



American
Dental
Hygienists'
Association

Journal of Dental Hygiene

October 2018 • Volume 92 • Number 5

- Advancing Dental Hygiene Education: What does research tell us about the future of dental hygiene?
- Relationships Between Course Capture Systems and Student Performance in Dental Hygiene Education
- Collaborative Skill Building in Dentistry and Dental Hygiene through Intraprofessional Education: Application of a quality improvement model
- Workplace Bullying: A survey of Virginia dental hygienists
- Dental Hygienists' Knowledge, Attitudes, and Comfort Level in Treating Patients with Dental Anxiety
- Blood Pressure Recording Practices Among Dental Hygiene Students
- A Comparison of Oral Hygiene Products and Professional Care: A six-week randomized clinical trial
- Dentsply Sirona/ADHA Graduate Student Clinician Research Abstracts

Journal of Dental Hygiene

October 2018 • Volume 92 • Volume 5

Statement of Purpose

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

Subscriptions

The Journal of Dental Hygiene is published bi-monthly online by the American Dental Hygienists' Association, 444 N. Michigan Avenue, Chicago, IL 60611. Copyright 2018 by the American Dental Hygienists' Association. Reproduction in whole or part without written permission is prohibited. Subscription rates for non-members are one year, \$60.

Submissions

Author guidelines and the manuscript submission process can be found at: http://www.adha.org/resources-docs/7833_JDH_Author_Guidelines.pdf

2018 – 19 ADHA Officers

President

Michelle Braerman, RDH, BSDH

Treasurer

Donnella Miller, RDH, BS, MPS

President Elect

Matt Crespin, RDH, MPH

Immediate Past President

Tammy Filipiak, RDH, MS

Vice President

Lisa Moravec, RDH, MS

ADHA/JDH Staff

Editor-In-Chief

Rebecca S. Wilder, RDH, MS
rebeccaw@adha.net

Chief Operating Officer

Bob Moore, MA, CAE
bobm@adha.net

Managing Editor

Catherine K. Draper, RDH, MS
cathyd@adha.net

Co-Director of Professional Development & Member Engagement

Sue Bessner
sueb@adha.net

Editor Emeritus

Mary Alice Gaston, RDH, MS

Layout/Design

Dorreen Petersen Davis, MS

Chief Executive Officer

Ann Battrell, MSDH
annb@adha.net

Editorial Review Board

Celeste M. Abraham, DDS, MS
Cynthia C. Amyot, RDH, EdD
Roland R. Arnold, PhD
Joanna Asadoorian, RDH, PhD
Kathryn Bell, RDH, MS
Kristy Menage Bernie, RDH, MS
Stephanie Bossenberger, RDH, MS
Denise Bowen, RDH, MS
Linda D. Boyd, RDH, RD, EdD
Jennie Brame, RDH, MS
Kimberly S. Bray, RDH, MS
Ann Bruhn, BSDH, MS
Lorraine Brockmann, RDH, MS
Patricia Regener Campbell, RDH, MS
Aubree Chismark, RDH, MS
Lorinda Coan, RDH, MS
Marie Collins, EdD, RDH
Sharon Compton, RDH, PhD
Amy E. Coplen, RDH, MS
Elizabeth T. Couch, RDH, MS
Susan J. Daniel, RDH, MS
Kathy Eklund, RDH, MHP
Melissa Efurud, RDH, MSDH, EdD
Deborah E. Fleming, RDH, MS

Priscilla Flynn, RDH, MPH, PhD
Jane L. Forrest, RDH, MS, EdD
Jacquelyn L. Fried, RDH, MS
Danielle Furgeson, RDH, MS, DHSc
Joan Gluch, RDH, PhD
Maria Perno Goldie, RDH, MS
Ellen B. Grimes, RDH, MA, MPA, EdD
Tami Grzesikowski, RDH, MEd
JoAnn R. Gurenlian, RDH, PhD
Linda Hanlon, RDH, MEd, PhD
Melanie J. Hayes, BOH, BHSc, PhD
Rachel Kearney, RDH, MS
Harold Henson, RDH, MEd, PhD
Kathleen Hodges, RDH, MS
Alice M. Horowitz, RDH, PhD
Janet Kinney, RDH, MS
Elizabeth C. Kornegay, CDA, RDH, MSDH
Deborah Lyle, RDH, BS, MS
Lisa F. Harper Mallonee, BSDH, MPH, RD/LD
Deborah S. Manne, RDH, RN, MSN, OCN
Sally M. Mauriello, RDH, EdD
Tanya Villalpando Mitchell, RDH, MS
Tricia Moore, RDH, EdD
Christine Nathe, RDH, MS

Jodi Olmsted, RDH, PhD
Pamela Overman, RDH, MS, EdD
Brian Partido, RDH, MS
Ceib Phillips, MPH, PhD
Lori Rainchuso, RDH, DHSc
Dorothy J. Rowe, RDH, MS, PhD
Tammy R. Sanderson, RDH, MS
Cynthia F. Sensabaugh, RDH, MS
Melanie Simmer-Beck, RDH, PhD
Deanne Shuman, BSDH, MS PhD
Ann Eshenaur Spolarich, RDH, PhD
Rebecca Stolberg, RDH, MSDH
Julie Sutton, RDH, MS
Sheryl L. Ernest Syme, RDH, MS
Terri Tilliss, RDH, PhD
Lynn Tolle, BSDH, MS
Bethany Valachi, PT, MS, CEAS
Marsha A. Voelker, CDA, RDH, MS
Donna Warren-Morris, RDH, MEd
Cheryl Westphal Thiele, RDH, MS, EdD
Karen B. Williams, RDH, MS, PhD
Tim Wright, DDS, MS
Pamela Zarkowski, BSDH, MPH, JD

Inside this Issue

Guest Editorial

- 4** **Advancing Dental Hygiene Education: What does research tell us about the future of dental hygiene?**
Colleen M. Brickle, RDH, EdD

Innovations in Education and Technology

- 6** **Relationships Between Course Capture Systems and Student Performance in Dental Hygiene Education**
Carly J. Havner, RDH, MS; Mary M. Gerkovich, PhD; Kimberly K. Bray, RDH, MS; Marsha A. Voelker, CDA, RDH, MS
- 14** **Collaborative Skill Building in Dentistry and Dental Hygiene through Intraprofessional Education: Application of a quality improvement model**
Tricia S. Barker, RDH, MEd; Chet A. Smith, DDS; Geri M. Waguespack, RDH, MS; Donald E. Mercante, PhD; Tina P. Gunaldo, PhD, DPT, MHS

Research

- 22** **Workplace Bullying: A survey of Virginia dental hygienists**
Gayle B. McCombs, RDH, MS; S. Lynn Tolle, RDH, MS; Tara L. Newcomb, RDH, MS; Ann M. Bruhn, RDH, MS; Amber W. Hunt, RDH, MS; Lanah K. Stafford, MA
- 30** **Dental Hygienists' Knowledge, Attitudes, and Comfort Level in Treating Patients with Dental Anxiety**
Lauren Kanzigg, RDH, MS; Ceib L. Phillips, PhD; Margot B. Stein, PhD; Lynne C. Hunt, RDH, MEd, MS; Rebecca S. Wilder, RDH, MS
- 38** **Blood Pressure Recording Practices Among Dental Hygiene Students**
Julie D. Sutton, RDH, MS; Sally A. Elledge, RDH, MS; JoAnna M. Scott, PhD; Chris D. Rice, DDS, EdS
- 45** **A Comparison of Oral Hygiene Products and Professional Care: A six-week randomized clinical trial**
Cristina E. Garcia-Godoy, DDS, MPH; Kevin L. Flores, BS, MPH; Malgorzata A. Klukowska, DDS, PhD; Erinn L. Conde, BS; Robert W. Gerlach, DDS, MPH
- 52** **Dentsply Sirona/ADHA Graduate Student Clinician Research Abstracts from the 2018 Annual Conference of the American Dental Hygienists' Association**

Advancing Dental Hygiene Education: What does research tell us about the future of dental hygiene?

Colleen M. Brickle, RDH, EdD



In June of this year, Rutgers University held a workshop, inviting researchers for the project “Advancing Dental Education: Gies in the 21 Century.” The project consisted of two phases. In phase one, background papers focusing on the trends that will determine the future direction of dental education were written and published.^{1,2} Phase two consisted of the workshop where participants reviewed the published papers and made recommendations to address the issues and challenges in dental education over the next 25 years. A common theme voiced throughout the workshop was for dental education to be innovative and responsive to current and new workforce models in order to meet the demands of all populations seeking oral health care.

Minnesota has a reputation for developing and implementing innovative and creative ways to meet the demands of a prepared and competent dental workforce. In 1969 Minnesota was the first state to mandate continuing education requirements to maintain licensure.³ In 2001, Minnesota was the third state to expand access to care by allowing dental hygienists to provide dental hygiene care beyond the traditional, brick and mortar practice setting.⁴ Then in 2009, Minnesota was the first state to authorize the licensure of dental therapists and certification of advanced dental therapists.⁵

Minnesota has not been resting on its laurels. In 2012, dedicated educators and administrators designed an innovative approach to move baccalaureate education forward as the entry level for dental hygiene. More than forty years ago, the American Dental Hygienists’ Association advocated elevating the profession with the baccalaureate degree as the entry level for dental hygienists.⁶ The American Dental Education Association also published a brief on expanding dental hygiene pathways toward a bachelor degree.⁷ In reality, the majority of dental hygiene associate degree programs already approach a minimum of three years due to the required prerequisite courses necessary to meet the Commission on Dental Accreditation standards.

Associate degree graduates (AA/AAS) are seeking seamless pathways to a bachelor degree. However, most importantly, baccalaureate education is necessary for dental hygienists to meet the oral health care needs of all populations in the 21st century, especially for our vulnerable populations.⁷ In order to meet the needs of these populations, dental hygiene programs must prepare students to deliver care in settings beyond clinical private practice. Today’s oral health care professionals need higher-level order of problem-solving skills to be able to think critically while applying evidence to inform practice. Meeting this challenge as well as the other competencies such as health literacy, cultural sensitivity, community-based and/or interprofessional practice, by simply adding more content to an already crowded associate degree curriculum, is not possible.

The most recent innovative education pathway from Minnesota is the option of a dual admissions and enrollment program.⁸ In addition to Minnesota, Texas has developed a similar model of dual admissions at Texas Women’s University.⁹ How does dual enrollment work in Minnesota? Students admitted and enrolled in an AS/AAS dental hygiene program can begin to take upper division courses simultaneously to obtain a bachelor degree in dental hygiene (BSDH). This creative and seamless pathway allows a student to graduate with an AA/AAS degree from a community or technical college and a bachelor’s degree simultaneously or within a semester of completing the AA/AAS degree.

