quality of life and contributing to social and economic burdens."<sup>1</sup> Healthy People 2010 listed injury and violence prevention as one of the top ten leading health indicators, with objective 15-31 dedicated to "Increase the proportion of public and private schools that require use of appropriate head, face, eye, and mouth protection for students participating in school-sponsored physical activities."<sup>2</sup>

Ten key dental associations: the Academy of General Dentistry [AGD]<sup>3</sup> American Association of Endodontists [AAE]<sup>4</sup>, the American Association of Orthodontists [AAO]<sup>5</sup>, the American Association of Oral and Maxillofacial Surgeons [AAOMS]<sup>6</sup>, the American Academy of Pediatric Dentistry [AAPD]<sup>7</sup>, the American Dental Association [ADA]<sup>8</sup>, the American Dental Hygienists' Association [ADHA]<sup>9</sup>, the Academy for Sports Dentistry [ASD]<sup>10</sup>, the Canadian Dental Association [CDA]<sup>11</sup> and the Canadian Dental Hygienists Association [CDHA]<sup>12</sup> are comprised of experts in their respective fields who promote injury prevention through mouthguard education and mandates.

The AAOMS and the ADA have recommended mouthguard use in 30 sports. They are acrobatics, baseball, basketball, bicycling, boxing, equestrian events, extreme sports, field events, field hockey, football, gymnastics, handball, ice hockey, inline skating, judo, lacrosse, martial arts, racquetball, rugby, skateboarding, skiing & snowboarding, skydiving, soccer, softball, squash, surfing, volleyball, water polo, weightlifting, and wrestling.<sup>6,8</sup>

### ***Youth and Sports Safety***

Prevention of Sports-related Orofacial Injuries, a 2006 policy generated by the AAPD, reports that approximately 46 million youth in the United States are involved in "some form of sports," further specifying that approximately 30 million children participate in organized programs.<sup>14</sup> In children, dental injuries were reported in 10-39% of sports accidents, with the most common injury [50-80%] involving the maxillary incisors.<sup>14</sup>

Since 1993, the National Youth Sports Safety Foundation [NYSSF] has raised awareness on issues such as eating disorders, emotional injuries, coaching education, and safety equipment through its campaign, "April is National Youth Sports Safety Month."<sup>15</sup> Beginning in the year 2000, the AAO, the AAOMS, and the AAPD collaborated to promote the use of helmets and mouthguards in their annual campaign, "April is National Facial Protection Month."<sup>16</sup>

### ***High School Sports and Mouthguards***

The governing body of high school activities, the National Federation of State High School Associations [NFHS], mandates the use of mouthguards within football, ice hockey, and lacrosse.<sup>17,18,19</sup> In 2006, NFHS provided more explicit guidelines regarding the visibility of mouthguards within football and ice hockey. The Official Rule Book states that "All tooth and mouth protectors shall be a color other than completely clear or white. The officials should, through normal observations, attempt to verify that each player is legally equipped prior to the ball becoming alive and if illegal equipment is detected, that player must fix the problem or leave the game."<sup>17,18</sup> In addition, ice hockey players must keep their mouthguard attached to their facemask at all times.<sup>18</sup>

Individual leagues, conferences, or states have the option to mandate athletic teams to wear mouthguards. The Massachusetts Interscholastic Athletic Association [MIAA] has taken the lead by requiring mouthguards in 7 school sponsored activities: basketball, field hockey, football, ice hockey, lacrosse, soccer, and wrestling.<sup>20</sup>

### ***College Sports and Mouthguards***

The National Collegiate Athletic Association [NCAA] currently oversees 360,000 student-athletes participating at 1,200 institutions within 3 divisions. Of its 23 intercollegiate sports, mouthguards are mandatory within only 4: field hockey, football, ice hockey, and lacrosse.<sup>21</sup> In 1990, additional appliance specifications were imposed stating that the mouthguard was to be "of any readily visible color [not white or transparent] with FDA approved base materials that covers all upper teeth."<sup>21</sup>

### ***Professional Sports and Protective Gear***

*ECHL*

The *ECHL*, formerly known as the East Coast Hockey League, serves as the developmental affiliate for the *AHL* and is comprised of 23 teams.<sup>22</sup> As defined within The Official Rule Book, "All players of both teams shall wear a helmet and visor of design, material and construction approved by the League at all times while participating in a game, either on the playing surface or the players' or penalty benches."<sup>23</sup>

#### *AHL*

The *AHL* serves as the developmental affiliate for the National Hockey League [*NHL*] and is comprised of 27 teams. The 6 month season runs from October through April.<sup>24</sup> Beginning with the 2006-2007 season the *AHL* moved to mandate visors.<sup>25</sup> The Official Rule Book states:

All players of both teams shall wear a helmet and clear protective visor of design, material and construction acceptable to the Competition Committee at all times while participating in a game, either on the playing surface or the players' or penalty benches. The helmet and visor must not be worn tilted back such that the protective capacity (integrity) of the visor is diminished... While the choice of visor model and manufacturer is left to the player; it is recommended that for optimal protection the bottom of the visor come to the tip of the nose.<sup>26</sup>

#### *NHL*

The world's elite professional hockey league, the *NHL*, is comprised of 30 teams throughout the United States and Canada.<sup>27</sup> The Official Rule Book declares helmets as the only piece of craniofacial safety equipment required and "All players of both teams shall wear a helmet of design, material and construction approved by the League at all times while participating in a game, either on the playing surface or the players' or penalty benches."<sup>28</sup> The *NHL* maintains a reactive stance on injury prevention with players given the option to wear a mask following facial injury.<sup>28</sup>

As illustrated above, The Official Rule Books of the *ECHL*, *AHL*, and *NHL* are devoid of any language pertaining to mouthguards.

#### *Hockey Canada*

Hockey Canada is the national governing body of ice hockey in Canada. The organization upholds their mission "Lead, Develop, and Promote Positive Hockey Experiences" while managing 13 regional branches of players ages 5-20.<sup>29</sup> In addition, Team Canada participates in the Deutschland Cup, International Ice Hockey Federation [IIHF] World Championships, Loto Cup, Sweden Hockey Games, Spengler Cup and the Winter Olympic Games. Beginning with the 2000-2001 season, Hockey Canada required all amateur hockey teams to implement the Hockey Canada Safety Program. Each team provided a representative who received training in topics such as abuse / bullying, first aid, protective equipment, and stretching.<sup>30</sup>

The Referee's Case Book states that all players and goaltenders must wear a "CSA [Canadian Standards Association] approved hockey helmet, to which a CSA approved facial protector, must be securely attached and not altered in any way."<sup>31</sup> For those divisions that allow the half visor, the use of a mouthguard is compulsory.<sup>31</sup> Referees have authority to issue team penalties when a player wears a mouthguard improperly or carelessly.<sup>31</sup>

#### *USA Hockey*

USA Hockey, Inc. is a national organization promoting the sport of ice hockey through relations with coaches, parents, players, and officials.<sup>32</sup> Activities include the expansion of grassroots hockey programs, the sponsorship of skill development camps / national tournaments and recommendations regarding protective equipment. The organization prepares the men's and women's teams for International World Championships and the Winter Olympic Games. USA Hockey partners include the International Ice Hockey Federation [IIHF], the National Collegiate Athletic Association [NCAA], the National Hockey League [*NHL*], and the United States Olympic Committee [USOC]. The Official Rules require all male and female players and goalkeepers under the age of 19 to wear "a colored (nonclear) internal mouthpiece covering all teeth of one jaw,

customarily the upper" with a "facemask and chinstrap certified by the Hockey Equipment Certification Council [HECC]."<sup>33</sup> USA Hockey encourages players to obtain the form-fitted mouthpiece from a dentist and strongly recommends all players continue to uphold these policies throughout their career.<sup>33</sup>

## **Review of Literature**

### ***History of Mouthguards***

The earliest mention of the mouthguard, previously referred to as a "gum shield," dates back to 1890 when Woolf Krause, a London dentist, originally fabricated the device of gutta percha. His son, dental counterpart and amateur boxer Philip Krause, primarily utilized the appliance to prevent lip lacerations.<sup>34</sup> Thomas Carlos, a Chicago dentist, manufactured the first mouthguard in the United States in 1916.<sup>34</sup> Mouthguards became mandatory in the boxing arena by the 1930s, while high school football followed suit in 1962.<sup>35</sup>

As dentistry has progressed, the materials used to fabricate custom-fitted mouthguards have improved. A number of materials have been tested alone or in combination pursuing convincing results in mouthguard attributes such as hardness, shock-absorbing capability, stiffness, tear strength, tensile strength and water absorption.<sup>35</sup> Polyvinyl chloride, latex rubber, acrylic resin, and polyurethane are examples of former mouthguard materials. Ethylene vinyl acetate is most widely used today.<sup>35</sup> Despite differing levels of protection offered by various materials, the use of any mouthguard provides orofacial protection not present otherwise.<sup>36</sup>

### ***Athletic Injuries***

The Centers for Disease Control and Prevention [CDC], Morbidity and Mortality Weekly Report [MMWR] indicates that "approximately one third of all dental injuries and approximately 19% of head and face injuries are sports-related."<sup>37</sup> Burt and Overpeck found that individuals aged 5-24 years accounted for 2.6 million of the 3.7 million emergency department visits for sports related injuries among persons of all ages.<sup>38</sup> It is estimated that for each avulsed tooth that is not able to be salvaged or properly re-implanted, approximately \$10,000-\$15,000 of cost will be amassed over a lifetime.<sup>13</sup>

A study of 282 Junior 'A' Hockey players by Stuart et al. analyzed the correlation between injuries amassed and extent of facial protection [full cage, half shield, none] present. The quantity of injuries increased as the level of facial protection decreased.<sup>39</sup> As a result, 52 injuries occurred in players wearing no facial protection, 45 injuries were documented for those wearing partial facial protection, and only 16 injuries were noted for those wearing full facial protection.<sup>39</sup> In those players wearing full facial protection, no eye or neck injuries occurred.<sup>39</sup>

Flik et al. analyzed the injuries of 8 NCAA Division I ice hockey teams during a season. Concussions were the most common injury, accounting for 18.6% of all injuries.<sup>40</sup>

Lahti et al. evaluated the cause and nature of dental and maxillofacial injuries of ice hockey players in Finland. Data was collected from insurance records of 479 players with a non-complicated crown fracture deemed the most common injury.<sup>41</sup> Orofacial protection was utilized in only 10% of players. The authors made recommendations to encourage mandatory facial protection and mouthguard use.<sup>41</sup>

Bemelmans and Pfeiffer created and distributed a questionnaire to top German athletes to evaluate attitudes toward mouthguards and incidence of orofacial injuries. Orofacial injuries occurred in 32% of the athletes surveyed.<sup>42</sup> Complaints were reported with boil and bite mouthguards on the inability to speak [19.9%], comfort / fit [4.8%] and breathing difficulty [3.4%].<sup>42</sup> The authors recommended athletes receive information on the benefits of a custom-made mouthguard.<sup>42</sup>

Lieger and von Arx studied the frequency of cerebral and orofacial injuries among professional athletes [basketball, handball, ice hockey, and soccer] in Switzerland. Athletes were surveyed regarding their injuries and mouthguard habits. Eighty-four percent of athletes did not wear a mouthguard.<sup>43</sup> Ice hockey accounted for the highest incidence of orofacial injuries when athletes did not wear a mouthguard at 59%, followed by soccer with 24%.<sup>43</sup> In addition, Lieger and von Arx questioned officials on their willingness to issue penalties to athletes who did not wear a mouthguard. Despite awareness of the infraction, officials revealed a reluctance to issue penalties for non-compliance. The authors encouraged students to pursue sports medicine and sports dentistry education with great emphasis placed on generating team dentists.<sup>43</sup>

### ***Attitudes / Compliance / Enforcement***

Walker et al. evaluated three soccer teams comprised of 7 and 8 year old children. The study randomly assigned each team with a stock, boil and bite, or custom-fitted mouthguard. The study found over 80% of the children wearing the boil and bite and custom-fitted mouthguards were "happy" or "enthusiastic" about its use.<sup>44</sup> The children wearing the stock mouthguard had negative feelings toward the appliance. Although 95% of parents understand that mouthguards aid in preventing injury, only 24% expressed a willingness to purchase the device for their child.<sup>44</sup> The study emphasized the need for education of parents and athletes regarding the benefits and comforts of a custom-fitted mouthguard.