Students admitted to Normandale Community College’s associate dental hygiene program are enthusiastic about the opportunity to dual enroll at Metropolitan State University. Testimonials from students show that this curriculum model is achievable and prepares students for practicing in settings outside of private practice. Licensed dental hygienists seeking a BSDH as part of the degree completion program enroll in the core upper division dental hygiene courses with the associate students. An unexpected outcome of this program has been the mentorship and guidance provided by licensed dental hygienists.

The BSDH courses are delivered online and easily fit schedules. The coursework is individualized and paced to encourage student success. The bachelor curriculum content includes such topics as project management, leadership, business planning, team-based care, health equity, interprofessional collaboration and public health. Students find the BSDH degree a gateway to further study by offering a direct path to a master's degree in dental therapy, education, business public health, dental therapy and other education or career opportunities.

Higher education views this model as a win-win for students and the institutions. Community colleges can count the associate degree graduates in their completion totals and the university can count the baccalaureate degree graduates in their completion totals. Funding from Delta Dental of Minnesota Foundation along with a Health Resources and Services Administration (HRSA) workforce grant has allowed for Normandale Community College to expand dual admissions and enrollment to include four other AA/AAS degree programs in dental hygiene in the state of Minnesota.

Constant communication and collaboration between institutions is the key to success when developing an innovative educational pathway such as the dual enrollment programs in Minnesota and Texas.¹⁰ Successful programs take commitment and dedication for the long haul and challenges will occur! Dental hygiene educators throughout Minnesota believe strongly that graduates need to be well prepared not only for traditional private practice settings but also for emerging practice settings in order to meet the needs of all populations.

For additional information and resources on dual admissions /enrollment as well as other innovative initiatives in Minnesota, access the Normandale Community College's signature website, "Minnesota 21st Century Dental Team at www.normandale.edu/mndentalteam.

Colleen M. Brickle, RDH, EdD is the Dean, Department of Health Sciences at Normandale Community College, Bloomington, MN.

References

1. Balit, HL, Formicola, AJ. Advancing dental education in the 21st century. J Dent Educ, 2017 Aug; 81 (8):1004-32.
2. Fried, JL. The allied professions: executive summary. J Dent Educ. 2017 Sept; 81 (9):1130-36
3. McDonnell, RE. The Minnesota experience: implementing mandatory continuing education. J Am Dent Asso. 1976 Jun;92 (6):1218-24.
4. Minnesota statutes 150A.10 subdivision 1. <https://www.revisor.mn.gov/statutes/cite/150A.10/pdf>.
5. Minnesota statutes 150A.105. <https://www.revisor.mn.gov/statutes/cite/150A.105>
6. American Dental Hygienists' Association. Policy manual [Internet]. Chicago: American Dental Hygienists' Association; 2018 [cited 2018 Oct 1] Available from: http://www.adha.org/resources-docs/7614_Policy_Manual.pdf.
7. American Dental Education Association. Bracing for the Future: opening up pathways to the bachelor's degree for dental hygienists. ADEA and the institute for higher education policy, 2011 [Internet]. Washington, DC: American Dental Education Association; 2018 [cited 1 Oct 2018]. Available from: https://www.adea.org/policy_advocacy/workforce_issues/Pages/default.aspx
8. Sidd, DJ. The journey to opportunity. Dimens Dent Hyg. 2017 Apr;15 (4):16-17.
9. Texas Woman's University. Dual admissions dental hygiene [Internet] Denton: Texas Woman's University; 2018 [cited 2018 Oct 1]. Available from: <https://twu.edu/dental-hygiene/programs/dual-enrollment-dental-hygiene/>
10. American Dental Hygienists' Association. Education partnership: associate to bachelor. Access [Internet]. 2017 Aug [cited 1 Oct]; 31(7):7-8. Available from: <http://pubs.royle.com/publication/?i=432204&ver=html5&p=19>.

Relationships Between Course Capture Systems and Student Performance in Dental Hygiene Education

Carly J. Havner, RDH, MS; Mary M. Gerkovich, PhD; Kimberly K. Bray, RDH, MS;
Marsha A. Voelker, CDA, RDH, MS

Abstract

Purpose: The aim of this mixed-methods longitudinal study was to assess student perceptions of technology use, and to examine the relationship between technology use and performance as reflected by self-reported student grade point averages.

Methods: Students (n=351) enrolled in a dental hygiene program within a dental school located in the mid-western United States were surveyed in three courses from 2008 through 2012 to gather their perceptions regarding usage of a lecture recording system (LRS). Additionally, self-reported grade point averages were collected over the same period of time. Data were analyzed using a statistical software program (IBM SPSS; Armonk, NY).

Results: The response rate was 82%. Descriptive statistics demonstrated that students believed that the LRS increased their success and satisfaction in the course and would be useful in other courses. Students also reported they would not choose to miss class sessions based on the availability of the recorded lectures. Correlation statistics found no relationship between student GPA and students' perceptions regarding the LRS.

Conclusion: Students reported LRS use and availability did not impact their attendance. No relationship was found between students' self-reported GPA and evaluation of the LRS use within the limits of this study.

Keywords: Lecture recording systems, course capture system, performance perceptions, dental hygiene education

This manuscript supports the NDHRA priority area: **Professional development: Education** (educational models).

Submitted: 1/2/18; accepted: 6/16/18

Introduction

Research on new teaching modalities supports the development and implementation of technology within the classroom setting as well as across all educational platforms. Higher education students have come to expect technology use within class formats; however due to the evolving nature of educational technologies, appropriateness of technology use is often overlooked.^{1,2} Implementing technologies primarily to satisfy student expectations is no longer adequate rationale for use; selecting appropriate educational technologies is essential for student development and achieving learning goals.

The Internet, or worldwide web, has been a major contributor to educational technology; educational systems utilizing the Internet are frequently referred to as web-based technologies.³ Web-based deliveries vary in use ranging from courses offering exclusively online learning experiences to blended or hybrid delivery of online components, and face-to-face/on-campus experiences.² Tegrity© (McGraw-Hill

Education; New York, NY), a web-based lecture recording system (LRS), is capable of recording lectures and classroom activities, including camera-view events, audio, and media-based slides and quizzes, for later use. The platform integrates camera video, audio, and multimedia slides into a seamless viewing experience⁴ and may be used as an online only format or in combination with face-to-face class sessions. Students may choose to play, pause, fast forward, rewind, and increase or decrease the playback speed of these recordings.

LRS technologies may be offered for a variety of reasons including institutional policy, instructor choice, student expectations, support for absent or special needs students, support for non-English speakers, and as a supplemental learning and/or teaching method.^{2,5-6} While the integration of e-learning materials into the classroom experience may be expected by Millennial or Gen Next students, their acceptance and use frequently depends on students' perception of the specific technology options. Acceptance of a LRS is often

dependent on personal experience with the format; multiple studies report that students view a LRS positively.^{5,7-10}

Previous studies have compared the effectiveness of web-based instruction to in-class instruction, however there are few studies reporting on blending digital education and traditional in-person classroom settings. Additionally, most studies have been short-term in nature, typically covering only one course or one class of students at a time. Little has been reported within the field of dental hygiene on blended educational technologies or on the relationship between LRS and student outcomes. The purpose of this study was to survey the perceptions of dental hygiene students over a five-year period regarding the use of a LRS with a focus on student satisfaction and content retention. Results of this study can serve to add to the body of knowledge regarding the use of LRS within dental hygiene education programs in addition to providing an aspect of program evaluation.

Methods

Study design

A descriptive, associational, and comparative study design was used to address the research questions. A descriptive model was used to summarize student demographic variables and the evaluation of the use of the LRS, Tegrity© (McGraw-Hill Education; New York, NY), within three separate dental hygiene courses utilizing both traditional and flipped classroom pedagogies. An associational approach was used to examine the relationships and possible predictors between the LRS use and self-reported student grade point averages (GPA) and a comparative approach was used to examine differences in the subgroups within analyzed data. Data collection methods and analysis were reviewed and determined exempt from the Social Sciences Institutional Review Board of the University of Missouri, Kansas City.

Study population

Program evaluation survey data, previously collected but not analyzed, was collected from a convenience sample of junior and senior students enrolled in the dental hygiene program at the University of Missouri, Kansas City, School of Dentistry. Each class consisted of approximately thirty dental hygiene students, totaling about sixty students per year. Inclusion criteria included all of the dental hygiene students enrolled in the program who were present for the final examination administered during the last on-campus session of selected courses dating from the summer of 2008 through 2012. Three courses, Oral Health, Dental Biomaterials, and Seminar in Dental Hygiene II, were assessed annually over

the five-year period. Faculty, LRS use including availability, functions, and video and audio of the instructor during recordings, remained the same throughout the period of study. Two courses, Oral Health and Biomaterials, utilized flipped classroom pedagogies. Students prepared for class sessions by viewing pre-recorded lecture content independently, prior to the class session and were expected to put the newly acquired knowledge into practice during class through collaborative activities, case study evaluations, dental product reviews, and laboratory procedure preparations. The third course, Seminar in Dental Hygiene II, utilized a traditional faculty centered approach. Students attended class sessions in person and the lectures recorded during class were available for study and review following the sessions. Additionally, students in the seminar course were able to use the LRS to review pre-recorded course content to gain knowledge for the laboratory procedures planned for the following day including sealant application, intraoral camera utilization, and air powder polishing. It is possible that multiple exit surveys were collected from an individual student as they moved through the required courses during the two-year Bachelor of Science program. The surveys contained no individual identifiers therefore it is unknown how many surveys were completed per student; however, the surveys were numbered for quality assurance, and were linked to the responses. Student anonymity was taken into consideration in order to encourage honest, useful feedback. Students choosing to participate gave implied consent with their participation, completed the survey and placed it in an envelope placed at the back of the room. Students choosing not to participate were free to turn in their final examination and the blank survey prior to leaving the classroom. The surveys were sorted and stored by course, semester, and year.

Survey instrument

The exit survey was developed for use in a similar study; however, modifications were made to personalize it and include specific questions related to the issues of perceived retention of course material as a result of using the LRS and the perceived advantages of access to course materials when unable to attend class sessions. Faculty experts on survey development in the School of Dentistry provided input and revisions to the survey instrument, and further revisions were made following a pilot test of the modified survey.