Miller et al. conducted a survey of Michigan high school ice hockey players and mouthguard use. A discrepancy in compliance was found with 80.3% of players wearing a mouthguard during games, but only 25.6% of players wearing one during practice.<sup>45</sup> A lack of education was cited, suggesting that coaches, parents, and healthcare professionals take on a greater role in delivering information about mouthguards.<sup>45</sup>

Berry et al. surveyed ice hockey players of the Central Collegiate Hockey Association [CCHA] on their player position, exposure to mouthguard education and mouthguard use. A correlation was substantiated between player position and mouthguard stance with "defensive players having more negative attitudes toward mouthguard usage compared to offensive players."<sup>46</sup>

Hawn et al. investigated the rate of mouthguard use as reported by certified athletic trainers [ATCs] of NCAA Division I, II, and III ice hockey teams. A large percentage of athletic trainers [93%] thought that mouthguards held a place in injury prevention; however, only 63% of their players regularly wore mouthguards in competition.<sup>47</sup>

Maestrello et al. surveyed 2,500 Virginia dentists on their pattern of mouthguard recommendation. Of those sampled, 97% of orthodontists, 84% of pediatric dentists, and 67% of general dentists recommended mouthguards to their athletically inclined patients.<sup>48</sup> Those dentists who did not recommend a mouthguard cited their lack of formal instruction on device fabrication as well as the patient's perceived financial burden.<sup>48</sup>

## **Methodology**

### ***Subjects***

The certified athletic trainer [ATC] for each of the 27 *AHL* teams was contacted to introduce the research study and to request participation. Three teams could not be contacted and an additional team was prohibited from participating by their *NHL* parent organization. The remaining 23 teams throughout the United States and Canada agreed to participate. The sample was estimated to include 394 players based on the cumulative number of surveys requested by the ATCs.

Each participating *AHL* team received a packet, via mail, containing a cover letter, statement of intent, and surveys requested. This occurred between January and March 2007. Each packet also included a self-addressed stamped envelope to encourage participation and expedite response time. A variety of donated oral hygiene samples were offered to the ATC and participants upon receipt of the completed surveys.

### Instrumentation and Measurement

Each ATC was instructed to present the statement of intent prior to administering the surveys. The statement introduced the researcher and the rationale behind the study.

Participants were asked to complete the survey to the best of their ability, keeping in mind that dental injuries should only be listed if the injury occurred while practicing or playing ice hockey. Following the introduction, the 5-page survey was to be distributed (Figure 1a, 1b, 1c, 1d). It was estimated to take between five and ten minutes to complete.

Figure 1

**Mouthguards in the American Hockey League**

1. How old are you?

<input type="checkbox"/> ≤ 18	<input type="checkbox"/> 33 – 39
<input type="checkbox"/> 19 – 25	<input type="checkbox"/> 40 +
<input type="checkbox"/> 26 – 32	

2. I value dental health. Mark only ONE.

<input type="checkbox"/>				
Strongly disagree	Disagree	No Opinion	Agree	Strongly agree

3. How would you BEST describe your dental / oral health?

- Excellent
- Good
- Fair
- Poor

4. My MOST recent dental visit was for a/an \_\_\_\_\_. Mark only ONE.

- Cleaning
- Emergency
- Screening

5. How would you BEST describe the frequency of your dental cleanings by a dental hygienist?

- Every 3 months
- Every 6 months
- Once a year
- Rarely
- Never

6. How many years have you been playing organized ice hockey such as Youth League, High School, Juniors, AHL?

<input type="checkbox"/> ≤ 5	<input type="checkbox"/> 21 – 25
<input type="checkbox"/> 6 – 10	<input type="checkbox"/> 26 – 30
<input type="checkbox"/> 11 – 15	<input type="checkbox"/> 30 +
<input type="checkbox"/> 16 – 20	

7. What position do you currently play?

- Defense
- Forward
- Goalie

8. In your opinion, is "toothless" an accurate portrayal of a hockey player?

<input type="checkbox"/> Yes	<input type="checkbox"/> No
------------------------------	-----------------------------

9. Have you EVER been advised to wear a mouthguard?  
 Yes  No

If yes, Who first advised you to wear a mouthguard? Mark only ONE.

- Athletic Trainer  
 Coach  
 Dental Professional [Dentist, Dental Hygienist, Orthodontist]  
 Parent / Family Member  
 Teammate  
 Other: \_\_\_\_\_

10. Do you currently own a mouthguard?

- Yes  No

If yes, What type of mouthguard?

- "One Size Fits All"  
 Boil & Bite  
 Custom Made

If no, Have you EVER owned a mouthguard?

- Yes  
 No

11. When did you first obtain a mouthguard? Mark only ONE.

- After Injury  
 Before Injury  
 Mandatory requirement from Coach, League, School  
 Do not own a mouthguard

12. Do you wear a mouthguard?

- Yes



- No

If no, When did you STOP wearing one?

- Upon arrival into the AHL

- Other: \_\_\_\_\_ [Skip to # 16]

If yes, When?

- Games and practice  
 Games only  
 Practice only

13. How would you BEST describe your mouthguard use?

- Always  
 Most times  
 Sometimes  
 Rarely

14. Why do you wear a mouth guard? Mark ALL that apply.

- Mandatory  Protect previous dental work  
 Protect teeth  Recommendation  
 Prevent concussions  Other: \_\_\_\_\_  
 Previous injury

15. Do you clean your mouthguard?  
 Yes  No

If yes, What method / products do you use? Mark ALL that apply.

- |  |  |
|--|--|
| <input type="checkbox"/> Rinse with cold water | <input type="checkbox"/> Toothbrush and toothpaste |
| <input type="checkbox"/> Rinse with hot water  | <input type="checkbox"/> Toothbrush only           |
| <input type="checkbox"/> Soak in mouthwash     | <input type="checkbox"/> Other: _____              |
| <input type="checkbox"/> Soak in water         |  |

16. Have you EVER experienced a dental injury as a result of playing ice hockey?  
 Yes  No

If yes, Mark ALL that apply.

- |  |   |
|--|---|
| <input type="checkbox"/> Avulsed [knocked-out] teeth | <input type="checkbox"/> TMJ problems [joint that allows you to open / close mouth] |
| <input type="checkbox"/> Chipped teeth               | <input type="checkbox"/> Other: _____   |
| <input type="checkbox"/> Fractured teeth             |   |
| <input type="checkbox"/> Jaw fractures               |   |

17. To the best of your knowledge, how was your dental injury treated? Mark ALL that apply.

- |   |                                       |
|---|---------------------------------------|
| <input type="checkbox"/> Bonding                    | <input type="checkbox"/> Implant      |
| <input type="checkbox"/> Crowns / "Caps" / Veneers  | <input type="checkbox"/> Oral Surgery |
| <input type="checkbox"/> Fixed Bridge               | <input type="checkbox"/> Root Canal   |
| <input type="checkbox"/> Flipper / Removable Bridge | <input type="checkbox"/> Other: _____ |

18. Have you EVER had a concussion as a result of playing ice hockey?  
 Yes  No

If yes, Were you wearing a mouthguard at the time of injury?

- Yes  No

19. In your opinion, how often should a mouthguard be replaced?
- After injury       At the start of every season  
 1 - 6 months       7 - 11 months  
 Once every year       When damaged
20. Rank the following safety equipment [1-6] in the order of importance to you.  
 1 = MOST important, 6 = LEAST important
- \_\_\_\_ Athletic Supporter  
 \_\_\_\_ Gloves  
 \_\_\_\_ Helmet  
 \_\_\_\_ Mouthguard  
 \_\_\_\_ Pads [Shoulders, Elbows, Shin]  
 \_\_\_\_ Visor
21. Who would you prefer to provide education about mouthguards? Mark only ONE.
- Athletic Trainer  
 Coach  
 Dental Professional [Dentist, Dental Hygienist, Orthodontist]  
 Other: \_\_\_\_\_
22. Do you believe that promotion / advertising should be done to encourage mouthguard use in ice hockey?  
 Yes       No  
 If yes, Rank the following methods [1 - 7] in the format the information should be delivered.  
 1 = MOST effective, 7 = LEAST effective
- \_\_\_\_ Billboard  
 \_\_\_\_ Health Fairs  
 \_\_\_\_ Internet / E-mail / Website  
 \_\_\_\_ Magazines [Advertisements or Articles]  
 \_\_\_\_ Public Service Announcements  
 \_\_\_\_ Tournament Booths  
 \_\_\_\_ TV Commercials
- Other suggestions? \_\_\_\_\_
23. Do you, as a professional athlete, consider YOURSELF to be a role model?  
 Yes       No
24. Children and teens are influenced by viewing professional athletes wearing mouthguards.
- |                          |                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> |
| Strongly disagree        | Disagree                 | No Opinion               | Agree                    | Strongly agree           |
25. Professional athletes have a responsibility to set the example for today's youth.
- |                          |                          |                          |                          |                          |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> |
| Strongly disagree        | Disagree                 | No Opinion               | Agree                    | Strongly agree           |

Thank you!

The survey was comprised of 25 questions. The first section addressed demographics and the value placed on dental health. Questions were posed regarding age, current position, and number of years playing organized ice hockey. Participants were asked to provide the reason for their most recent dental visit and the frequency of their professional dental cleanings. A Likert scale question allowed the participants to evaluate their own dental / oral health status.

The second section addressed the ownership, use and habits regarding mouthguards. It gathered specifics on who initially recommended their use, when [practice / games] they were worn, how often, and why they were being used. Participants were also asked how and when they clean and replace their mouthguard, respectively.

The third section investigated dental injuries, concussions, and safety equipment. Participants were asked to report to the best of their ability the orofacial injuries they had suffered and the treatment they had received. In addition, the survey asked participants to rank standard ice hockey safety equipment [athletic supporter, gloves, helmet, mouthguard, pads, and visor] in the order of importance to them.

The final 5 questions examined education and promotion of mouthguards. The influence of professional athletes as role models and their responsibility to set a positive example to children and teens was also explored.

Survey data was entered into an Excel spreadsheet and a statistical analysis was performed. Results of this study were anonymous; no player or team was named.

## **Results**

Of the 394 surveys mailed to 23 *AHL* teams, 344 surveys from 18 teams were returned. A total of 324 surveys were deemed acceptable for analysis with a final response rate of 82.2% [324/394]. The sample was comprised of professional male ice hockey players with 74% of players between the ages of 19 and 25. The sample included 191 forwards, 110 defenders and 23 goalies.

Ninety percent [n=292] of respondents agreed or strongly agreed with the statement "I value dental health." Participants were also asked to evaluate their own dental / oral health status. The majority of players [69.4%] felt that the best description of their dental / oral health was "good." Less than one percent [n=2] responded "poor." A total of 240 participants responded that a cleaning was the reason for their most recent dental visit. Additional responses included "a week ago," "jaw check," "February 28," "filling," "summer 2006" and "wisdom teeth."

Thirty-one percent [n=102] of ice hockey players reported their frequency of a dental prophylaxis by a dental hygienist to be every six months, while 58.3% [n=189] responded once a year.

When participants were asked whether or not they believed that "toothless" was an accurate portrayal of a hockey player, 39.1% [n=127] of respondents agreed with this stereotype while 60.8% [n=197] did not.

Almost all players [93.8%] had been advised to wear a mouthguard, with a parent / family member [n=110] first to advise on their use. Other individuals responsible for advising on mouthguard use were reported as "girlfriend," "league," "organization," and "self." The most common reason [n=144] for first obtaining a mouthguard was a mandatory requirement by a coach, league, school, or team.

A total of 245 ice hockey players [75.6%] reported owning a mouthguard. Of these, 238 were custom-made mouthguards, 5 were boil and bite mouthguards and 2 were stock mouthguards. While 79 participants did not currently own a mouthguard, 64 stated they had previously owned one. Approximately 67.3% of ice hockey players wore a mouthguard in some capacity. Forwards had the highest percentage of wear at 74.8% [n=143/191] while the percentage of wear for defenders was slightly less at 66.4% [n=73/110]. Only two goalies reported wearing a mouthguard, accounting for the lowest rate of compliance at 8.7% [n=2/23].

Of the 241 players between the ages of 19 and 25, 68.4% [n=165] reported wearing a mouthguard; this was the highest rate of mouthguard use among all age groups. Only 28 players reported wearing the appliance during both games and practice, as the majority of mouthguards were worn only in games [86.2%].

Of those individuals who received a dental prophylaxis every 6 months, 71.5% [n=73/102] wore a mouthguard. Of those ice hockey players who reported a cleaning every year, 67.1% [n=127/189] reported wearing a mouthguard. Of the individuals who admitted to "rarely" getting their teeth cleaned, 51.8% [n=14/27] admitted to wearing a mouthguard. Lastly, of the four ice hockey players who had never had their teeth cleaned, two reported wearing a mouthguard.

Of those who did not wear a mouthguard, 33 [31%] ceased wearing one upon arrival into the *AHL*. Seventy-three participants reported when they stopped wearing a mouthguard: "3rd year pro," "15 years ago," "college," "*ECHL*," "forgot it after trade," "I am goalie," "juniors," "never wore one," and "OHL-Ontario Hockey League."

"Protecting the teeth" topped the list of reasons why ice hockey players wear a mouthguard, followed closely by "preventing concussions." Additional reasons to wear a mouthguard were reported as "just do" and "braces gave me a great smile."

One hundred seventy-five ice hockey players reported cleaning their mouthguard with differing methods and products, while 43 [19.7%] admitted they did not. "Soaking in mouthwash" was totaled as the most common cleaning technique [n=86], while rinsing the mouthguard with hot and cold water was also done. Only *one* individual reported using a toothbrush and toothpaste to clean their mouthguard. Written responses included the use of "cleaning soap" and "soaking in Gatorade."

Dental injuries were numerous, occurring within 63.3% [n=205] of ice hockey players. Forwards reported the highest incidence of injury at 68% [n=130/191] while 61% [n=67/110] of defenders accrued injuries. Injury was reported within 34.7% [n=8/23] of goaltenders.

The most frequently reported injury was chipped teeth [n=160], followed by avulsed teeth [n=65], fractured teeth [n=61], TMJ problems [n=20] and jaw fractures [n=16]. Injuries were most commonly repaired with crowns [n=86], followed by bonding [n=78], root canals [n=62], flippers [n=30], fixed bridges [n=21], oral surgery [n=20], and implants [n=18]. Additional written responses regarding treatment included, "filled in," "minor, nothing been done," "sealant," "splint," "too small to fix," and "surgery on TMJ." One hundred eighty-five ice hockey players reported experiencing a concussion, with 61% [n=113] wearing a mouthguard at the time of injury.

Approximately 30% [n=98] of ice hockey players believed that a mouthguard should be replaced at the start of every season, and 22% [n=72] alleged once every year was sufficient. Six individuals felt that a mouthguard should be replaced at the start of every season and when damaged.

Participants were asked to rank standard safety equipment with the number "1" assigned to the most important item and the number "6" assigned to the least important item. The helmet was found to be the most important receiving 66.8% [n=189] of "1" votes. This was followed by the athletic supporter with 17.3% [n=49], pads at 11% [n=31], visor with 2.5% [n=7], and gloves with 1.8% [n=5]. Mouthguards received only two "1" votes representing the least important piece of safety equipment [ $< 1\%$ ].

Forty-nine percent of professional ice hockey players would prefer ATCs to provide education about mouthguards while 43% chose a dental professional [dentist / dental hygienist / orthodontist]. Approximately 8.6% [n=28] of players thought coaches or others would be appropriate including "medical doctor," "nobody," "no one, personal decision," and "yourself."

Approximately 58.6% [n=190] of participants believe advertising / promotion should be done to encourage mouthguard use within the sport. Overall, ice hockey players believe TV commercials constitute the most effective means of promoting mouthguards. Other suggested methods of advertising were, in order, magazines, internet, public service announcements, tournament booths, and lastly, health fairs and billboards. Five additional suggestions were offered including "come around and talk to teams," "discounts for players," "dressing room advertisements," "explaining benefits," and "representative talk to minor league hockey - kids." One player commented further, "I think everybody understands the benefits of wearing protection but many who opt not to, do so out of preference. It's easier to breathe and communicate, which are very important for hockey players."

A total of 287 [88.6%] ice hockey players consider themselves role models, with 69.1% agreeing or strongly agreeing that children and teens are influenced by viewing professional athletes wearing mouthguards. Furthermore, 85.8% [n=278] of the ice hockey players felt professional athletes have a responsibility to set an example for today's youth.

## **Discussion**

The findings of this study concur with the findings of other studies which have highlighted the deficiency of mouthguard education and high rate of injuries within the sport of ice hockey.<sup>13,15,30,34,39,40-48</sup> These claims were substantiated within the *AHL* with numerous orofacial injuries and concussions coupled with irregular use of mouthguards. Almost all players [93.8%] had been advised to wear a mouthguard, but consistent use and care of the appliance was not stressed. Players should be encouraged to wear the mouthguard during both practice and games for ultimate protection. Additional education should be focused on the maintenance and cleansing of the device. Players must be advised to avoid hot water, sunlight and alterations that can lead to distortion, thus decreasing the effectiveness of the mouthguard.<sup>3,12,49,50</sup>

Many participants remarked that their first exposure to mouthguards was through a parent / family member or ATC. A lack of continuity and regularity in receiving dental care may play a role in the lack of recommendations by dental professionals. The percentage of individuals wearing a mouthguard was directly proportional to the frequency of professional dental cleanings. Forwards and defenders averaged a similar rate of mouthguard use, while goalies' rate of compliance was poor. This finding was aligned with attitudes of ATCs who believed goalies would be exempt from participating in

the survey. It appears that the presence of a face mask persuades many ice hockey goalies to view the use of a mouthguard as excessive and redundant protection.

A number of participants confessed that they did not wear a mouthguard in youth leagues, high school and college where supposedly strict rules currently exist.<sup>17,18,19,20,21</sup> This dilemma is due in part to the fact that coaches and officials fail to hold players accountable for non-compliance.

Upon entering the ranks of professional ice hockey, another decline in mouthguard use was noted. At a time when the risk of injury is highest, the amount of required safety equipment is lowest. The overwhelming choice of helmets as the most important piece of safety equipment is not surprising considering their requirement in every ice hockey league.<sup>23,26,28,31,33</sup> Therefore, to aid in reducing the incidence and severity of orofacial injuries, it is recommended that mouthguards be elevated to mandatory status in the *AHL* and all professional affiliates.

Since *AHL* ice hockey players deemed TV commercials as the most effective means to promote mouthguards, it is only appropriate that they headline this advertisement. The presence of a recognizable professional athlete may elevate the weight of the recommendation due to their esteem and visibility in the public arena. Most notably, this commercial has the potential to reach a diverse demographic [age, ethnicity, socioeconomic status] targeting those who do not have access to a healthcare provider.

It is recommended that this study be replicated among male and female ice hockey players within various levels of competition. Future research should target the function of mouthguards in concussion prevention as no substantial evidence exists on this topic.

### ***Limitations***

The ebb and flow of players defines the partnership between the *ECHL*, *AHL*, and *NHL*. This quality allows players to be "called up" or "sent down" to replace others resolving injury, illness, performance, or personal matters. In addition, the *NHL* trade deadline [February 27, 2007] may have reduced those available to complete the survey, decreasing the purposive sample size. In the future, surveys should be distributed at the start of the season [October] to minimize the interruption of "call ups," injuries and playoff scheduling.

Due to time constraints and financial resources, all data was self-reported and clinical examinations were not conducted. Therefore, restorative materials and prosthetic appliances may have been incorrectly identified by survey participants. Digital photographs, radiographs, Current Dental Terminology [CDT] coding and dental records would have provided the most accurate documentation of injury and treatment.

### **Conclusion**

Despite mouthguard use, the prevalence of dental injury remains a concern within the sport of ice hockey. Although restoration is possible, it is time consuming and less desirable than initial efforts of prevention.

In an attempt to preserve the endurance of the *AHL* and its players, it is recommended that mouthguards become mandatory safety equipment. Emphasis should also be placed on educating health professionals of all disciplines who interact with athletes of all ages [ATCs, coaches, dentists / dental hygienists, health / physical education teachers, pediatricians, physical therapists and school nurses] so they can become an integral safety advocate to those individuals the "6 month recall" fails to reach. Moreover, advertisements utilizing professional role models should be implemented to encourage athletes to keep playing... *safely*.

### **Update**

2007-2008: The American Hockey League expanded to 29 teams.

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## **Notes**

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## **Clinical and antibacterial effectiveness of three different sealant materials**

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***Purpose.*** *The aim of this work is to study and compare the retention rate, caries-preventing and antibacterial effects of resin-modified glass ionomer and flowable composite in comparison to conventional fissure sealant.*

***Methods.*** *Forty-five children aged 7-10 years with newly erupted lower first permanent molars were randomly divided into three equal treatment groups. Group I: sealed by a conventional resin sealant; Group II: sealed by resin modified glass ionomer (RMGI); and Group III: sealed by flowable composite. Retention and caries status of the sealed teeth were recorded after 1 month, 6 months, year and 2 years. In addition, Streptococcus mutans counts were assessed at baseline, 1 day, 1 month, 6 months, 1 year and 2 years after sealant application. Data were analyzed by Fisher exact, chi-square and ANOVA tests.*

***Results.*** *Group III and Group I showed significantly higher retention rates than Group II fissure sealant ( $p < 0.05$ ). There were no differences of the caries-preventive effects between the tested sealant materials throughout the duration of the study. Streptococcus mutans counts were significantly lower in group II compared to group I or group III up to 6 months of the study ( $p < 0.05$ ). After 1 year of the study the differences of Streptococcus mutans counts were not significant ( $p > 0.05$ ).*

***Conclusion.*** *This study indicated a lower retention of RMGI compared to flowable composite and resin sealant without significant difference in caries prevention or long-term bacterial inhibition.*

**Keywords:** sealant, retention, caries, bacteria

### **Introduction and literature review**

By the end of the 20th century, the global distribution of dental caries among school children showed wide variations between developed and developing countries<sup>1</sup>. However, it has been reported that the relative contribution of pit and fissure caries to overall caries level in 12-year-old children is about 80%.<sup>2,3,4</sup> In this context, use of pit and fissure sealants as an adjunct to oral health care strategies and fluoride therapy in preventing dental caries would be worthwhile.

Nevertheless, the capacity of a sealant to prevent dental decay relies directly upon the ability of the sealant material to thoroughly fill pits, fissures, and/or morphological defects and remain completely intact and bonded to enamel surfaces for a lifetime.<sup>5</sup> Additionally, studies demonstrated that incipient carious lesions may inadvertently be sealed with dental

sealants and the fate of bacteria is of significance.<sup>6</sup> Therefore, additional antibacterial protection provided by sealants, especially against *Streptococcus mutans*, would be of value to prevent subsequent deterioration at the sealant-tooth interface and caries initiation.<sup>7</sup>

Nowadays, the most widely used fissure sealants are based on bisphenyglycedyl dimethacrylate (BisGMA) resins or urethane-based products. Since the introduction of resin sealant, various materials and techniques have been developed and/or proposed to improve the sealing quality of pits and fissures and to enhance sealant longevity.<sup>8,9</sup> Glass ionomer materials have been successfully employed for a number of applications and recently a growing interest in their use as fissure sealants has aroused.<sup>10,11</sup> However, conventional, chemically cured glass ionomer cements tried as pit and fissure sealants generally exhibited a poor retention rate and are too viscous to penetrate deeply into narrow fissures.<sup>12</sup> Many investigators found the retention rate of conventional glass ionomer to be lower than that of resin sealants, but without significant differences in caries prevention.<sup>13,14,15</sup> However, other research reports, did not support this view.<sup>16,17</sup>

On the other hand, the visible-light-polymerized resin-modified glass ionomer (RMGI) exhibited a significantly better compressive strength than conventional auto-cured glass ionomer cements.<sup>18</sup> Furthermore, RMGI has higher fracture and wear resistances than does self-cured glass ionomer without hindering the rate of fluoride release.<sup>19</sup> These improvements of glass ionomer materials are expected to increase the effectiveness of RMGI sealant.