The modified survey consisted of 26 multiple-choice and Likert-scale items with several opportunities for students to write comments about their use and perceptions of the LRS. Students were asked about number of opportunities of use, actual uses of, and reasons for the use of the LRS. If the student did not use LRS, written answers were requested

asking for reasons and in what circumstances the student might find the LRS useful. Student perceived comparisons between courses in which the LRS was used and those in which the LRS was not used were requested, as well as direct comparison between the LRS and voice-narrated lecture slides only (no video) utilized in other courses taken by the student cohort. Additionally, questions regarding student perceptions of course content retention following individual LRS use and the video option within the LRS system were examined.

Data collection

The multiple-choice item answers included nominal, dichotomous, and ordinal; student perception items were considered ordinal. Medians and interquartile ranges were calculated as central tendency measures for findings ordinal in nature. The majority of answer options included broad categories, although several answers offered yes or no options only. Additional written comments were elicited in many cases.

Demographic variables included age range, race, gender, personal ownership of video-viewing device, and self-reported grade point average. Ownership of a personal video-viewing device, such as a smart phone, did not imply the device was utilized to view recorded lectures, merely that the student owned such a device. The remaining variables were collected to test the research questions regarding instructor use; student perceived advantages, disadvantages, and satisfaction level of LRS use; and, the relationship of LRS use to GPA.

Analysis

Data entered and analyzed in statistical software program (IBM SPSS; Armonk, NY) using descriptive statistics and correlation statistics to identify possible relationships between variables. Written comments were categorized and entered manually into a spreadsheet.

Results

Of the 429 students (n=429) estimated to be present during the period of study, a total of 351 surveys (n=351) were completed for the three courses over the five-year period for a response rate of 82%. The sample was predominately white, female, between the ages of twenty and twenty-two, with a self-reported GPA of 3.0 or higher, and owned some type of mobile recording device (Table I). This is comparable to the population demographic of eligible participants (i.e. dental hygiene students).

Over half of the students, 60%, reported instructors used the LRS in two or more courses in an online format. A majority, 81%, of the students reported using the LRS for review and study purposes. Students who used the LRS reported it aided

Table I. Sample Demographics

Characteristic	Number (Percentage)
Gender	
Male	11 (3.2%)
Female	333 (96.8%)
Age	
20 - 22 years of age	167 (48.8%)
23 - 25 years of age	96 (28.1%)
26 - 30 years of age	40 (11.7%)
30 plus years of age	39 (11.4%)
Race/Ethnicity*	
American Indian/Alaskan Native	1 (0.3%)
Asian	5 (1.7%)
Black or African American	3 (1.0%)
Native Hawaiian/Other Pacific Islander	5 (1.7%)
White	262 (90.7%)
Asian <i>and</i> White	0 (0.0%)
Black or African American <i>and</i> White	4 (1.4%)
American Indian/Alaskan Native <i>and</i> Black or African American	3 (1.0%)
Hispanic/Latino	6 (2.1%)
Self-reported GPA Category	
3.5 – 4.0	145 (50.2%)
3.0 – 3.4	118 (40.8%)
2.5 – 2.9	24 (8.3%)
Below 2.4	2 (0.7%)
Video viewing device ownership	
iPod music player	120 (35.0%)
iPod video player	42 (12.2%)
iPhone	66 (19.2%)
MP3 player other than iPod	24 (7.0%)
No MP3 player but plan to buy one	7 (2.0%)
None of the above	84 (24.5%)

* Race-ethnicity categories are those used in the U.S. census

in retention of course material (80%), increased their overall success (54%), and increased satisfaction with the course (53%). The majority of students believe the inclusion of the video of the instructor speaking in the LRS recordings was helpful (68%), and that they preferred the LRS recordings over voice narrated lecture slide sets (72%). Students reported rarely or never experiencing technical issues while using the LRS (67%). Seventy-five percent of students indicated the availability of the LRS recordings would not increase their likelihood to miss class and had no impact on their decision to attend class sessions (Table II). However, it is important to note that professional programs, such as dental hygiene, often have attendance policies, and influence of such policies may affect student responses to attendance-related questions.

In addition to describing the sample characteristics and item specifics, some variables were used to create sub-scales that were compared to student responses to the LRS use and evaluation items. Factor analysis (principal axis factor solution; varimax rotation; KMO = 0.80) was used to identify sub-groups of items that represented underlying constructs. Two subscale scores emerged from the dataset. The first subscale score (eigenvalue = 3.31), representing student evaluative perceptions, was derived from four survey items seeking feedback on student perceptions of overall satisfaction, impact on success, usefulness in other courses, and overall satisfaction in the course. The Cronbach's alpha score for the evaluative subscale was 0.82. The second factor (eigenvalue = 1.20), representing student frequency of use, was derived from two survey items seeking student feedback on the frequency of use for review, and the frequency of use for study purposes. The Cronbach's alpha score for the frequency subscale was 0.78.

Subscale scores were calculated for survey items measuring student evaluation of the LRS and compared to self-reported student GPA. In the initial set of surveys, students were asked to denote their GPA based on the following ranges: below 2.4, 2.5 – 2.9, 3.0 – 3.4, 3.5 – 4.0. All GPA data was calculated in range values with no significant relationship found between the LRS evaluation items and GPA scores 2.5 and above. However, the statistical analysis suggested significant correlation between the LRS evaluation items and students with a GPA range below 2.4. For this category, Spearman's rho was .191 (p value .001) and may be misrepresentative due to small sample size (n=2) in this category. Following the first year of data collection, students were asked to indicate their exact GPA in writing on the survey. No significant relationships were found between the LRS evaluation score and students' hand-written GPA.

Thematic analyses of the written comments on all surveys was conducted and three major categories of themes were identified (Table III). Theme one represented students' reports on how they used the LRS, including using it to supplement the regular class sessions, review of class material, in lieu of attending class sessions in-person, and for emergency situations or due to illness. Theme two, effects on attendance, included the subcategories of student preference and program attendance requirements. Evaluation of the LRS use was the third theme and included positive and negative comments regarding use, and the impact of technical issues.

With regards to how instructors and students utilized the LRS, students overwhelmingly reported use was blended, with the majority of lectures available online. Students wrote, "All lectures were available online," "Most lectures were prerecorded," and "Teachers posted every lecture." Additionally, students noted the LRS use was dependent on the specific instructor and was used predominantly "to review" following class or prior to an assessment. Students overwhelmingly commented that they would not be tempted to miss class sessions due to the LRS availability, often citing the program's attendance policy as a reason. Student comments included, "Can't miss or will fail the class," "I don't like being counted absent," "We can't miss class in the hygiene program," and "I always go to class."

Students perceived the LRS as positive overall, with many commenting on the usefulness of availability should a class be missed, increased repetition and retention of course materials, and increased attention and focus when viewing due to video of instructor. Survey comments included, "If I was ill and was unable to get out of bed I would consider making it up by reviewing the LRS recording," "Only if I had to, I prefer in-class lectures, but knowing I could review exactly what everyone else heard would be helpful if I really needed to miss class," "I would not intentionally miss but if I did have to, it is nice that it is there," "With reading issues it helped me retain material faster and easier," "It was helpful to hear the material repeated," and the video of the instructor was "... more interactive" and "Helps me focus on what the instructor is saying." Some students reported dislike of the particular LRS used due to technical issues, preferring alternate review resources, along with the amount of time needed to review recorded lectures outside of class time. Students wrote, "It freezes up occasionally mid-lecture," "Files that were very large could not be downloaded at home," "Certain browsers won't let me use it," "Takes a while to load," "I enjoy voice narrated slide lectures more," and "I don't like having both a lecture online and, in the classroom...I don't have time for both."

Table II. LRS Use

	Number (Percentage)
Instructor use:	
Less than 25% of the lecture material was online	39 (12%)
More than 25% but less than 50% of the lecture material was online	96 (28%)
50 – 100% of the lecture material was online	199 (60%)
Would student miss a class due to LRS availability?	
Yes	85 (25%)
No	255 (75%)
Student use for review:	
Never	15 (4%)
Rarely	50 (15%)
Sometimes	141 (41%)
Often	98 (29%)
Almost always	39 (11%)
<i>Did not use LRS (missing value, n=2)</i> Positive frequency of use total (Sometimes/Often/Always)	278 (81%)
Student use for study:	
Never	17 (5%)
Rarely	53 (16%)
Sometimes	115 (33%)
Often	107 (31%)
Almost always	51 (15%)
<i>Did not use LRS (missing value, n=2)</i> Positive frequency of use total (Sometimes/Often/Always)	273 (80%)
Student internet access:	
Wireless broadband access (cable, DSL) in an off-campus residence	266 (78%)
Use the computer lab in the library	38 (11%)
Use non-wireless broadband access (cable, DSH) in an off-campus residence	34 (10%)
Don't know	5 (1%)
Use dial-up access	0 (0%)
Compared to non-LRS courses, how did LRS availability affect decision to attend this course?	
Significantly reduced / Reduced somewhat	9 (3%)
No impact	325 (94%)
Significantly increased / Increased somewhat	11 (3%)
Compared to non-LRS courses, how did LRS affect study time in this course?	
Significantly reduced / Reduced somewhat	23 (7%)
No impact	226 (65%)
Significantly increased / Increased somewhat	96 (28%)

Discussion

In courses where face-to-face attendance was mandatory or highly encouraged some students found no need to access the LRS, instead depending on in-class presentations and other course materials for learning.^{8, 11} Examples are found in students' comments regarding why they did not use the LRS such as, "I attended all class sessions", "Got information from other sources", and "I rarely used it because I never missed class." The controversy surrounding attendance and web-based technologies continues when student perceptions are examined. Previously surveyed students have expressed that the availability of recorded lectures negatively affects their class attendance, tempting them to miss class.¹²⁻¹³ However, the findings of this study aligned with multiple other studies reporting that the availability of a LRS had no impact on students' decisions to attend class.^{8-9, 14-18}

Within the literature reviewed for this study, the most common LRS barriers students report are technical issues, unfamiliarity of a LRS, and a lack of awareness of LRS benefits to the learning process.⁹ However, the students in this study reported rarely or never having technical issues with the particular LRS used. It is important to address technical issues encountered as this barrier may deter students from utilizing a LRS.¹¹ Time limitations were also noted as a deterrent to LRS access by the students in this and previous studies.^{13,19}

Regarding web-based educational technologies in general, student outcomes including final course grades, GPAs, and examination scores, are believed to be enhanced through the use of technology.²⁰ Though previous studies on student achievements and lecture recordings are generally positive, they vary significantly in methodologies and field of study. Findings from this study did not identify a significant association between the students' evaluation of the LRS and a higher GPAs; however, a relationship was found between a higher evaluation of the LRS with students reporting GPA's of 2.4 or lower. This suggests students who are struggling overall have a more positive rating of the LRS. However, as previously discussed, the small sample size for this category decreases the validity of this finding. It is possible that struggling students relied more heavily on lecture recordings in an effort to improve their