In the past several years, the use of flowable composites as pit and fissure sealants has been widely suggested because of their beneficial properties, such as low viscosity, low modulus of elasticity, and ease of handling.<sup>20,21</sup> It has been reported that higher amount of filler particles in flowable composites provide lesser porosity and better wear resistance than conventional resin-based pit and fissure sealants.<sup>22</sup> Autio-Gold reported an equivocal retention rate and cariostasis of flowable composite and conventional sealants.<sup>23</sup>

Improving sealant materials is important since it may dramatically change the calculations on cost-benefit. Although there is a growing interest in the use of resin-modified glass ionomer and flowable composite as pit and fissure sealing materials, the evidence is still limited relative to evaluating and comparing their clinical effectiveness. Moreover, the antibacterial activities of composite and glass ionomer have only been examined in number of in-vitro studies.<sup>24,25,26</sup> No in-vivo studies have been conducted to clarify this issue. These studies reported different levels of short-term antibacterial properties of diverse materials against cariogenic bacteria. The authors of this study were not aware of any published data comparing the long-term effectiveness of these materials in lowering cariogenic bacteria when used as sealants.

## **Aim of the work**

The aim of this study was to:

1. Clinically assess the retention rates and caries-preventive effects of resin-modified glass ionomer and flowable composite in comparison to conventional fissure sealant;
2. Compare the long-term inhibitory effects of the tested materials on salivary streptococcus mutans counts.

## **Materials and methods**

### ***Study design***

This study was carried out as a controlled experimental clinical trial to test and compare the clinical and antibacterial effectiveness of the tested materials.

### **Subject selection**

Forty-five caries-free children aged 7-10 years were randomly selected from Pedodontic Clinic, Faculty of Dentistry, Tanta University. Each child had 2 lower first permanent molars with at least two-thirds of occluso-cervical length erupted. The eruption time of these molars did not exceed 3 years. Teeth were selected based on the existence of deep narrow central fissures and supplemental grooves with no evidence of cavitation, pre-cavitation, or probe catching with stained fissures.<sup>27</sup> Children with chronic systemic diseases or children with physically or mentally handicaps were excluded from the study. Also, those taking antibiotic therapy in the last 3 months before the start of the study were not included.

The children were randomly divided into 3 equal groups composed of 15 children each according to the type of sealant used.

#### **Group I:**

The fissures of the 2 newly erupted lower first permanent molars were sealed by a conventional-light-cured bisGMA resin fissure sealant (*Helioseal F*, Viva Dent Benderstrasse.Schaan, Liechtenstein, Austria). This group was considered a positive control group.

#### **Group II:**

The fissures of the 2 newly erupted lower first permanent molars were sealed by visible light-cured resin modified glass ionomer (RMGI) (*FujiIII LC*, GC, Tokyo, Japan).

#### **Group III**

The fissures of the two newly erupted lower first permanent molars were sealed by flowable composite (*Tetric Flow*, Viva Dent Benderstrasse.Schaan, Liechtenstein, Austria).

The teeth were cleaned with a dry pointed bristle brush in a low-speed hand piece and isolated with a rubber dam. Occlusal surfaces of Groups I and III were etched with 37% phosphoric acid gel (*Ultra Etch*, Ultradent Products Inc., USA) for 30 seconds and the RMGI group participants were scrapped with *GC Dentine Conditioner* (GC, Tokyo, Japan) for 20 seconds according to the manufacturers, instructions.

The surfaces were rinsed for 10 seconds with an air/water spray and occlusal fissures were dried with oil-free compressed air for 15 seconds.

The sealants were applied to etched surfaces of the treatment groups according to manufactures' instructions using a syringe needle tip included with each material. All sealants were then photo-cured for 40 seconds. The occlusion was examined after sealant application and the high spots were adjusted.

Sealant retention and dental caries status of all teeth were evaluated at 1 month, 6 months, 1 year and 2 years after sealant application under normal clinical conditions with a dental operating light, mouth mirror, and sharp dental explorer. The retention of the sealant was scored as:

1. Totally present: no crevice detected by explorer
2. Partially lost: partial exposure of fissures
3. Totally lost: complete loss of sealant (28)

Caries presence was scored without radiographs, according to World Health Organization dental caries criteria.<sup>27</sup> Diagnosis was primarily visual; probing was used only to confirm diagnosis.

### **Saliva sample collection and microbiological procedures**

Saliva samples were taken before sealant application to obtain base-line streptococcus mutans count for each participant. Another sample was taken 1 day after sealant application from all groups. Subsequently, saliva samples were taken at 6 months, 1 year and 2 years.

Saliva samples were taken in the morning before breakfast and the participants were requested not to perform tooth cleaning on the sampling days. The samples were collected with the children sitting, swallowing, and allowing saliva to pool in the mouth for 2 minutes. All saliva samples were taken from underneath the tongue by means of a sterile plastic pipette.<sup>29</sup> Subjects gave approximately 2 mL samples of unstimulated whole saliva collected into sterile test tubes.

Samples were immediately transported to the laboratory and processed within 30 minutes. Aliquots of 0.5 ml of saliva were diluted in 10-fold solution of sterile, phosphate-buffered saline and 20 mL was plated on Mitis-Salivarius agar, which is supplemented with bacitracin (0.2units/ ml) and 10% sucrose. The plates were incubated in 5% carbon dioxide environment at 37 OC for 48 hours.<sup>30</sup>

The bacteria were counted blindly of study groups with the help of a coordinator. Mutans streptococci identification was based on its distinct colony morphology which appear as hard, coherent, dark blue, and berry-like with raised colonies varying in size from 0.5 to 1 mm in diameter.<sup>31</sup> (Figure 1)



**Figure 1.** Streptococcus mutans colonies cultured on mitis salivarius bacitracin medium

### ***Patients' rights***

Informed consents were obtained from the parents of children after the nature and aim of the trial were outlined and it was explained that some of their teeth would be fissure sealed and that participation is voluntary. Children received oral hygiene instructions and they continued their usual oral hygiene practices including the use of fluoridated toothpaste throughout the study.

### ***Examiner reliability***

All sealants placements and dental examinations were conducted by one examiner. Intra-examiner calibration was assessed before the start of the study by re-examination of 10 children with sealed lower permanent molars with 1 week interval between examinations (kappa = 0.8 for both caries detection and sealant retention).

### ***Statistical analysis***

Data were collected, presented, and statistically analyzed using the SPSS statistical package system.<sup>32</sup> Fisher exact test, chi square test, ANOVA, and LSD post hoc tests were used according to the type of data. Partial and complete sealant losses were summed to facilitate statistical analysis. The level of significance used was 5%.

## Results

The clinical evaluation of retention of the 3 sealants in the tested groups during the study period is shown in Table I and Figure 2. As determined by the Fisher exact test, there was no statistically significant difference between the 3 groups after 1 month ( $p = 0.36$ ). However, chi-square test revealed that there were statistically significant differences between the 3 groups after 6 months, 1 year and 1 years ( $p = 0.02, 0.003, 0.00$ , respectively). Tetric flow showed the highest retention rate followed by Helioseal F and lastly FujiII LC fissure sealant. At the end of the study, the sample attrition in Groups I, II, and III were 2, 3 and 1 children respectively.

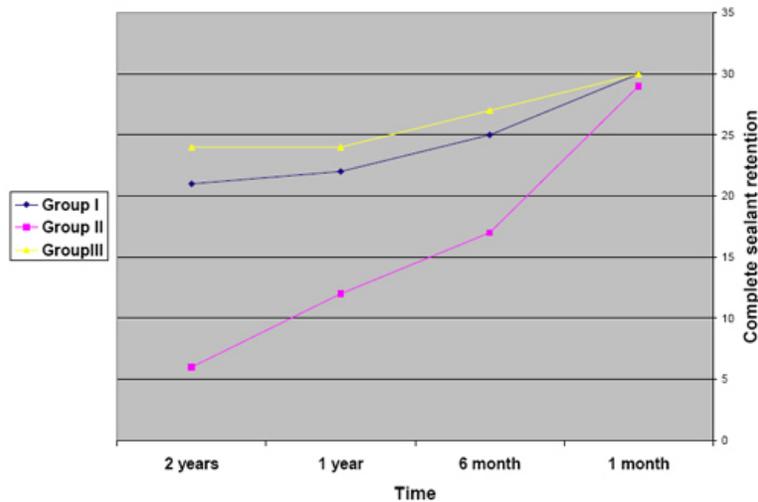


Figure 2.: Retention rate of the study groups during follow up periods

Table I. Comparison of retention rate between tested groups during study period.

Time	1 month			6 months			One year			Two years		
	GI	GII	GIII	GI	GII	GIII	GI	GII	GIII	GI	GII	GIII
No sealant loss	30	29	30	25	17	27	22	12	24	21	6	24
Partial sealant loss	0	1	0	3	5	3	3	7	4	2	5	3
Complete sealant loss	0	0	0	2	6	0	3	7	0	3	13	1
P-value	0.36			0.02*			0.003*			0.00*		

\* Significant at 5% level

As shown in Table II, no caries were found among the study groups either at 1 month or 6 months follows up. Similarly, 96% of the sealed teeth in all groups were sound after 1 year and 2 years from the start of the study.

Table II. Caries status of the sealed teeth among study groups during different follow up periods

Time	1 month			6 months			One year			Two years		
	GI	GII	GIII	GI	GII	GIII	GI	GII	GIII	GI	GII	GIII
Sound	30	30	30	30	28	30	27	25	27	25	23	27
							96.4%	96.1%	96.4%	96.1%	96%	96.4%
Carious	0	0	0	0	0	0	1	1	1	1	1	1
							3.6%	3.9%	3.6%	3.9%	4%	3.6%

A comparison between salivary Streptococcus mutans colony forming units (CFU) in the 3 groups during the study is shown in Table III. The mean number of Streptococcus mutans colony forming units was  $231 \times 10^3$ ,  $223 \times 10^3$ , and  $227 \times 10^3$ , respectively at the start of the study. The differences between all groups were not statistically significant ( $F = 0.27$ ,

p = 0.77). After one day of sealant application until 6 months follow up, the mean Streptococcus mutans count was highest in Group III, followed by Group I and lastly Group II. ANOVA and LSD tests revealed that the differences between all groups were statistically significant (F =46.8, 90.6, 75.6, respectively, p = 0.00). After one year until the end of the study, the differences of the mean streptococcus mutans count between study groups were not statistically significant (F = 0.47, 0.72, p = 0.64, 0.52, respectively).

**Table III.** Salivary streptococcus mutans count in study groups (CFU/ml)

Time	Group I	Group II	Group III	F	LSD
	$\bar{X}$ ± SD	$\bar{X}$ ± SD	$\bar{X}$ ± SD		
Baseline	231 X 10 <sup>3</sup> 13 X 10 <sup>3</sup>	223 X 10 <sup>3</sup> 11 X 10 <sup>3</sup>	227 X 10 <sup>3</sup> 12 X 10 <sup>3</sup>	0.27 P= 0.77	
One day	213 X 10 <sup>2</sup> 7 X 10 <sup>2</sup>	174 X 10 <sup>2</sup> 6.5 X 10 <sup>2</sup>	231 X 10 <sup>2</sup> 1 X 10 <sup>3</sup>	46.8* P= 0.00	Group I vs group II* Group I vs group III* Group II vs group III*
One month	242 X 10 <sup>2</sup> 9.6 X 10 <sup>2</sup>	203 X 10 <sup>2</sup> 605 X 10 <sup>2</sup>	284 X 10 <sup>2</sup> 5.5 X 10 <sup>2</sup>	90.6* P= 0.00	Group I vs group II* Group I vs group III* Group II vs group III*
Six months	284 X 10 <sup>2</sup> 8.5 X 10 <sup>2</sup>	234 X 10 <sup>2</sup> 1.5 X 10 <sup>3</sup>	341 X 10 <sup>2</sup> 6 X 10 <sup>2</sup>	75.6* P= 0.00	Group I vs group II* Group I vs group III* Group II vs group III*
One year	237 X 10 <sup>3</sup> 6.4 X 10 <sup>3</sup>	238 X 10 <sup>3</sup> 4 X 10 <sup>3</sup>	235 X 10 <sup>3</sup> 13 X 10 <sup>3</sup>	0.47 P= 0.64	
Two years	243 X 10 <sup>3</sup> 5.1 X 10 <sup>3</sup>	234 X 10 <sup>3</sup> 6.5 X 10 <sup>3</sup>	249 X 10 <sup>3</sup> 8.6 X 10 <sup>3</sup>	0.72 P= 0.52	

\*Significant at 5% level

## Discussion

In this study, sealant application was performed during the posteruptive maturation phase of first permanent molars when they are at risk of developing dental caries. This may highlight the differences in caries preventive effects between the tested materials.<sup>10</sup> Diagnosis of fissure caries, especially under defective sealants presented more difficulties without radiographs.<sup>13</sup> However, caries diagnosis was performed primarily visually to avoid exposing the children to unnecessary radiations.

The retention rates of resin sealant and resin modified glass ionomer observed at the end of this study were congruent to those of recent trials using the same materials.<sup>13,21,33</sup> Furthermore, the considerably lower retention rates obtained with resin modified glass ionomer (Group II) compared with resin sealant (Group I) in all follow up periods were in agreement with previous investigations.<sup>15,34</sup> This could be attributed to the deep narrow fissure systems selected for this trial which might result in an entrapment of air voids under relatively thick RMGI, hence reducing the strength of adhesive joints.<sup>35</sup> This, also, confirmed the early assumption that glass ionomer sealant should only be used for fissures more than 100 µm in width.<sup>36</sup> Additionally, glass ionomer sealants are more technique-sensitive than resin-based sealants and a minute saliva exposure would predispose surface degradation and early loss of sealant.<sup>35</sup>

In the present work, the significantly higher retention of flowable composite (Group III) in comparison to resin-modified glass ionomer (Group II) paralleled that of Pardi et al.<sup>21</sup> This could be due to a poorer bond of resin-modified glass ionomer to tooth structure than flowable composite.<sup>37</sup> The better retention of flowable composite than the conventional resin-based fissure sealant observed in this study was in accordance with Corona et al (5) but was not in agreement with Autio-Gold.<sup>23</sup> These discrepancies in results might be attributed to the differences in the follow up periods between these studies. It is to be noted that, while flowable composite sealant material used in this trial had an optimal performance throughout the duration of the study, these results might not be applied for all diverse flowable composite materials with different compositions.

In this study, the rate of sealant loss as a function of time seemed to be different between the tested materials. There was an initial high rate of resin-modified glass ionomer sealant loss; while for resin-based and flowable composite sealants, the rate of loss seemed to be fairly constant. The initial high loss of glass ionomer sealant has been reported by other researchers<sup>37,38</sup> and is thought to depend mainly on unfavorable fissure morphology.

Nevertheless, the question of cariostasis remains the main issue to address. After two years of this clinical trial, 4% and 3.6% of resin-modified glass ionomer (Group II) and flowable composite (Group III) sealed teeth became carious which was in a complete agreement with Pardi et al.<sup>21</sup> Also, the 3.9% carious teeth detected in Group I at the end of this work was in accordance with the 2 year study of Fross et al.<sup>13</sup>

The nearly similar caries increment detected in the present work among the study groups, despite of a clear difference in the retention rate, are analogous to those seen in previous studies employing comparable materials and give credence to the concept of a possible benefit of glass ionomer sealant.<sup>34,39</sup> The fact that the glass ionomer remains in the deeper recesses of the occlusal fissures may explain why no caries was recorded in Group II teeth despite macroscopic sealant loss. Moreover, glass ionomer acts as a mean of sustained fluoride release to the adjacent tooth structure and to the oral environment.<sup>40</sup> On the other hand, the results of the present study contradicted that of Poulsen et al who reported that the glass ionomer sealant had a less caries-protective effect than resin-based sealant.<sup>10</sup> These differences in results might be due to differences in selection criteria, of the sealed teeth, different caries diagnostic criteria and the use of chemical-cured glass ionomer sealant in the former study instead of light-cured resin-modified glass ionomer tested in this work.

With the recent advances in materials sciences, the mechanical properties of dental materials have been extensively studied. However, little efforts have been made to revise their biological properties. Thus, in this study, examination of the antibacterial properties of the sealants against streptococcus mutans was conducted. In this context, long-term in vivo studies are preferred than in vitro studies as they can predict if the antibacterial activities will last for extended periods of times. Moreover, the in vivo situations allow the tested microorganisms to interact at their full viability with the oral flora.<sup>41,42</sup>

In this study, culturing of Streptococcus mutans was made by use of mitis salivarius bacitracin (MSB) agar medium. Although some investigators have reported that trypticase yeast-extract cystine sucrose bacitracin (TYCSB) medium yields a significantly higher amount of mutans Streptococcus from oral samples than does MSB medium. However, non-mutans Streptococcus are more abundant on TYCSB than on MSB medium and, in some instances, so numerous that they make detection of the mutans streptococci is difficult.<sup>43</sup> Therefore, MSB medium was preferred in the present study.

In this work, the immediate reductions of salivary streptococcus mutans counts noted in all groups after one day of sealant application were in a complete agreement with Going, who reported that, the acid etching procedure itself reduces the number of cultivable microorganism by approximately 95%.<sup>44</sup> Additionally, teeth prophylaxis before sealant application may contribute to the observed diminution of streptococcus mutans count.

The results of the present work clearly demonstrate that Streptococcus mutans counts were significantly lower in Group II compared to Group I or Group III up to 6 months of the study. This reconfirms and extends the knowledge base gathered from previous investigations on the antibacterial property of glass ionomer materials.<sup>25,26</sup> The etiology of the observed reduction of streptococcus mutans counts in group II children is speculative at this time and may be related to fluoride

released by ionomeric materials.<sup>42</sup> Additionally, a significant amount of aluminum release from glass ionomer that has been previously reported may play a role in this bacterial inhibition.<sup>45</sup> Aluminum has an inhibitory effect on ATPase enzyme of streptococcus mutans which plays an important role in the maintenance of the bacterial metabolism and intracellular pH.<sup>46,47</sup>

Similarly, the significantly lower counts of streptococcus mutans, observed in this study in Group I compared to Group III for 6 months follow up, emphasizes the antibacterial effects of fluoride-releasing resin sealants observed in previous studies.<sup>7,48</sup> Also, the significantly higher streptococcus mutans counts observed in Group III compared to Group I and Group II until the end of 6 months of this study come in a line with some in vitro studies.<sup>41,49</sup> This could be explained by the fact that resin composite extracts and unpolymerized ethylene glycol monomers, released from composite resins, have growth-promoting effects on cariogenic bacteria.<sup>50,51</sup>

After one year of the clinical trial until the end of this study, there was no statistically significant difference of streptococcus mutans count between all groups which was in accordance with previous studies.<sup>43,52</sup> The recovery of bacteria throughout the study may stem from the potential streptococcus mutans reservoirs on soft tissues that remain unaffected by sealant application.<sup>53</sup> Moreover, the release of fluoride from glass ionomer was found to be the greatest in the first few months, after which it decreases to a constant level over a prolonged period of time.<sup>54</sup> This might explicate the recolonization of streptococcus mutans in Group II after one year until the end of the study.

Finally, due to the relatively small sample size of this work, this study could be considered a pilot clinical trial which recommends further studies involving larger sample sizes.

## **Conclusion**

The results of this study indicated a lower retention of RMGI compared to flowable composite and resin sealants without significant difference in caries prevention or long term bacterial inhibition.

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## **Notes**

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## **Calibration Of Clinical Dental Hygiene Faculty**

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*The Ohio State University College of Dentistry Dental Hygiene*

*The purpose of the study was to evaluate the outcome of a faculty workshop and to determine if faculty calibration has been enhanced. Calibration of faculty in the clinical setting is crucial to effective teaching and learning.*

*The Ohio State University Dental Hygiene Program conducted a clinical calibration session in December 2006. Three clinic scenarios faculty may encounter were developed for discussion. Turning Point technology was utilized to present the clinical situations. Throughout the discussions, it was evident that there were varied opinions on how to address each situation. Since part-time faculty are responsible for clinical teaching and do not always attend faculty meetings, we decided to record copious notes and distribute faculty meeting minutes to all faculty in a timely manner via e-mail. In addition, clinical directors meet with each dental hygiene class once a week in "clinical rounds". The information discussed at these events would also be emailed to all faculty in a timely manner by the clinical directors.*

*In August 2007, a 10 question, 4 point Likert scale survey was developed to assess faculties' beliefs on the value of the exercises and the communication modality implemented (1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree). Seventeen out of a possible 19 faculty responded to the anonymous electronic survey with a response rate of eighty-nine percent.*

*The results reveal that the majority of the faculty believe the information contained in faculty minutes help clinical calibration (52.9% agree; 29.4% strongly agree; mean = 3.12). The majority also reviewed the minutes circulated in a timely manner (58.8% strongly agree; 35.3% agree; mean = 3.53). Similarly, the faculty feel calibration exercises during faculty meetings would improve their clinical teaching (47.1% strongly agree; 52.9% agree; mean = 3.47), yet forty-seven point seven percent disagree (mean = 2.71) that monthly faculty meetings are sufficient to insure adequate calibration and communication among clinical faculty. Results of this survey suggest that faculty find value in clinical calibration exercises and believe that current practices could be improved.*

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## **Development, Implementation And Evaluation Of A "Paper Chase" Experience To Help Dental Hygiene Students Transisition From Pre-Clinical Into Clinical Rotations**

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*The Ohio State University*

*The purpose of this new program was to assess Dental Hygiene (DH) students' perceptions regarding an experience to help with clinical process and form completion in patients charts as they proceed from pre-clinic to clinic. As students started clinical rotations, they reported that they did not understand the paper work and suggested more explanation for the next class.*

*The "paper chase" experience was created to prepare students for clinical process and completion of clinical forms. This was a three-hour time slot utilizing faculty and senior practicum students as tour guides and group leaders. The practicum students were in charge of showing and explaining the front desk, the cashier station, the insurance office, the location of forms and how to clean dentures. Faculty rotated to small groups of students to help them with clinic forms such as risk assessment, treatment plan, perio patient protocol, cashier slip, dental specialty consults, grade sheets, medical consults, broken appointments and needed signatures in the chart. Each faculty had enough forms so students could follow along as explanations were given.*

*A ten- question Likert survey was given to the students (N=32) following the experience. One-hundred percent of students either strongly agreed (SA) or agreed (A) that the topics were appropriate and that they felt comfortable asking any question during the experience. Ninety-seven percent either SA or A that they liked the way faculty rotated to different groups, that the practicum students were helpful and that the paper chase should be given to next years class. A student commented, "Breaking up into small groups made it easier to ask questions. It was also a nice break from regular lecture and class." Another said, "I liked the way we got to look at forms while the instructors explained things to us."*

*The dental hygiene students reported they liked the paper chase and that it was helpful as they started clinical experiences. Some students reported that it lasted too long, but many had studied all night for two midterms held earlier the same day. We will continue to schedule the paper chase prior to the first clinical patient.*

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## **Expanding Dental Hygiene Services To The Underserved Through Distance Learning Education: Setting Your Sites**

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*University Of Maryland Dental School - Division Of Dental Hygiene*

*It is a known fact that lower socioeconomic individuals in rural areas are without dental care on a regular basis. In order to meet the growing oral health needs in the outlying areas of the state, The University of Maryland, Division of Dental Hygiene has implemented a distance-learning site on Maryland's Eastern Shore. Local oral health professionals, regional feeder schools and consumers indicated that qualified applicants would pursue the profession of dental hygiene as a career choice, if a high quality program were made available in their region. Resultantly, a vision of distance learning combining an on-line didactic program with local clinical and laboratory applications evolved. The Eastern Shore satellite program, which renders a Baccalaureate Degree in Dental Hygiene, became a reality in August 2006.*

*The question to be addressed is: Can a distance learning dental hygiene program in a rural area impact the oral health needs of the community? This poster will provide baseline data describing the Eastern Shore's oral health care needs, address the start up plan for the distance-learning program, and demonstrate how the program is making a difference in providing oral health care to a cross section of the population. Evaluation of the program's ability in meeting area dental needs is currently in progress. Preliminary data reflecting student provision of dental hygiene services, obtained through chart review and tabulation of computer entered dental insurance codes, indicates a positive result. Student participation in community outreach programs, since the inception of the program, will also be described.*