Table III. Themes of Written Survey Comments Regarding LRS

Major Theme Sub-theme	Examples of Comments
How LRS is Used	
For review/supplement in regular class	<p>“It was a hybrid class, so the lectures were online while the tests and supplemental materials were in the classroom.”</p> <p>“Two classes used it to record in-class lectures, I used it to supplement in-class overview lectures.”</p>
In lieu of in-person class session	<p>“The whole course was online.”</p> <p>“Almost 100% was on LRS”</p>
Emergency/illness situations	<p>“If I was ill and was unable to get out of bed I would consider making it up by reviewing the LRS recording.”</p> <p>“Only if I had to, I prefer in-class lectures, but knowing I could review exactly what everyone else heard would be helpful if I really needed to miss class.”</p>
Effect of Use on Attendance	
Student preference	<p>“If no absence policy, I would miss it if I could watch it on the LRS.”</p> <p>“More likely to miss than if not available. “</p>
Program requirements regarding attendance	<p>“Don’t miss classes (not allowed).”</p> <p>“We can’t miss class in the hygiene program!”</p>
Evaluation of LRS Use	
Positive comments regarding use	<p>“I wish all classes used the LRS. Having dyslexia, it is hard to keep up with all the reading assignments and full understand what I am reading.”</p> <p>“Love it, wish all instructors used it!”</p>
Negative comments regarding use	<p>“I don’t enjoy the LRS that much, but will use it when there is info I need from it.”</p> <p>“I do not like LRS based classes. I enjoy learning in class but not when teacher just reads from slides.”</p>
Impact of technical issues	<p>“Froze a lot, lectures were too long, too detailed, PowerPoints/handouts not detailed enough so hard to keep pausing to get all the details which made them even longer!”</p> <p>“I would love if it were easier to download via the LRS app so I am not using as much of my data plan on my phone.”</p>

grades, which could be considered positive as students are often encouraged to utilize all available resources. Possible relationships between student GPAs and LRS warrants further study.

Options provided by the type of LRS may also alter study results. Statistically significant higher exam scores are found with the integrated recording systems currently used versus the older version LRS featuring a separate audio, video, and additional media files.²¹ Other types of online learning and review methods, such as online quizzes, have been shown to improve final course grades for those students who access the resource multiple times versus students who access them only once or not at all.²²⁻²³ Future studies should address the various individual online options for reinforcing and supplementing course content.

The majority of studies focusing on faculty and student perceptions are based on survey data. Survey methodology has innate flaws including participant recall/memory issues, traditionally low response rates, pressure of producing a desirable response, lack of focus or true desire to complete survey truthfully, and questionnaire item validity issues. Despite these shortcomings, questionnaires easily gather extensive data inexpensively as compared to alternate methods. Based on the known number of students in each course, the response rate in this study was optimal. Attempts were made to minimize other issues, including that the faculty members were not present during survey completion, no identifiers were included within the survey, and individual survey items were reviewed by unbiased field experts.

Because so many levels of technology integration exist, authors of previous studies suggest further research be completed to create a broader understanding of utilization of technology.²⁴⁻²⁵ The majority of previous studies have examined a small sample over a limited time frame creating future research opportunities that include larger and more diverse samples.^{7,11,14,21,24-25} Furthermore, few studies report on associations between the use of a LRS and GPAs or other assessment outcomes. Future studies investigating possible relationships between LRS and examination scores, including national board scores, could be of value as well as examining the actual recorded cumulative GPAs

of students upon graduation. While it was the intent to analyze associations between LRS use and National Dental Hygiene Board Examination (NBDHE) scores in this study, appropriate data was not available.

Conclusion

Students responded positively to the use of the LRS in the three courses surveyed with the majority believing that the LRS aided in retention of course material, and increased their success and course satisfaction levels. Students reported that LRS use and availability did not impact their attendance in the course; and technical issues rarely occurred during use. Results show faculty utilized LRS in a blended format in multiple courses. No relationship was found between student GPA and students' evaluation regarding the use of a LRS. This longitudinal study, supports previous similar research, adding to the body of evidence for informed decision making regarding the selection and implementation of web-based strategies in dental hygiene education and other related fields of study.

Carly J. Havner, RDH, MS is a registered dental hygienist and a graduate of the Master's degree program; *Mary M. Gerkovich, PhD* is an associate professor, Department of Biomedical & Health Informatics; *Kimberly K. Bray, RDH, MS* is a professor, Division of Dental Hygiene; *Marsha A. Voelker, CDA, RDH, MS* is an associate professor, Division of Dental Hygiene; all from the University of Missouri Kansas City School of Dentistry, Kansas City, MO.

Corresponding author: Marsha A. Voelker, CDA, RDH, MS; voelkerm@umkc.edu

References

1. McCann AL, Schneiderman ED, Hinton RJ. E-teaching and learning preferences of dental and dental hygiene students.
2. Cheurprakobkit S. Web-based criminology/criminal justice programs in Texas colleges and universities. *J Criminal Justice Educ*. 2000 Aug;11(2):279-94.
3. Sitzmann TM, Kraiger K, Stewart DW, Wisher RA. The comparative effectiveness of web-based and classroom instruction: a meta-analysis. *Pers Psychol*. 2006 Aug;59:623-664.
4. McGraw-Hill Education. Tegrity case study: the university of Alabama achieving record growth while maintaining a strong student-teacher connection [Internet]. New York (NY): McGraw-Hill Education; 2008 [cited 2016 Oct]. Available from: <https://s3.amazonaws.com/ecommerce-prod.mheducation.com/unitas/highered/platforms/tegrity/case-studies/case-study-university-of-alabama.pdf>.
5. Gosper M, McNeil M, Woo K. Web-based lecture technologies and learning and teaching: a study of change in four Australian universities. *J Asynchronous Learning Networks*. 2010 Nov;15(4):84-95.
6. Horvath Z, O'Donnell JA, Johnson LA, et al. Use of lecture recordings in dental education: assessment of status quo and recommendations. *J Dent Educ*. 2013 Nov;77(11):1431-42.
7. Brann DW, Sloop S. Curriculum development and technology incorporation in teaching neuroscience to graduate students in a medical school environment. *Adv Physiol Educ*. 2006 Mar;30(1):35-45.
8. Drouin MA. If you record it, some won't come: using lecture capture in introductory psychology. *Teach Psychol*. 2013 Dec;41(1):11-19.
9. Hew KF. Use of audio podcast in K-12 and higher education: a review of research topics and methodologies. *Educ Tech Res Dev*. 2009 Dec; 57:333-57.
10. Sadik A. Students' preferences for types of video lectures: lecture capture vs. screencasting recordings. *Int J Higher Educ [Internet]*. 2015 Sept 15 [cited 2016 Oct];4(4):94-104. Available from: <http://www.sciedu.ca/journal/index.php/ijhe>
11. Gorissen P, van Bruggen J, Jochems W. Students and recorded lectures: survey on current use and demands for higher education. *Res Learn Technol*. 2012 Jan;20:297-311.
12. Leadbeater W, Shuttleworth T, Couperthwaite J, Nightingale KP. Evaluating the use and impact of lecture recording in undergraduates: evidence for distinct approaches by different groups of students. *Comput Educ*. 2013 Feb; 61:185-92.
13. Scutter S, Stupans I, Sawyer T, King S. How do students use podcasts to support learning? *Aust J Educ Technol*. 2010;26(2):180-91.
14. Copley J. Audio and video podcasts of lectures for campus-based students: production and evaluation of student use. *Innov Educ Teach Int* 2007 Nov;44(4):387-99.
15. Smith K, Morris NP. Evaluation of biomedical science students use and perceptions of podcasting. *Biosci Educ*. 2014 Jul;22(1):3-15.

16. Cardall S, Krupat E, Ulrich M. Live lecture versus video-recorded lecture: are students voting with their feet? *Acad Med.* 2008 Dec;83(12):1174-8.
17. Pearce K, Scutter S. Podcasting of health sciences lectures: benefits for students from a non-English speaking background. *Aust J Educ Technol.* 2010;26(7):1028-41.
18. Wang R, Mattick K, Dunne E. Medical students' perceptions of video-linked lectures and video-streaming. *Res Learn Technol.* 2010 Mar;18(1):19-27.
19. Sowan AK, Jenkins LS. Designing, delivering and evaluating a distance learning nursing course responsive to students needs. *Int J Med Inform.* 2013 Jun; 82:553-64.
20. Woo K, Gosper M, McNeill M, et al. Web-based lecture technologies: blurring the boundaries between face-to-face and distance learning. *Res Learn Technol.* 2008 Jun;16(2):81-93.
21. Griffin DK, Mitchell D, Thompson SJ. Podcasting by synchronizing PowerPoint and voice: what are the pedagogical benefits? *Comput Educ.* 2009 Sep; 53:532-9.
22. Williams A, Birch E, Hancock P. The impact of online lecture recordings on student performance. *Aust J Educ Technol.* 2012;28(2):199-213.
23. Selvig D, Holaday LW, Purkiss J, Hortsch M. Correlating students' educational background, study habits, and resource usage with learning success in medical histology. *Anat Sci Educ.* 2015 Jan-Feb; 8:1-11.
24. Gallagher JE, Dobrosielski-Vergona KA, Wingard RG, Williams TM. Web-based vs. traditional classroom instruction in gerontology: a pilot study. *J Dent Hyg.* 2005 Summer;79(3):1-10.
25. Garland KV. E-learning vs. classroom instruction in infection control in a dental hygiene program. *J Dent Educ.* 2010 Jun: 637-43.

Collaborative Skill Building in Dentistry and Dental Hygiene through Intraprofessional Education: Application of a quality improvement model

Tricia S. Barker, RDH, MEd; Chet A. Smith, DDS; Geri M. Waguespack, RDH, MS; Donald E. Mercante, PhD; Tina P. Gunaldo, PhD, DPT, MHS

Abstract

Purpose: The purpose of this study was to apply a quality improvement model in the application of an intraprofessional educational experience by improving student perceptions of collaboration and increasing the number of collaborative experiences within the dental hygiene curriculum.