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## **International Service Learning**

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*Western Kentucky University*

*Students in health care professions, including dental hygiene, have been involved in service learning long before it became a new trend in education. However, due to rigorous class and clinical schedules, study abroad was a more difficult aspiration to obtain. Utilizing the University's Winter Term, faculty within the College of Health and Human Services at Western Kentucky University collaborated among departments (Allied Health, Nursing, Public Health and Recreation) and developed an International Service Learning Program that accomplishes both.*

*During Winter Term, students can take an International Health and Service Learning course and have the opportunity to travel to the country of Belize, CA. While staying in or near small villages, students are able to provide a variety of healthcare services, including preventive dental care. Students not only have the opportunity to see how healthcare is provided in other countries; they also gain interdisciplinary healthcare experience as they rotate through providing care with physicians, nurses, dentists, dental hygienists and pharmacists. In addition to providing care, students are involved in the assessment and planning for future programs. Students are able to gain first hand experience in cultural diversity, treating patients in both Mayan and Creole villages. While in Belize, students are immersed in the culture of the country and have opportunities to participate in community events and visit various regions of the country.*

*Reflection is an important part of the program. Students keep daily journals and meet nightly to discuss the experiences from each day. Upon their return the United States, the students provide presentations to campus and community groups. Program participants have noted that the experience greatly exceeds their initial expectations, increases their self-confidence and inspires them to be more involved in their own communities. Initial funding for this project was obtained through Western Kentucky University.*

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## **Primary Health Care Dental Hygiene Model**

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*The primary oral health care professional educational-curriculum model is an advanced dental hygiene curriculum model. This model integrates research, education, and public health components. The model proposed by the author would stimulate collaborative/interdisciplinary health care education. The goal of this model is to graduate an oral health professional prepared to participate in a more comprehensive and cost effective healthcare system. The concept of the model is supported by HMPP 139, Colorado State Practice Act, ADHP of ADHA, and other state practice models.*

*Epidemiologically established public health needs, workforce challenges, and current alternative practice settings provide the foundation to support the need for new oral health curriculum models. The significant difference between the PHCDH model and the ADHP model is the masters-prepared practitioner would have the educational, philosophical, and intellectual preparation to practice collaboratively as an educator, clinician, researcher, and policy maker in varied health and educational settings.*

*The successful execution of the model would involve professional, educational, and public advocacy for change in state licensure and practice acts. The objectives of the model are to: 1. Integrate oral health with systemic health; 2. Increase skills and awareness of oral health professionals regarding systemic health and in turn other health professionals' awareness of oral health; and 3. Increase access to oral health services including preventative and disease control services.*

*The achievement of program goals would be evaluated by education and practice outcomes including:*

- 1. Acceptance of the model by professional organizations, legislature, policy makers, and board of registration;*
- 2. Adoption and implementation of curriculum by varied health professions in higher education;*
- 3. Increase in collaborative oral and overall health research and policy development; and*
- 4. Integration of health and oral health services in private and public settings. Implementation of this model is a method of meeting the challenges set forth in the Surgeon General's Report.*

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## **Survey Of Dental Hygienists' Diabetes Knowledge And Practices**

Linda D Boyd, RDH, RD, EdD, Maryann Hartman, MA, RD, CDE and Jean Calomeni

*Linda D. Boyd, RDH, RD, EdD is from Idaho State University. Maryann Hartman, MA, RD, CDE and Jean Calomeni are from the Idaho Diabetes Prevention and Control Program.*

*Given the increasing incidence of diabetes in the United States and the risk for more severe periodontal disease in individuals with poorly controlled diabetes, it is essential to provide access to professional education to prepare oral health providers to care for this population. The purpose of this survey was to assess the diabetes knowledge, beliefs, and practices of dental hygienists in order to identify professional continuing education needs.*

*A five-part survey was constructed using the American Diabetes Association 2007 Clinical Practice Guidelines for standards of care for diabetes mellitus along with an American Association of Periodontology Commissioned Review of diabetes and periodontal disease.*

*An invitation to participate was disseminated electronically via mailing lists and a newsletter sent to American Dental Hygienists' Association (ADHA) members. A convenience sample of dental hygienists (n=392) with representation from 48 states participated. The majority of the respondents were female (99%), ages 41 to 60 (60.1%), and in practice > 16 years (58.3%). Seventy to eighty percent of participants responded correctly to the questions on general diabetes and oral health knowledge. The major deficit in knowledge was associated with the patient's hemoglobin A1c (HbA1c) value and implications for diabetes control (50%).*

*The survey responses indicated confusion about the current classifications of diabetes with approximately seventy percent of respondents using classifications which are no longer recognized. Seventy-five to ninety percent of participants were unfamiliar with the impact of various types of insulin and newer diabetes medications on dental care. The sample of dental hygienists in this survey demonstrated a need for enhancing knowledge about diabetes as it applies to clinical patient care. In particular, the areas of greatest need included the American Diabetes Association Clinical Practice Guidelines for standards of care, diagnosis of diabetes mellitus, medications, and best practices for interacting with other health professionals caring for people with diabetes.*

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## **Prevalence Of Academic Dishonesty In Texas Dental Hygiene Programs**

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*This study investigated cheating in Texas dental hygiene (DH) programs, the frequency of didactic and clinical cheating behaviors, justifications for cheating, and if ethics courses, honor codes, and faculty discussions on cheating affect prevalence. Reports of cheating in dentistry have highlighted the need for faculty to promote academic integrity. Because cheating may result in substandard patient care, it is important to determine if cheating occurs in DH schools, why it occurs, and what interventions may be undertaken to ensure that an environment of academic integrity prevails.*

*Surveys were mailed to 20 program directors to include 400 graduating students. Class presidents were instructed to administer the survey during class time without faculty present. Usable survey returns were 289 for a response rate of seventy-two percent. Data were analyzed using SPSS with frequencies, cross-tabulations, and chi-square tests. Eighty six percent of graduating students have cheated a minimum of one time while enrolled in DH school. Students have copied assignments from others (n=137), allowed others to copy from them (n=151), and collaborated on assignments meant to be done independently (n=131). Just over 25% of the students were able to obtain previous exams without the instructor's knowledge.*

*Respondents reported participating in violations of infection control protocol (n=153), recording false vital signs (n=128), and copying previous periodontal findings to use as current findings (n=69). Three reasons cited for participating in academic dishonesty included demands at school, pressure to pass a course, and clinic requirements. Of the students who had an ethics course, whose school has an honor code, or whose instructor(s) discussed cheating, approximately 87% self-reported cheating.*

*Results show that cheating is widespread. Evidence suggests that if a student chooses to engage in academic dishonesty, it is likely to continue in the professional clinical setting; hence, the exigency in developing strategies to curtail the prevalence of academic dishonesty.*

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## **The effect of using a powered toothbrush on MCP-1 and RANTES levels in patients with Gingivitis**

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*University of North Carolina at Chapel Hill*

*The purpose of this pilot study was to investigate if a powered toothbrush significantly reduced the concentration of MCP-1 and RANTES over time in a gingivitis group when compared to a manual toothbrush. MCP-1 and RANTES are pro-inflammatory cytokines that are expressed in gingival crevicular fluid of patients with gingival inflammation. This study looked at the levels of these cytokines as indicators for a reduction in the host inflammatory and immune response.*

*Twenty gingivitis patients, 18-65 years of age with pocket depths  $\leq 6$ mm and a minimum of 10% bleeding upon probing were enrolled in this IRB approved pilot study. Participants randomly assigned to one of two treatment arms, the powered toothbrush or the manual toothbrush, were seen for five study visits and gingival crevicular fluid samples were collected at baseline and 24 weeks post therapy.*

*No statistically significant differences were found between groups at baseline in clinical measurements, GCF levels of MCP-1 and RANTES and demographics, with the exception of race ( $p=0.01$ ). When comparing the treatment group to the control group, no statistical differences were found between the GCF levels for MCP-1 and RANTES at baseline and 24 weeks post treatment ( $p=0.20$  and  $p=0.19$ , respectively).*

*Within the limitations of this study, a trend in the reduction of the local indicators of inflammatory response was seen; however, the differences were not statistically significant. Further investigation needs to be conducted, with a larger sample size, to evaluate the effect of a powered toothbrush on the inflammatory mediators, MCP-1 and RANTES. This pilot study was nested within a larger, ongoing study of 84 participants.*

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## **Predicting Student Success In A Three Year Associate Degree Dental Hygiene Program Using A Practical Programmatic Model**

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***Purpose:*** The purpose of this study is to identify early and practical programmatic variables to predict success or failure in a three-year dental hygiene program. Using the National Board Dental Hygiene Examination (NBDHE) as an outcome measure of success, this study focuses on final grades in first year basic science and dental hygiene courses as variables to help identify at risk students for early remedial intervention.

***Problem:*** Existing literature suggests that entering GPA may hold promise as a predictor of success on NBDHE for specific programs, other literature identifies a multitude of courses throughout the dental hygiene curricula as variables to predict success, biology being one. A more practical and evidence based indicator may be students' first semester final grades.

***Methodology:*** Academic aggregate data was collected on 132 students (n=132) over 3 years (2005-2007). Final grades in first year Anatomy and Physiology I and II, Dental Anatomy and Head and Neck Anatomy courses were chosen because they typically challenge students. These courses were mapped with NBDHE scores using Venn diagramming to plot variable sets of three in a universal set. Multiple set combinations were tested.

***Results:*** The set of Dental Anatomy, Head and Neck Anatomy and NBDHE scores showed the strongest relationship for identifying at-risk students. Final grades were plotted and it was established that not only were failures in the courses indicators, but final grades below 75% plot as at-risk.

***Conclusion:*** The Venn diagram was a practical tool in identifying variables to predict success and inform remediation for at-risk students, as well as, consideration for raising the program's grade requirement from 70% to 75%. Venn diagramming may be a practical tool for other programs to use to identify their unique variables for success.

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## **Is there value for administering a mock corroborative clinical practicum prior to the final exam? A two-year perspective for 1st year clinical dental hygiene students**

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***Purpose:** To assess the value of administering a mock corroborative clinical exam to the beginner learner in reducing anxiety and increasing performance on the final corroborative clinical exam.*

***Hypothesis:** A mock corroborative clinical exam administered prior to the final exam will reduce anxiety and therefore increase the comfort level and skill performance of the 1st year dental hygiene student.*

***Method:** During the fall 2006 and 2007 a mock corroborative clinical practicum was administered to ninety-three first year pre-clinical dental hygiene students at week eleven of the fourteen week semester and re-administered as a final practicum. During the previous ten weeks of the semester students were introduced to the area-specific curets, universal curet, anterior and posterior sickles. Practice sessions with each instrument were followed with skill evaluations. To prepare for the practicum exam students were given exam guidelines and a sample grade sheet. Students were randomly assigned to two exam groups. Twenty minutes was allotted for each student to demonstrate the correct use of the Gracey 5/6, 13/14, 15/16, and the SH5/33. For the mock exam two faculty evaluated each student; three faculty evaluated the final exam. The grade for the mock exam was not calculated into the grade for the course. Two faculty group leaders and time keepers were designated. The survey instrument consisting of sixteen dichotomous (yes/no) and open-ended (essay) questions was submitted for IRB approval. The survey was administered through the Assessment section of the College's Blackboard Program (2006) and Zoomerang (2007).*

***Questions to be answered:** Do you feel the mock corroborative clinical practicum prepared you for your final corroborative clinical practicum exam? Do you feel that the twenty minutes you were given for the exam was sufficient for the tasks you were asked to perform? Did the grade you received on the final corroborative clinical practicum change significantly from the grade you received for the mock practicum?*

***Results:** Ninety three surveys were administered to 1st year dental hygiene students 46 were completed (48%). Eighty-four percent of the respondents felt adequately prepared/less anxious. Eighty-four percent of the respondents felt that week eleven was appropriate place in the curriculum based on the timing of the final exam.*

***Conclusion:** Students felt that it was beneficial to have a mock corroborative clinical exam week eleven of the semester to better prepare them for the final exam. The students experienced a decrease in anxiety in knowing what to expect. The results indicated that there was no definitive change in the final grade.*