Methods: A quality improvement model, Plan, Do, Study, Act (PDSA) developed by the Institute for Healthcare Improvement (IHI), was used to initiate an intraprofessional education experience for dental hygiene and dental students. Faculty members utilized the PDSA worksheet to plan, implement, and analyze the educational experience. Pre- and post-session surveys were used to measure dental hygiene student perceptions of their ability to perform four Interprofessional Education Collaborative (IPEC) sub-competencies. Statistical analysis was carried out on the pre and post session surveys. Students were also given the opportunity to discuss their learning and intraprofessional experiences in a reflection assignment.

Results: Dental hygiene students demonstrated positive changes from pre- to post-session survey data in all four targeted IPEC sub-competencies. Statistical significance was noted in three of the four IPEC sub-competency rating statements. Themes from the reflection assignments indicated student learning in the areas of teamwork and communication. Dental hygiene faculty applied the information gained from the assessments as part of the IHI PDSA cycle for improvement in health care to evaluate and plan for future learning experiences.

Conclusion: Meaningful intraprofessional education experiences between dental hygiene and dental students support collaborative practice skills and should be integrated into dental and dental hygiene curricula. Applying a continuous quality improvement model, such as the IHI PDSA, can assist educators in planning, implementing, and evaluating curricular changes in order to improve student learning outcomes.

Keywords: intraprofessional collaboration, intraprofessional education, dental hygiene education, quality improvement models

This manuscript supports the NDHRA priority area: **Professional development: Education** (Educational models).

Submitted for publication: 6/7/17; accepted 7/9/18

Introduction

Academic communities in dental hygiene have been advocating for collaborative practice models between dental and dental hygiene providers through formal curricular training dating back to 1986.¹ Intraprofessional education involves students from different disciplines within the same profession to learn from, about and with, each other.^{2,3} Kee and Darby discussed the development of mutual respect and understanding as positive collaborative practice outcomes resulting from intraprofessional education.¹

More recently, both Hamil and Formicola, et al. have promoted the inclusion of intraprofessional learning activities in dental education.^{2,4} Specifically, Formicola et al. state that “cost-effective, efficient quality oral health care depends upon teamwork in dental practice.”⁴ The authors also emphasize the need to focus renewed attention on collaboration within the dental workforce, beginning with educational experiences, especially in the clinical arena.⁴ Research conducted on intraprofessional learning attitudes and perceptions within dentistry, as well as in other health professions, indicates

that both students and professionals value intraprofessional learning and agree that shared, formal learning models can improve teamwork and communication.^{3,5-7} However, a study conducted by Brame et al., indicates that the majority of dental and dental hygiene curricula do not include an emphasis on intraprofessional education.⁵

A lack of focus in intraprofessional education could be a result of the increased attention to interprofessional education (IPE), defined as education that occurs when individuals from two or more professions learn about, from and with each other.⁸ The foundational knowledge and skills needed for effective collaboration from either an interprofessional or intraprofessional perspective are complimentary² and both perspectives are necessary to prepare students to practice collaboratively.²⁻⁷ Collaborative practice has been defined as occurring when health care workers from different professional backgrounds provide comprehensive care by working with patients, their families, and communities.⁷ The Commission on Dental Accreditation (CODA) promotes collaborative practice through required educational accreditation standards.⁹ Dental hygiene Standard 2-15 requires competency in communicating and collaborating with other members of the health care team to support comprehensive patient care.¹⁰ IPE as well as intraprofessional education experiences can serve to support Standard 2-15. Specifically, intraprofessional educational experiences within dentistry can encourage comprehensive patient care through co-assessment and co-therapy.³

Faculty developing intraprofessional educational activities emphasizing the use of collaborative skills can refer to the Interprofessional Education Collaborative (IPEC) competencies to guide student learning,¹¹ as these collaborative behaviors are foundational to both types of learning. The IPEC competencies, created by a panel of health education organizations including American Dental Education Association, focus on the promotion of collaborative behaviors among health students and health professionals.¹¹ The IPEC expert panel established four main competency domains for collaborative practice: Values and Ethics (VE), Roles/Responsibilities (RR), Interprofessional Communication (CC), and Teams and Teamwork (TT).¹¹

While not specifically defined in the literature, barriers for intraprofessional education may mimic barriers for IPE. Furgeson and Inglehart found that over half of the hygiene program directors in the United States consider IPE as an important initiative for the dental hygiene community, fewer than half consider it to be important for their academic institutions.⁹ Casa-Levine's survey of dental hygiene program directors and faculty in the Northeastern United States showed that a majority of the respondents recognized the

value of IPE in order to prepare students for collaborative practice; however, only 6% reported extensive application of IPE into their program curriculum.¹² This discrepancy is not surprising as dental hygiene educators have been shown to experience similar barriers related to integrating IPE into their programs, as compared to other health professional programs.^{2,9,13-15} Common issues include difficulties with schedule coordination, an overloaded curriculum, and the lack of necessary faculty training required to create meaningful IPE experiences.^{2,9,13-16} Administrative support along with identifying leaders within the academic institution, are also crucial to the success of both IPE and intraprofessional education initiatives.¹⁷

Studies by Leisnert, et al. and Reinders, et al. measured competencies in professional roles and responsibilities gained through intraprofessional learning experiences between dental and dental hygiene students and reported positive outcomes resulting from these experiences.^{18,19} Understanding professional roles and responsibilities is fundamental to team-based care and intraprofessional educational experiences can provide students with opportunities to discuss their training and respective scope of practice. Leisnert, et al. noted that intraprofessional experiences increased dental student knowledge regarding the professional roles of dental hygienists.¹⁸ while Reinders, et al. found both dental and dental hygiene student attitudes had shifted regarding tasks considered to be "dentist-centered" following an intraprofessional intervention.¹⁹

The Institute for Healthcare Improvement (IHI) is a non-governmental organization founded in 1991 as part of the National Demonstration Project on Quality Improvement in Healthcare.²⁰ The IHI works with health care systems along with other countries and organizations on improving quality, safety and value in healthcare.²⁰ Using a business management model created by the Associates for Process Improvement, the Plan-Do-Study-Act (PDSA) cycle was developed by the IHI as a means to begin improvement efforts on a small scale as a means to leverage the learning gained to plan for scaling up for a system-wide change.²¹ The IHI Model for Improvement poses three questions as the basis for the PDSA cycle: "What are we trying to accomplish?"; "How will we know that a change is an improvement?"; "What changes can we make that will result in improvement?".²¹ The Model for Improvement as created by the IHI is not meant to replace an existing change model within an institution or organization but rather serve to accelerate improvement.²¹ By utilizing the scientific method, the PDSA focuses on what has been learned through planning and observation of the results in real work settings.²¹

Louisiana State University Health-New Orleans (LSUH-NO) established a Center for Interprofessional Education and Collaborative Practice (CIPECP) in 2015 to support the development and implementation of collaborative learning experiences across its six schools, including the dental, dental hygiene and dental laboratory technology programs housed in the School of Dentistry (SOD). As the SOD is separated by a significant distance from the other LSUH-NO schools, creating logistical challenges in creating IPE activities, dental and dental hygiene faculty members explored educational opportunities to engage in intraprofessional collaborative practice activities within the SOD. The dental hygiene faculty was also interested in developing a program that could be part of a formal curriculum management plan as required by CODA Standard 2-24.¹⁰ With this in mind, faculty wanted to utilize principles of continuous quality improvement in order to systematically plan, implement, and evaluate such an activity. Dental hygiene faculty at the SOD received support from the CIPECP to develop the intraprofessional educational experience as part of a pilot project utilizing the IHI PDSA Model for Improvement. Quality improvement models such as the IHI PDSA have been used in health care professions;^{22,23} however, there is a gap in the literature regarding its use in dental hygiene education. The purpose of this pilot study was to apply a quality improvement model to the development of a new intraprofessional educational experience, as a foundational activity to prepare students for future collaborative practice.

Methods

The educational pilot study was developed as a quality improvement initiative within the dental hygiene and dental programs in the SOD at LSUH-NO during the spring semester of 2017. An intraprofessional experience was integrated into an existing first year dental hygiene clinical course. Institutional Review Board approval was not required. Dental hygiene and dental faculty and members of the CIPECP utilized the IHI PDSA worksheet,²⁴ to plan and evaluate the outcome of the intraprofessional activity focused on measuring change in student perceptions in four targeted IPEC sub-competencies. (Figure 1). Data was collected for the purpose of evaluating the activity as part of the PDSA Model for Improvement. The IHI PDSA worksheet outlining the process of the activity is shown in Figure 2.

Thirty-one first year dental hygiene students (n=31) participated in the intraprofessional experience as a required activity during their second semester, clinical dental hygiene course. Each student was scheduled for one session in the oral diagnosis clinic which took place twice a week over a period

Figure 1. Faculty Selected IPEC¹¹ Sub-competency Areas

- **Roles and Responsibilities (RR1):** Communicate my roles and responsibilities clearly to the patient, family, and other health professionals.
- **Teams and Teamwork (TT3):** Engage other health professionals in shared patient-centered and population-focused problem solving.
- **Interprofessional Communication (CC2):** Communicate information with patients and families in a form that is understandable, avoiding discipline-specific terminology.
- **Interprofessional Communication (CC4):** Listen actively, and encourage ideas and opinions of other team members.

of 10 weeks. Each dental hygiene student was paired with a third-year dental student during an oral diagnosis patient appointment. All dental hygiene students were oriented to the rotation at the same time by the same dental hygiene faculty member. Students were provided a paper copy of the learning session document. The document included the definition of IPE, the four IPEC sub-competency student learning objectives, discussion topics and details on the time and location of the rotation. Students were instructed to introduce themselves to their assigned dental student on the day of the rotation and were also expected to introduce themselves to the patient and explain their role during the appointment, independent of the dental student.

Dental hygiene students participated in collecting information included in the initial assessment (oral exam findings and periodontal assessment findings), while also observing the communication between the dental student and the patient and/or family. Dental hygiene students were instructed to make note of the use and context of discipline-specific terminology and any positive aspects of the communication made by dental students to the patient and/or family during the visit.

Dental hygiene and dental students were expected to discuss aspects of the appointment following the session. The post-session discussion was to be guided by the following topics identified on the intraprofessional education session document: review the positive aspects of communication between the student and patient; work together to find other terminology/phrases that can be used to explain assessment

Figure 2. Institute for Healthcare Improvement Plan-Do-Study-Act Worksheet²⁴

PDSA Worksheet
<p>Objective: Develop and implement an intraprofessional education experience using the framework utilized to develop an interprofessional experience with the goal of improving dental hygiene student perceptions in targeted IPEC sub-competencies.</p>
<p>1. Plan: Plan the test, including a plan for collecting data.</p> <p>Questions and predictions: The intraprofessional experience will improve dental hygiene student perceptions in targeted IPEC sub-competencies.</p> <p>Who, what, where, when: The intraprofessional educational experience will be integrated into an existing dental hygiene course during the spring 2017 semester. First year dental hygiene students will attend one oral diagnosis rotation with a third-year dental student.</p> <p>Plan for collecting data: Dental hygiene student perceptions will be measured through a voluntary pre- and post-survey. In addition, they will be asked to evaluate and reflect on the experience.</p>
<p>2. Do: Run the test on a small scale.</p> <p>Describe what happened: Dental hygiene and dental students were paired during an oral diagnosis clinic rotation which included the initial assessment of a patient.</p> <p>What data did you collect? Dental hygiene student perceptions of their ability to perform the IPEC sub-competencies, student evaluation of the experience, and suggestions to improve the experience.</p> <p>What observations did you make? See results for the pre- and post-surveys, student evaluation, and student reflection.</p>
<p>3. Study: Analyze the results and compare them to your predictions.</p> <p>Summarize and reflect on what you learned: Dental hygiene students demonstrated positive changes from pre- to post-scores in all four targeted IPEC sub-competencies. All student feedback was positive. Results are consistent with the prediction.</p>
<p>4. Act: Based on what you learned from the test, make a plan for your next step.</p> <p>Determine what modifications you should make — adapt, adopt, or abandon: The intraprofessional education experience was adopted for the first year dental hygiene students. Faculty will adapt various aspects of the intraprofessional experience based on the limitations identified. New changes will be tested on a larger scale.</p>

and treatments to patients in a form that is understandable; discuss the options for treatment and plan for prevention from the perspective of a dental hygienist and dentist. No recordings were made of the student statements during the post-session discussions.

Prior to the assigned session in the oral diagnosis clinic, each dental hygiene student received a standardized email

from a dental hygiene faculty member requesting their participation in a pre-session survey, prior to meeting their assigned dental student. A link to the survey was embedded in the email. Students received a second email the day after their rotation requesting participation in a post-session survey to be completed the same day. Pre- and post-session survey participation was voluntary; accessing the email implied consent to participate.

The pre-session survey included four questions and the post-session survey included seven questions. The first four questions on both surveys were identical and were directly related to students' perceptions of their ability to perform the four identified IPEC sub-competencies for the learning experience. The post-session survey included two additional components evaluating the intraprofessional experience and an additional question requesting suggestions for improvement. Students also had the option to complete a reflection assignment which included the following two open-ended questions: "Was the intraprofessional experience meaningful to your learning? If so, why?" and "How could this experience affect how you interact with other professions in the future?"

Dental hygiene student perceptions of their ability to perform the IPEC sub-competencies before and after the intraprofessional experience were measured using a Likert scale ranging from strongly disagree to strongly agree (1 to 5). The same scale was used to measure the responses regarding the activity questions in the post-session survey. Analyses were performed using the Statistical Analysis System, version 9.4 (SAS Institute; Cary NC). Pre/post session survey paired comparisons were performed using the t-test. A dental hygiene faculty member and the CIPECP director evaluated student suggestions for improving the learning experience and analyzed the two reflection questions for common themes. After the questions were independently themed, the faculty member and the CIPECP agreed upon the common themes.

Results

Twenty-nine dental hygiene students (n=29) participated in the pre-session survey; however three students completed the demographic questions, but did not answer the perception questions. Twenty-seven students (n=27) participated in the post-session survey; one student did not answer the perception

questions. After the data was cleaned for missing responses, twenty-six paired data sets (n=26) remained for an overall participation rate of 84%. Statistical significance ($p < .05$) was noted in pre-and post-survey scores for three IPEC sub-competencies: Teams and Teamwork (TT3); Interprofessional Communication (CC2) and (CC4). No statistical significance was found for Roles and Responsibilities (RR1). Table I provides a summary of the IPEC sub-competencies data analysis.

Thirteen students (n=13) responded to the post-survey open-ended question regarding suggestions to improve the learning experience. All responses contained positive feedback. Two students indicated the experience could be improved if

Table I Dental Hygiene Student Perceptions of Achieving IPEC Sub-Competencies (n=26)

IPEC Sub-Competency	Pre-Survey Mean (SD)	Post-Survey Mean (SD)	Post-Pre Survey Mean (SD)	<i>p value</i>
I am able to communicate my roles and responsibilities clearly to the patient, family, and other dental professionals (RR1).	4.28 (0.67)	4.48 (0.58)	0.20 (0.50)	0.0569
I am able to engage other dental professionals in shared patient-centered and population-focused problem solving (TT3).	3.88 (0.72)	4.44 (0.65)	0.56 (0.65)	0.0002*
I am able to communicate information with patients and families in a form that is understandable, avoiding discipline-specific terminology (CC2).	4.20 (0.76)	4.64 (0.56)	0.44 (0.82)	0.0131*
I am able to listen actively, and encourage ideas and opinions of other team members (CC4).	4.28 (0.73)	4.76 (0.43)	0.48 (0.71)	0.0026*

*Denotes statistical significance $p < .05$

Table II: Student Evaluation of the Intraprofessional Learning Experience (n=26)

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
This intraprofessional activity increased my confidence in participating on an intraprofessional team with dental providers.	0%	0%	0%	26.92% (n=7)	73.08% (n=9)
This intraprofessional activity increased my appreciation for a team-based approach to healthcare.	0%	0%	0%	19.23% (n=5)	80.77% (n=21)

the dental students were more informed about the rotation and one student requested for dental hygiene students to have more active engagement during the patient evaluation/assessment. Table II summarizes the student evaluation of the intraprofessional learning experience.

A total of 29 students (n=29) completed the reflection assignment. All students indicated that the experience was meaningful to their learning with the majority of students commenting positively on the opportunity to learn from, about and with the dental students. When asked how the experience might influence future interactions with other health care professionals, the respondents discussed how the experience increased their confidence with communication skills. Table III provides an overview of four themes identified in the reflection assignments and respective student quotes.

Discussion

Developing, implementing, and assessing intraprofessional education activities in an academic environment can be challenging; however, results from this pilot project demonstrate that even brief intraprofessional experiences can be meaningful to student learning. Incorporating a continuous quality improvement cycle model, such as the IHI PDSA²¹, when introducing a new educational methodology or curriculum, can be beneficial to both the educator and the learner by testing for change within the work setting.²¹ The IHI PDSA process utilizes predicted changes as part of the planning process followed by an analysis of the results of the intervention as compared to the prediction and reflection on what was learned in the process.²¹

In this study, faculty predicted that dental hygiene student perceptions in targeted IPEC sub-competencies would improve following the intraprofessional

Table III. Reflection Assignment Themes and Student Quotes

Theme	Student quote
Increased confidence when speaking to other professionals/ students (n=3)	<i>“This experience put me at ease when talking to other professions. It also made me feel valued.”</i>
Importance of providers working together (n=6)	<i>“Now I understand how important it truly is for all professions to be on the same page.”</i>
Team approach will benefit the patient (n=7)	<i>“I learned that communication is key, and in order to do what’s best for the patient, the dentist and dental hygienist should be able to discuss options and treatment plans in a professional manner.”</i>
Importance of collaborative practice, using non-discipline specific language (n=3)	<i>“The rotation helped me to really focus on how the dental student talked with the professor and the patient while presenting the case. I enjoyed using proper dental terminology with the student clinician and then explaining the same information to the patient in a way the patient could understand.”</i>

experience. Results demonstrated positive changes in all four targeted IPEC sub-competencies. Changes in perceptions regarding the ability to engage other dental professionals in problem solving (TT3) showed the strongest level of statistical significance. Examining which aspect of the learning activity may have influenced this change is part of the PDSA process. One component of the learning activity included a discussion between the dental and dental hygiene students regarding possible treatment options for the patient. Integrating a discussion component between the students after the patient encounter had the potential to strengthen dental hygiene students’ perceptions of their abilities for TT3.

Results from the pre-session surveys showed that students scored themselves relatively high in the IPEC sub-competency areas of RR1, CC2, and CC4. Over-estimation of one’s level of competence can be explained by the Dunning-Kruger effect.²⁵ Novices who are potentially incompetent in collaborative healthcare delivery skills, but are unaware of their incompetence, can overestimate their actual performance.²⁵ In this pilot study, students’ higher estimation of their competency in collaborative skills could explain the weaker statistical significance when comparing the changes for CC2 and CC4, and why there was no statistical significance for RR1. Another factor that may have contributed to the low statistical difference found in RR1 for

dental hygiene students is that this intraprofessional experience was embedded in the early portion of the second semester of the dental hygiene curriculum and the students may have been less confident regarding their full scope of practice.

A significant limitation of this intraprofessional experience was the lack of information regarding the dental student perceptions in the selected IPEC sub-competencies either prior to or following the activity. One of the advantages of using the PDSA process for quality improvement is that each intervention is carried out on a small scale, analyzed and changes implemented prior to the next cycle.²¹

Other limitations of the pilot project initial outcomes include one site implementation and a single learning experience. Participation in the pre and post survey assessments was voluntary, which could explain why some students did not participate in the survey or why some questions were not answered.

The final aspect of the PDSA cycle focuses on planning the next steps in the activity or intervention. Modifications are discussed and decisions to adapt, adopt or abandon are made. Based on the results from this pilot study, dental hygiene faculty members decided to adopt this intraprofessional experience for first year dental hygiene students with adaptations made based on the limitations previously identified. Dental students’ perceptions of their ability to perform the IPEC sub-competencies will be measured in future intraprofessional education experiences. Future considerations will also include moving beyond the assessment of perceptions and including assessment of student knowledge. Targeted questions supporting RR1 such as “What is the role of a dentist and/or what is the role of a dental hygienist?” could be included in the pre-session survey. Completion of a validated communication instrument, such as the Communication Assessment Tool²⁶ could be incorporated into the intraprofessional experience to provide further support for CC2.

Additional modifications include having the same dental hygiene faculty member orient both the dental hygiene and dental students prior to beginning the clinical rotation experience. Having the same dental hygiene faculty member deliver the orientation and expectations of the learning experience will enhance consistency of information. Differences between intraprofessional and interprofessional education and

their roles in successful collaborative practice can be emphasized in future orientations. Participation in surveys assessments could also be a required aspect of the rotation.

Results from the pilot project provided faculty members with sufficient information to improve future intraprofessional experiences as part of a continuous quality improvement process. Increasing the number of meaningful and sustainable collaborative experiences within the curriculum addresses accreditation standards¹⁰ in addition to aligning student learning with healthcare delivery expectations. Utilization of the IHI PDSA cycle²¹ provided a formalized process for the pre-planning, implementation, analysis and future plans for implementing an intraprofessional experience at LSUH-NO.