Source: Journal of Dental Hygiene, Vol. 82, No. 5, October 2008

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## **The Effect Of Dental Hygiene Student Learning Styles On Achievement In The Online Learning Setting**

Kathryn E Spears, RDH, BS, Jacquelyn L Fried, RDH, MS, Nezhat Olia, PhD, Marion Manski, RDH, MS, James Craig, EdD and Barbara Covington, PhD

*University Of Maryland, Baltimore*

*Distance education is growing at an incredibly fast pace in colleges and universities throughout the world. Within this area of education, online learning specifically has begun to replace the traditional face-to-face classroom. Dental and dental hygiene education is quickly adopting the online educational methodology. Technological advances have made the computer an invaluable tool for educating students, and through its use, an increased number of students are being reached online.*

*Distance education is capable of opening doors to various educational teaching methods through the use of communication techniques, visuals, multi-media video and audio. As online learning continues to spread throughout dental and dental hygiene programs in the United States, significant thought and research should explore the learning styles of individuals and how they relate to success in the online classroom.*

*This study was designed to determine the relationship between dental hygiene students' learning styles as measured by the Kolb Learning Style Inventory (Kolb LSI) and the Witkin's Group Embedded Figures Test (Witkin's GEFT) and academic achievement as measured by final course scores in the online learning setting. The Kolb LSI and the Witkin's GEFT were administered to a convenience sample of 27 junior-level dental hygiene students at the University of Maryland Dental School.*

*Analysis of variance (ANOVA) and bivariate correlational analysis (Pearson's  $r$ ) were used to determine the possible relationship between dental hygiene student learning styles and online course achievement. No statistically significant relationships ( $p > .05$ ) were found between learning style and achievement; however, interesting learning styles and characteristics were identified. This study supports prior research that: (1) a student's preferred learning style does not affect their achievement in an online learning course, and (2) learners are able to adjust their learning style to succeed in the online learning environment.*

Source: Journal of Dental Hygiene, Vol. 82, No. 5, October 2008

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## **Urban Smiles: Providing A Dental Need To The Memphis Area**

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*University Of Tennessee Health Science Center*

*Dental caries continue to be the most prevalent chronic childhood disease in the United States according to Chu et al in the January 2007 JADA article, "The Dental Care of U.S. Children." Urban Smiles, The University of Tennessee Health Science Center (UTHSC) dental hygiene faculty practice, has treated over 4,000 children between August 2004 and August 2007 in an effort to improve this trend. The purpose of this study was to compare the percentage of annually treated Urban Smiles children to the Healthy People 2010 Dental Goals for untreated dental decay and sealants.*

*The 2010 dental goals are for less than 21% of children aged 6-8 years old to have dental decay in addition to a minimum of 50% of children aged 8 years old and adolescents aged 14 years old to have existing molar sealants. By manually going through the August 2004-August 2007 Urban Smile's patient charts and calculating the children by age, dental decay and sealants; it was determined that 18.2% (N=1,573) of the Urban Smiles children aged 6-8 years old had dental caries, 29.5% (N=828) of Urban Smiles children aged 8 years old had molar sealants and 31.6% (N=196) of adolescents aged 14 years old had molar sealants prior to having sealants placed by Urban Smiles.*

*It could be concluded from this study that 1) The Urban Smiles children have reached the Healthy People 2010 Dental goals for untreated dental decay and 2) The Urban Smiles children and adolescents have not reached the Healthy People 2010 Dental Goals for molar sealants. However, once sealants were placed by Urban Smiles, the percentage of 8 year olds with molar sealants increased to 76.6% (N=828) and the percentage of 14 year olds with molar sealants increased to 53.6% (N=196) and the dental sealant goals were subsequently met.*

Source: Journal of Dental Hygiene, Vol. 82, No. 5, October 2008

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## **Muscle Activity Comparisons In Dental Hygiene Students When Using Different Fulcrums While Scaling**

Susan Lynn Tolle, BSDH, MS, Mary Elizabeth Cosaboom, RDH, MS, Michele L Darby, BSDH, MS and Martha L Walker, PT, PhD

*Susan Lynn Tolle, BSDH, MS; Mary Elizabeth Cosaboom, RDH, MS and Michele L. Darby, BSDH, MS are from Gene W. Hirschfield School of Dental Hygiene. Martha L. Walker, PT, PhD is from School of Physical Therapy, Old Dominion University.*

*The high incidence rate of cumulative trauma disorders in dental hygienists attests to the musculoskeletal problems experienced by dental hygienists. Research is ongoing to investigate ergonomic practices that will minimize muscle trauma when providing scaling and root debridement. The purpose of this study was to determine differences in the activity of four forearm muscles, (extensor carpi radialis longus, flexor carpi ulnaris, biceps brachii and pronator teres) when using five different finger fulcrums while scaling in dental hygiene students.*

*A convenience sample of 29 consenting senior dental hygiene students participated in the study. Using a 4 x 5 counterbalanced research design, participants used a Gracey 11/12 curet to scale artificial calculus from each permanent first molar tooth on a typodont. While scaling, each participant had sEMG sensors attached to each muscle under investigation to measure muscle activity via electromyography. Participants scaled using one of 5 finger fulcrums (opposite arch, standard intra-oral, basic extra-oral, cross arch and finger on finger) on 5 different typodonts resulting in a total of 20 sEMG readings per participant. The highest amount of muscle activity was observed in the pronator teres ( $X=28.73$ ) and the least in the biceps brachii ( $X=13.39$ ).*

*Data analysis with two-way ANOVA revealed a statistically significant difference only in the activity of the biceps brachii muscle when a change in fulcrum occurred. ( $p=0.0002$ ). Using an average of all four muscles ANOVA revealed no statistically significant differences when comparing scaling with different fulcrums and the amount of muscle activity generated ( $p=0.0776$ ) In this clinical study that measured the activity of four forearm muscles when scaling, only the biceps brachii was affected by a change in fulcrumming technique.*

*Results suggest that similar muscle activity is produced when scaling regardless of the muscles measured and the type of fulcrum used. More research is needed to clarify the role of fulcrums and individual muscle activity in the ergonomic practice of dental hygiene.*

Source: Journal of Dental Hygiene, Vol. 82, No. 5, October 2008

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## **Admission Indicators Of Failure On The National Board Dental Hygiene Examination**

Denise A Kissell, BSDH, EFDA, MPH, Wendy J Moore, BSDH, EFDA, MS and Michele P Carr, RDH, BS, MA

*The Ohio State University*

*Dental hygiene licensure requires a score of 75 or higher on the National Board Dental Hygiene Exam (NBDHE). During admissions, academically motivated candidates are sought for success in the dental hygiene program at The Ohio State University. Although the failure rate has historically been low, the admissions committee continually strives to improve admission criteria to ensure academic success and passage of the NBDHE. The objective of this retrospective study was to determine which identifiers for admissions and occurrences within the program are indicators of potential failure on the NBDHE.*

*Fifteen academic and demographic categories were reviewed from transcripts of students who failed the NBDHE from 1996-2007, to identify any significant trends. Results: A total of 11 students failed the NBDHE during the specified time period, for a failure rate of 4%. Three academic categories of the fifteen correlated with failing scores. Of the ACT scores, 55% were below the current national and state averages of 21.1 and 21.5, respectively. Transcripts revealed that 73% of the students repeated a prerequisite science course and 45% of the students failed a dental hygiene course, which had to be repeated. In addition, 100% of the students received a C or lower in a dental hygiene course.*

*In conclusion, this study showed that low ACT scores, combined with difficulty in pre-dental hygiene science courses, correlated to failure of dental hygiene courses and ultimately failure on the NBDHE. It is recommended that admission committees require the submission of ACT scores on the admission application and be more critical if repetition of a prerequisite science course is noted. Since licensure is a goal of dental hygiene programs, it is imperative that admissions committees be able to admit the best candidates for success within the program and our profession through selective admissions.*

Source: Journal of Dental Hygiene, Vol. 82, No. 5, October 2008

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## **What Victims Of Domestic Violence Need From The Dental Profession**

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*Texas A&M Health Science Center Baylor College Of Dentistry*

*Purpose of the study was to determine whether 1) victims of domestic violence present in dental offices with signs of abuse; 2) are asked about their injuries by the oral health care provider; 3) are given referral and/or assistance; and 4) if they would like their injuries to be recognized by the dental professional.*

*Although numerous studies report that the majority of domestic violence (DV) victims sustain head and neck injuries, few dentists recognize that DV is a problem that their patients may encounter. A 14-question survey was developed and mailed to 15 domestic violence shelters in the North Texas area. Eleven of 15 shelters participated in the study, for an institutional response rate of 73.3%. Each shelter was mailed 15 surveys and of the total number of surveys mailed (N= 165), 112 were returned for an overall response rate of 67.8%. Descriptive statistics were analyzed and a one-way Analysis of Variance (ANOVA) was used to determine whether the participants' age, race, or sex was statistically significant in determining the likelihood of abuse. The majority (76%) of participants had suffered from a head, neck, or mouth injury as a result of abuse. Over half of participants had seen a dentist when signs of abuse were present, yet 88.6% were not asked about their injuries. In addition, 69.2% responded that they would have liked to have been asked about their injuries. Of the total 112 participants, 76% have experienced an abusive head, neck, or mouth injury due to domestic violence. A one-way Analysis of Variance (ANOVA) found statistically significant differences in abuse rates for different ethnic groups. African Americans and Native Americans had significantly higher abuse rates ( $p < .05$ ).*

Source: Journal of Dental Hygiene, Vol. 82, No. 5, October 2008

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## **Utilizing Public Health Clinics For Service-Learning Rotations In Dental Hygiene: A Four-Year Retrospective Study**

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*University Of Missouri-Kansas City*

*National reports outlining major disparities in oral healthcare in the United States have focused attention on ways to encourage healthcare providers to become more involved in public health. Service-learning in professional health education programs is one method being explored. The purpose of this study was to conduct a descriptive, retrospective review of the effectiveness of a service-learning rotation within a dental hygiene public health course. Areas of particular interest included student awareness of the underserved, cultural diversity, ethical patient care and interest in public health as a career choice.*

*Data sources were generated by students as part of course evaluation and included student journals (qualitative/quantitative), Likert-scaled (quantitative) and open-ended (qualitative) student satisfaction survey items. Data was collected from four classes of baccalaureate dental hygiene students over a four year period (n=104).*

*A mixed methodology was employed, utilizing both qualitative and quantitative data analysis techniques. The constant comparative approach provided qualitative analysis of student journals and open-ended response items on student satisfaction surveys. In addition, percentage calculation of theme occurrence yielded a quantitative method of analysis for qualitative data. Median analysis was conducted for Likert-scaled survey items allowing for triangulation of results between the multiple data sets.*

*Results suggested that the service-learning rotation was an effective teaching strategy for increasing student awareness of underserved populations, cultural diversity and ethical patient care. The study also suggests that the service-learning experience helped students determine their level of interest in public health as a career choice by giving them a real-world experience in a public health setting.*

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## **Dental Hygiene Student's Personal Style And Preference To On-Line Vs. Classroom/Lecture Courses**

Eva M Lupovici, RDH, MS, Judy Kreismann, RDH, MA, Lisa Stefanou, RDH, ED and Cheryl Westphal, RDH, MS

*New York University College Of Dentistry*

*A Survey of Personal Styles and a questionnaire on attitudes to on-line vs. classroom/lecture courses were administered to 57 recent graduates of a dental hygiene program to assess if there is a correlation between personal style, and preference to on-line vs. classroom lecture courses. The I-Speak Your Language, ® questionnaire was used, it is based on the theory developed by Carl Jung that identifies four major personal styles individuals use in varied situations: Intuitor (I), Thinker (T), Feeler (F), and Senser (S). There are main functions of behavior associated with each style, which may indicate a preference for on-line vs. classroom courses. In conjunction, a self-developed questionnaire on attitudes to on-line vs. classroom lecture courses was administered. The results of the survey of the primary style under non-stress conditions were 37% had personal style of F, 28% S, 25% T, and 10% I. One half of all I and T groups stated that they liked taking on-line courses, compared to 31% of S and 28% of F styles. Preference for classroom/lecture courses were 37% by S, 33% I and 28% for each of the T and F groups. The I group preferred to have the curriculum equally divided between lecture and on-line at 33%, to 9% by F. Taking re-licensure C.E. courses on-line was planned by 100% of I, 80% by F, and 64% and 62% by T, S respectively. Future enrollment in a baccalaureate degree on-line program results ranged from 57% by F to low of 42% by T.*