Conclusion

Meaningful intraprofessional education experiences between dental hygiene and dental students support collaborative practice skills and should be integrated into dental and dental hygiene curricula. Offering ongoing opportunities for intraprofessional collaboration will support students as they prepare for collaborative practice. The IHI Model for Improvement and the PDSA cycle provides health care organizations with a process for testing change in real-world settings. Applying continuous quality improvement models, such as the IHI PDSA, can assist educators in planning, implementing, and evaluating curricular changes in order to improve student learning outcomes.

Disclosure

This study was supported in part by 1 U54 GM104940 from the National Institute of General Medical Sciences of the National Institutes of Health, which funds the Louisiana Clinical and Translational Science Center. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Acknowledgements

Bobby Moore, MA, assisted in the development and coordination of the IPE activity and Julie H. Schiavo, MLIS, AHIP assisted in the literature review and formatting of the references.

Tricia S. Barker, RDH, MEd is an assistant professor of clinical comprehensive dentistry and Biomaterials in the dental hygiene program; **Chet A. Smith, DDS** is an associate professor of clinical diagnostic sciences in the school of dentistry; **Geri M. Waguespack, RDH, MS** is a professor of clinical comprehensive dentistry and biomaterials in the dental

hygiene program; **Donald E. Mercante, PhD** is an associate dean for academic affairs and professor of biostatistics; **Tina P. Gunaldo, PhD, DPT, MHS** is the Director, Center for Interprofessional Education and Collaborative Practice; all are at the Louisiana State University Health – New Orleans, LA

Corresponding author: Tina P. Gunaldo PhD, DPT, MHS; tgunal@lsuhsc.edu

References

1. Kee A, Darby ML. Collaborative practice model for dental and dental hygiene students: Guidelines for curriculum development. *Educ Dir Dent Hyg.* 1986 Dec; 11(4):9-17.
2. Hamil LM. Looking back to move ahead: Interprofessional education in dental education. *J Dent Educ.* 2017 Aug; 81(8):eS74-eS80.
3. Jones VE, Karydis A, Hottel TL. Dental and dental hygiene intraprofessional education: a pilot program and assessment of students' and patients' satisfaction. *J Dent Educ.* 2017 Oct; 81(10):1203-11.
4. Formicola AJ, Andrieu SC, Buchman JA, et al. Interprofessional education in U.S. and Canadian dental schools: an ADEA team study group report. *J Dent Educ.* 2012 Sep; 76(9):1250-68
5. Brame JL, Mitchell SH, Wilder RS, Sams LD. Dental and allied dental students' attitudes towards and perceptions of intraprofessional education. *J Dent Educ.* 2015 Jun; 79(6):616-25.
6. Meijer LJ, de Groot E, Blaauw-Westerlaken M, Damoiseaux RA. Intraprofessional collaboration and learning between specialists and general practitioners during postgraduate training: a qualitative study. *BMC Health Serv Res.* 2016 Aug 11; 16(a):376.
7. Jelley W, Larocque N, Borghese M. Perceptions on the essential competencies for intraprofessional practice. *Physiother Can.* 2016 Spring; 65(2):148-51.
8. World Health Organization. Framework for action on interprofessional education and collaborative practice [Internet]. Geneva: World Health Organization; 2010 [cited 2017 May 12]. 64 p. Available from: http://www.who.int/hrh/resources/framework_action/en/.
9. Furgeson D, Inglehart M. Interprofessional education in dental hygiene programs and CODA standards: dental hygiene program directors' perspectives. *J Dent Hyg.* 2017 Apr; 91(2):6-14.

10. Commission on Dental Accreditation. Accreditation standardsfordentalhygieneeducationprograms[Internet]. Chicago: Commission on Dental Accreditation; 2018 [cited 2018 March 12]. 46 p. Available from: <http://www.ada.org/-/media/CODA/Files/dh.pdf?la=en>.
11. Interprofessional Education Collaborative Expert Panel. Core competencies for interprofessional collaborative practice: 2016 update. [Internet]. Washington, D.C.: Interprofessional Education Collaborative (US); 2016. [cited 2017 May 12]. 22 p. Available from: <http://www.aacn.nche.edu/education-resources/IPEC-2016-Updated-Core-Competencies-Report.pdf>
12. Casa-Levine C. The value of interprofessional education: assessing the attitudes of dental hygiene administrators and faculty. *J Dent Hyg.* 2017 Dec; 91(6):49-58.
13. Palatta A, Cook BJ, Anderson EL, Valachovic RW. 20 Years beyond the crossroads: the path to interprofessional education at U.S. dental schools. *J Dent Educ.* 2015 Aug; 79(8):982-96.
14. Vernon M, Moore N, Cummins L, et al. Respiratory therapy faculty knowledge of and attitudes toward interprofessional education. *Respir Care* 2017 Jul; 62(7):873-81.
15. Rye KJ, Shelledy DC. Utilization of interdisciplinary education in respiratory care curricula. *Respir Care Educ Ann* 2011 Fall; 20:1-10.
16. Furgeson D, Kinney JS, Gwozdek AE, et al. Interprofessional education in U.S. dental hygiene programs: A national survey. *J Dent Educ.* 2015 Nov; 79(11):1286-94.
17. Brashers V, Owen J, Haizlip J. Interprofessional education and practice guide No. 2: developing and implementing a center for interprofessional education. *J Interprof Care.* 2015 Mar; 29(2):95-9.
18. Leisnert L, Karlsson M, Franklin I, et al. Improving teamwork between students from two professional programs in dental education. *Eur J Dent Educ.* 2012 Feb; 16(1):17-26.
19. Reinders JJ, Krijnen WB, Stegenga B, van der Schans CP. Percieved dentist and dental hygienist task distribution after dental and dental hygiene students' team intervention. *J Dent Educ.* 2017 Apr; 81(4):413-19.
20. IHI. Improving health care worldwide [Internet]. Boston; Institute for heathcare improvement; c2018. About IHI; 2018 [cited 2018 Mar 22]; [about 2 screens]. Available from: <http://www.ihl.org/about/Pages/default.aspx>
21. IHI. Improving health care worldwide [Internet]. Boston; Institute for heathcare improvement; c2018. Science of improvement; 2018 [cited 2018 Mar 22]; [about 2 screens]. Available from: <http://www.ihl.org/about/Pages/ScienceofImprovement.aspx>
22. Laverentz DM, Kumm S. Concept evaluation using the PDSA cycle for continuous quality improvement. *Nurs Educ Perspect.* 2017 Sep/Oct; 38(5):288-90.
23. Oliver BJ, Potter M, Pomerleau M, et al. Rapid health care improvement science curriculum integration across programs in a school of nursing. *Nurse Educ.* 2017 Sept/Oct; 42(5S Suppl 1): s38-s43.
24. IHI. Plan-do-study-act (PDSA) worksheet. [Internet]. Boston; Institute for Healthcare Improvement. c2017. [cited 2017 Oct 26]. Available from: <http://www.ihl.org/resources/Pages/Tools/PlanDoStudyActWorksheet.aspx>
25. Kruger J, Dunning D. Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments. *J Pers Soc Psychol.* 1999 Dec; 77(6):1121-34.
26. Makoul G, Krupat E, Chang CH. Measuring patient views of physician communication skills: Development and testing of the Communication Assessment Tool. *Patient Educ Couns.* 2007 Aug; 67(3):333-42.

Workplace Bullying: A survey of Virginia dental hygienists

Gayle B. McCombs, RDH, MS; S. Lynn Tolle, RDH, MS; Tara L. Newcomb, RDH, MS;
Ann M. Bruhn, RDH, MS; Amber W. Hunt, RDH, MS; Lanah K. Stafford, MA

Abstract

Purpose: Workplace bullying in health care has been identified as a problem that negatively affects career satisfaction, career longevity and patient outcomes. The purpose of this pilot study was to determine the prevalence of workplace bullying in a convenience sample of dental hygienists in the state of Virginia.

Methods: Two hundred and forty Virginia dental hygienists attending a continuing education seminar were invited to participate. Using the Negative Acts Questionnaire-Revised (NAQ-R), respondents were asked to indicate how often they had experienced 22 negative acts or behaviors according to rate of occurrence (never, now and then or monthly, weekly or daily). Bullying was defined as experiencing two or more of the specified negative behaviors over the past 6 months. The negative behaviors were categorized into three subgroups: work-related bullying, personal bullying and physical intimidation.

Results: The response rate was 64%. Data revealed almost one fourth (24%) of respondents experienced workplace bullying. The most frequent behaviors experienced by those being bullied were having their opinions and views ignored (73%), experiencing unmanageable workloads (68%) and having their work excessively monitored (68%), on a weekly or daily basis.

Conclusions: Results from this study suggest approximately 1 out of 4 Virginia dental hygienists responding to this survey experience workplace bullying. Education and support to ensure identification of bullying may be helpful in promoting proactive awareness, prevention strategies and a healthier work environment leading to greater job satisfaction.