*The results of the survey and questionnaire indicated that the I personal style students whose associated characteristics are described as original, imaginative, creative, broad-gauged, and idealistic were more in favor of on-line courses. With the ever increasing on-line courses offered in DH and higher education curriculums, knowledge of a student's individual personal style may be used by faculty to recognize the associated personal style characteristics to mentor, and develop educational strategies to meet students' needs in on-line or classroom/lecture courses.*

Source: Journal of Dental Hygiene, Vol. 82, No. 5, October 2008

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## **Personality Styles Of Graduates Of A Dental Hygiene Program**

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*New York University College Of Dentistry*

*I-Speak Your Language, ® A Survey of Personal Styles was administered to 57 recent graduates of a dental hygiene program to determine each student's favored primary personal style, and group profile based on 4 major personal styles. The Survey is based on the theory developed by Carl Jung, and is designed to measure individual primary personal style, and associated styles of behavior in favorable and stressful conditions.*

*The 4 major personal styles are: Intuitor(I), Thinker(T), Feeler(F), and Senser(S). The results of the survey indicate that under favorable conditions 37% of the graduates were F, who relate to and understand experiences through emotional reactions and responds to feeling. There were 28% S, who experience mainly on the basis of their own sensory perceptions. There were 25% T who analyze and order in logical fashion, and 10% I, who conceive, project, and are creative. In unfavorable conditions or stress, 39% of all the graduates were F, 33% S, 16% I, and 12% T. The changes in styles are the following: Under stress 43% of the graduates whose style that of an F, remained the same, while 48% reverted equally to I or S, and 9% T. Under stress, 38% of the S personal style remained the same, 44% reverted to F, 12% I, 6% T. Under stress, 21% of the T personal style remained the same, 36% became F, and 36% S, and 7% I. The I style became 50% S, with the remaining equally divided among the other 3 personality styles.*

*The results of the Survey identified the personal styles of graduates of one dental hygiene program in favorable and unfavorable conditions, and the main functions associated with each style. Knowledge of individual primary personal styles and associated characteristics by educators and students could assist each to self-analyze behavioral observations to help each individual to determine the extent to which his/her style applications are working constructively or not. It gives a clear understanding of how over reliance on some styles or under-use of other styles may be contributing to success or difficulties in school and life. Approaches to life are different for the various personal styles.*

Source: Journal of Dental Hygiene, Vol. 82, No. 5, October 2008

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## **Raising Oral Health Awareness among Nephrology Nurses**

Elaine M Sanchez Dils, RDH, MA, Kim T Isringhausen, BSDH, MPH and Christine Mary Blue, BSDH, MS

*Elaine M. Sanchez Dils, RDH, MA is from the University of New Mexico, Division of Dental Hygiene. Kim T. Isringhausen, BSDH, MPH is from the Virginia Commonwealth University School of Dentistry, Division of Dental Hygiene. Christine Mary Blue, BSDH, MS is from the University of Minnesota School of Dentistry, Division of Dental Hygiene.*

*According to The National Kidney Foundation, 20 million Americans have Chronic Kidney Disease (CKD). Given the prevalence of conditions such as diabetes and hypertension, it is estimated that an additional 20 million people are at an increased risk for developing CKD. Research suggests chronic renal failure can give rise to a wide spectrum of oral manifestations affecting the hard or soft tissues of the mouth. Likewise, periodontitis may contribute to the burden of systemic inflammation in these patients. Unfortunately, CKD patients and their health care providers are often unaware of the oral complications of the disease as well as the multiple systems that can be affected. The complexity of care for patients with CKD reinforces the need for collaboration between healthcare providers. The purpose of this study was to raise oral health awareness by providing educational seminars to healthcare providers, specifically nephrology nurses. By doing so they should be able to recognize early oral manifestations, provide basic patient education, and when necessary, make referrals to address these concerns.*

*Educational seminars entitled Oral Health and Chronic Kidney Disease were delivered by calibrated dental hygiene educators to renal nurses in three different regions in the United States. The nurse participants (n=106) were given randomly assigned pre- and post-tests, assessing their knowledge of oral health (OH) and its relation to CKD. These tests consisted of six multiple choice and four true/false questions.*

*Pre-tests revealed that nurses had little knowledge of oral health and its relation to CKD. Regardless of questionnaire order, a significant increase of knowledge was observed for both groups ( $p\text{-value} \leq 0.015$ ), increasing from 61% to 76% on average. Incorporating interdisciplinary education, such as the educational seminar, benefits nurses' knowledge and can potentially lead to greater quality of life outcomes and improved overall health in patients with Chronic Kidney Disease.*

Source: Journal of Dental Hygiene, Vol. 82, No. 5, October 2008

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## **Assessment Of A Service-Learning Component At The Armstrong Atlantic State University Dental Hygiene Department**

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*Armstrong Atlantic State University*

*With the development of the Americans with Disabilities Act (ADA) of 1990 and the move toward deinstitutionalization, there has been an increased awareness of the health needs of persons with disabilities. However, it has been reported that only 10 percent of general dentists surveyed treat children with special needs on a regular basis, citing patient behavior as the greatest barrier to care. Educational research has shown that by integrating service-learning into dental and dental hygiene curricula, graduates are better prepared to provide dental care for diverse populations and more likely to treat individuals with developmental disabilities in the future. The purpose of this non-experimental study is to measure the comfort and confidence levels of senior dental hygiene students in the dental management of individuals with disabilities.*

*The sample population consisted of 19 senior dental hygiene students at Armstrong Atlantic State University in Savannah, GA. Elements of the Service-Learning component were incorporated into existing didactic dental hygiene courses and included didactic instruction related to service-learning pedagogy, issues surrounding ethics and civil responsibility of health professionals, and the dental management of individuals with disabilities. Each student was required to provide dental hygiene services to a minimum of two patients with special needs in the onsite clinic, as well as participate in a clinical rotation at Georgia Regional State Hospital's Dental Clinic.*

*In the form of a survey, each student indicated on a five-point Likert scale, the level of confidence and comfort she feels with respect to treating patients with nine possible disabilities (dementia, mental illness, cerebral palsy, mental retardation, severely medically compromised, limited dexterity, visually impaired, hearing impaired, and wheelchair-bound). In addition, each student will complete three "reflection" exercises during the course, and at the end, of the semester. Results are being analyzed utilizing quantitative and qualitative methods.*

Source: Journal of Dental Hygiene, Vol. 82, No. 5, October 2008

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## **Tobacco Cessation Education In North Carolina Dental Hygiene Programs**

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*University Of North Carolina At Chapel Hill*

*Inadequate training in tobacco cessation counseling is a recognized, but mutable, barrier to implementation of tobacco cessation education (TCE) and intervention strategies in dental practice. Without adequate instruction or opportunity to develop competence, dental hygienists are less likely to provide regular tobacco cessation counseling and education to patients.*

*Objectives: To identify the practices and perceptions of senior dental hygiene students (SDHS) in North Carolina (NC) regarding their didactic training in TCE and integration of TCE into their clinical dental hygiene curricula.*

*Methods: A 26-item questionnaire was developed, pre-tested, and administered to a non-random, convenience sample of 241 graduating SDHS enrolled in all 12 NC dental hygiene programs (DHPs) via mail (n=180) or email via Survey Monkey (n=61). Data analyses including frequency distributions and tests of chi-square were conducted using JMP 6.0.2.*

*Results: Response rate was 65% (n=156). Of respondents, 99% agreed that hygienists should be trained to provide TCE. Most SDHS reported receiving classroom instruction about the American Dental Hygienists' Association's smoking cessation initiative (Ask.Advise.Refer.) (73%) and/or the 5 A's of tobacco cessation (68%). Sixty-nine percent stated their classroom instruction was reinforced by clinical instructors. Nearly all SDHS (99%) had one or more patients who smoked and 81% had one or more patients who used spit tobacco. Eighty-nine percent had one or more patients that expressed a desire to quit. Most SDHS were comfortable providing TCE to both smokers (92%) and spit tobacco users (93%); however, 26% reported that they were not comfortable providing quit messages to patients unwilling to quit. SDHS who are non-tobacco users were 2.9 times more likely to discuss the potential benefits of quitting than SDHS who are current tobacco users.*

*Conclusions: Deficiencies in TCE exist in NC DHPs. Enhancements to TCE in dental hygiene curricula may increase incorporation of TCE by Hygienists' in future practice.*

Source: Journal of Dental Hygiene, Vol. 82, No. 5, October 2008

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## **Motivational Interviewing (MI) As An Intervention For Early Childhood Caries Risk-Related Behaviors**

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*The purpose of this pilot study was to assess whether an individualized motivational interviewing (MI) approach to oral health education affected early childhood caries (ECC) risk-related behaviors of mothers enrolled in a WIC Program. ECC risk is higher in select populations, and conventional educational practices are ineffective in addressing universal behavior change.*

*After human subjects' approval, seventy-two mothers were recruited and randomly assigned to one of two groups. Pretest questionnaires were completed followed by posttests one month later. The Readiness Assessment of Parent's Concerning Infant Dental Decay (RAPIDD) is a valid and reliable instrument developed to assess a parent's stage of change. The Parental Care of Child's Teeth (PCCT) instrument was developed and pretested prior to this study to assess differences in parental ECC risk-related behaviors. Between pretests and posttests, the researcher provided an MI counseling type session and individualized follow-up telephone calls promoting positive oral health behaviors for mothers in the intervention group.*

*No statistically significant differences were found between groups' demographics. Repeated measures ANOVA, Kolmogorov-Smirnov Test and Wilcoxon Signed Ranks Test were used to analyze collected data. No clinically significant change was found in the four constructs measured with RAPIDD: valuing dental health, permissiveness, convenience and change difficulty, or openness to health information. Results of the PCCT questionnaire found statistically significant positive changes in the number of times the children's teeth were cleaned or brushed and the use of shared eating utensils. The nonparametric McNemar Test analyzed differences in the use of shared utensils. MI is a promising approach that may guide parents to adopt preventive oral health measures and decrease their children's risk of ECC. Extending the length of time for the intervention and studying motivation of parents' from diverse population groups to adopt oral health behaviors might impact future results. Further study is needed.*

*Conclusions: Deficiencies in TCE exist in NC DHPs. Enhancements to TCE in dental hygiene curricula may increase incorporation of TCE by Hygienists' in future practice.*

Source: Journal of Dental Hygiene, Vol. 82, No. 5, October 2008

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## **The explanatory model of Mexican American Mothers' perception of Dental decay**

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*Idaho State University*

*The purpose of this study was to describe the explanatory model of Mexican American mothers' perceptions of dental decay and to determine the decay rate of their children. A mixed methods research design was used to understand mothers' perception of dental decay. The sample was derived from volunteers in a community in Southeast Idaho, who responded to flyers posted at Hispanic organizations' locations. Mexican American mothers who had children between the ages of 3-14 and could read or write in Spanish or English scheduled appointments for an interview and their children's dental screening.*

*Interviews were conducted using Kleinman's explanatory model to illicit the mothers' perceptions of dental decay related to: etiology; onset of symptoms; pathophysiology; course of decay; and treatment. Interviews were conducted by three Hispanic health promoters, who used scripted open-ended questions. To assess the current decay rates of the children, a DMFT/deft and an active decay score were collected. One researcher conducted the dental assessments while another research recorded the data.*

*Thirty mothers and 54 children participated in the study. The qualitative data revealed that mothers were familiar with dental decay through personal experience and family members' experiences. Mothers were unaware of the cause of dental decay and recognized the onset of disease through pain. Pain was experienced on many levels and severe pain influenced daily functioning. Mothers believed cavities could progress and used home remedies to decrease pain. Professional dental treatment for decay was sought when pain was no longer manageable at home. Barriers such as a lack of money, lack of insurance, and problems related to language and transportation inhibited the participants' access to care.*

*The children's dental assessment data reported an average deft/DMFT score of 5.06 teeth and an active decay score of 2.11 teeth per child. These scores are consistent with past research on Mexican American children's high rate of decay. Mothers believed that decay was a serious condition; however, they faced many barriers in accessing oral health care.*