This manuscript supports the NDHRA priority area: **Professional development: Occupational health** (career satisfaction and longevity)

Keywords: workplace bullying, workplace harassment, unprofessional behavior, psychological wellbeing, occupational health

Submitted for publication: 1/26/18; accepted 6/6/18

Introduction

Workplace bullying is a problem associated with occupational health and safety, negative job satisfaction and overall adverse health effects.¹⁻¹² Within healthcare, bullying is such a significant and persistent problem it is considered an occupational hazard.⁹⁻¹⁰ Workplace bullying is characterized by abusive, repetitive, health-harming mistreatment by a perpetrator that is broadly defined as persistent abusive behavior that is considered humiliating, offensive, intimidating, threatening and or demeaning to an individual or a group.⁸⁻¹⁰ Vertical bullying occurs between a boss and subordinate while lateral bullying takes place between co-workers. Consciously or unconsciously, bullies thrive on immediate power. Several types of workplace bullying have been identified including intimidation, harassment, victimization, aggression, emotional abuse, and psychological

harassment or mistreatment.¹³⁻¹⁵ Bullying behaviors offend, degrade, insult, and or threaten the target and undermine an individual's right to self-esteem or dignity in the workplace.¹³⁻¹⁵

Bullying in the workplace is a serious issue and has been reported in healthcare settings throughout the world.²⁻⁹ Portuguese researchers found that 8% of health care workers surveyed experienced bullying and in Australia almost 25% of the allied health professionals surveyed reported being a victim of workplace bullying.^{3,4} In the Pacific Northwest, researchers found 48% of nurses surveyed reported being victimized in the workplace, with 12% reporting being bullied at least weekly.⁹ Additionally, Simons studied bullying in a group of Massachusetts nurses and found a 31% prevalence rate.⁵ Consequently, with the increase in workplace bullying, researchers discovered that as bullying intensified, participants indicated their intention to leave the employment setting.^{5,6}

Victims of bullying who are subjected to repeated negativity find it difficult to defend themselves against a perpetrator who engages in systematized, focused, long-term abuse. Patterns of abusive conduct associated with bullying create an ineffective work and learning environment and targeted victims report experiencing physiological and psychological stress.⁷⁻¹¹ Employee career satisfaction, mental health, burnout, and overall patient outcomes may be affected by bullying.^{11,12,15-19} Health professionals who are bullied may be more likely to make errors in judgement and treatment, which consequently affects all parties involved.¹⁸⁻²⁰

Research suggests workplace bullying fosters an ineffective work environment and ongoing destruction of confidence and skills. In addition, it can cultivate negative attitudes toward a chosen job.¹¹⁻¹⁵ Studies by both Lahari et al. and Yildirim suggest bullying leads to low self-esteem, poor physical health and low self-confidence that can be manifested in self-doubt and a lack of work initiative and innovation.^{10,11} Research in the nursing profession suggests victims of bullying experience adverse occupational health outcomes that are both physiological and psychological in nature.¹⁵⁻¹⁸ Headaches, sleep disturbances, memory problems, weight changes, substance abuse, anxiety, loss of concentration and depression were common stress related manifestations reported by those experiencing bullying.¹¹⁻¹⁵ Both Spence et al and Takaki et al found that a toxic work environment created by bullying can cause nurses to experience post-traumatic stress disorder (PTSD), a serious anxiety condition.^{16,21} Moreover, it is common for health professionals to blame themselves for being bullied, resulting in increased stress, depression, and psychological distress.¹⁸

A toxic work environment perpetuated by bullying may cause health professionals to practice less competently, leading to clinical errors and ultimately lowering the quality of patient care and negatively impact patient outcomes.¹⁹⁻²¹ Additionally, research suggests bullying negatively affects the work performance of health care providers.¹⁹⁻²¹ Burnes and Pope found that nurses who were bullied withdrew from certain tasks, reduced their commitment to certain job responsibilities and many decreased their amount of time in the workplace to avoid encountering the bully.²² A person bullied often feels incompetent and incapable of doing his or her job. Carter and colleagues determined that nurses experiencing workplace bullying felt their performance was impaired as they were unable to think clearly and concentrate on procedures and tasks.² The impact of prolonged workplace bullying means that the workplace becomes dysfunctional; for the perpetrator, the bystander-patient or employee, and for the target of bullying,¹⁵

Victims of bullying have a larger propensity to be less productive, have more frequent missed work days and even leave the work force compared to those who are not bullied.¹⁶⁻¹⁷ Interestingly, Simons et al., discussed the bullying behaviors of more experienced nurses as “eating their young,” causing newer nurses to want to quit their jobs, consequently creating an un-helpful, hostile work environment.⁶ As individuals terminate their positions, high staff turnover reflects poorly on the organization and places an undue burden on employers and employees as the result of hiring and orienting new staff. Interestingly, Erikson et al., found that bullying increased women’s long-term work related absenteeism due to illness, however, men who were bullied just left their jobs.⁷ All health care professionals have the right to practice in a safe workplace, free from bullying; dental hygienists are no exception. The hierarchical nature of dentistry, gender and cultural stereotypes combined with the competitive nature of production goals may reinforce a culture of bullying in dental settings.

Few studies are available in the dental literature investigating the prevalence of bullying. In a study of 156 post graduate dental students in India, Lahari et al., found that 79% of students experienced bullying although it was reported to administrators as only 34%.¹⁰ Steadman and colleagues found that out of 136 respondents, 25% of hospital dentists surveyed in the U.K. reported being victims of bullying; 60% reported experience with at least one of the identified bullying behaviors in the past year.²³ Similarly, Demir et al., found 24% of the 166 allied health professionals surveyed, reported being bullied.²⁴ In a multi-national study involving 655 participants from five dental schools, 10% of respondents from the American dental school surveyed reported being victims of bullying.²⁵ Overall, results of the international study revealed 35% of all dental students surveyed reported bullying.²⁵

Currently, there is a gap in the research related to dental hygienists and whether or not they are affected by workplace bullying. The purpose of this study was to explore the prevalence of workplace bullying in a convenience sample of Virginia (VA) dental hygienists. Information garnered from this study will help individuals and employers recognize and manage bullying behaviors in order to minimize adverse consequences.

Methods

A descriptive survey design was utilized to generate information regarding the extent to which dental hygienists in the state of Virginia (VA) perceived experiencing workplace bullying. The Negative Acts Questionnaire-Revised (NAQ-R), a valid and reliable instrument designed to measure workplace bullying, was used to survey a convenience sample of 240

VA dental hygienists attending a continuing education (CE) program.²⁶ The NAQ-R questionnaire determines how frequently participants experience various negative acts or behaviors that characterize bullying. The Institutional Review Board approved, online survey, was available to the target population during the duration of the 3-day CE program. An introductory statement informed individuals that participation was voluntary and informed consent was obtained prior to beginning of the survey. Computers were available throughout the conference or participants could complete the survey on their personal mobile device. The instrument focused on 22 specific negative acts or behaviors with a Cronbach alpha value of .90. Three types of bullying were measured with the NAQ-R: work related, personal and physical intimidation. In order to avoid possible response bias, the term “bullying” was not used at the beginning of the survey or in any of the survey questions. Participants indicated how often they experienced each negative behavior or act (never, now and then, or monthly, weekly or daily) in the workplace within the past six months. According to Einarson et al., experiencing at least two negative behaviors at least weekly over the past six months indicates bullying.²⁶ In addition to the NAQ-R participants responded to six demographic questions (age, gender, education, ethnicity, employment and position), a question on recent workplace bullying and if their current employment setting had written policies on bullying. Data was collected with Qualtrics statistical program (Provo, Utah). The survey program was set with the option “Prevent Ballot Box Stuffing,” so respondents could respond only one time to the survey.

Results

Of the 240 VA hygienists invited to participate, 153 completed the survey in its entirety (n=153) for a response rate of 64%. Data revealed that 42% of the participants were employed in a solo dental practice, followed by 39% in a group practice. The vast majority of participants were female (97%) and white (84%). Approximately two thirds, 62%, had obtained a baccalaureate degree and 26% an associate’s degree. Just over one half (53%), of the respondents were under the age of 50 and 10% over the age of 60 (Table I). The prevalence of negative behaviors experienced by all participants in each of the three categories (work-related, physical intimidation, personal) are shown in Table II. Within the three categories (work-related, physical and personal), experiences of work-related bullying were the most common, followed by personal and physical intimidation (Table II).

Results suggest that approximately 24% of the participants experienced work related bullying weekly or daily in the past 6 months as defined by the NAQ-R. Of these, 18% reported experiencing three or more negative acts at least weekly (Table

Table 1. Demographics and Characteristics of Respondents

Characteristics		No. of Respondents N (%)
Gender		
	Male	4 (3%)
	Female	149 (97%)
Ethnicity		
	White	128 (84%)
	Black or African American	7 (5%)
	Hispanic	9 (6%)
	Asian	6 (4%)
	Other	3 (2%)
Highest Education		
	Associate Degree	40 (26%)
	Bachelor Degree	95 (62%)
	Master’s Degree	16 (10%)
	Doctoral Degree	2 (1%)
Practice Setting		
	Solo Private Practice	65 (42%)
	Education	11 (7%)
	Public Health	8 (5%)
	Other	7 (5%)
	Group Private Practice	59 (39%)
	Corporate Setting	3 (2%)
Age Range		
	20 to 29	20 (13%)
	30 to 39	33 (22%)
	40 to 49	28 (18%)
	50 to 59	56 (37%)
	over 60	16 (10%)

III). Results of the negative act survey responses from all candidates, as compared to the 24% of respondents who met the criteria for bullying are shown in Table IV. The most frequent negative behaviors experienced on a weekly or daily basis by those who met the criteria for bullying were: opinions and views ignored (73%), experiencing unmanageable workloads (68%) and having one’s work excessively monitored (68%) (Table IV).

At the end of the survey a definition of bullying was provided and all participants were asked the question, “are you experiencing work-place bullying?” to which 14% indicated yes. However, based on the criteria for bullying (2 or more negative acts) 24% of respondents

Table II. Frequency of Negative Acts Experiences by All Respondents

Negative Acts	Never		Now and Then or Monthly		Weekly or Daily	
	N	(%)	N	(%)	N	(%)
Work Related Bullying						
Been exposed to unmanageable workload	46	(30)	75	(49)	32	(21)
Given tasks with unreasonable/impossible targets/deadlines	96	(63)	41	(27)	16	(10)
Had information withheld that affected your performance	73	(48)	64	(42)	16	(10)
Had your opinions and views ignored	51	(33)	75	(49)	27	(18)
Had your work excessively monitored	80	(52)	52	(34)	21	(14)
Ordered to do work below your level of competence	106	(69)	34	(22)	13	(8)
Pressured into not claiming something to which entitled	122	(80)	24	(16)	7	(5)
Personal Bullying						
Been ignored or faced hostile reactions when you approached	103	(67)	37	(24)	13	(8)
Been ignored, excluded, or isolated from others	88	(58)	49	(32)	16	(10)
Been subjected to practical jokes	124	(81)	23	(15)	6	(4)
Experienced persistent criticism on your work and effort	118	(77)	29	(19)	6	(4)
Had false allegations made against you	116	(76)	32	(21)	5	(3)
Had gossip and rumors spread about you	95	(62)	47	(31)	11	(7)
Had insulting/offensive remarks made about you.	94	(61)	50	(33)	9	(6)
Had key tasks removed, replaced with trivial unpleasant tasks	126	(82)	22	(14)	5	(3)
Humiliated or ridiculed in connection to your work	115	(75)	27	(18)	11	(7)
Received hints or signals from others that you should quit job	129	(84)	16	(10)	8	(5)
Reminded repeatedly of your errors or mistakes	91	(59)	44	(29)	18	(12)
Subjected to excessive teasing and sarcasm	128	(84)	19	(12)	6	(4)
Physical Intimidation Bullying						
Been intimidated with threatening behavior	120	(78)	25	(16)	8	(5)
Been shouted at or targeted with spontaneous anger (or rage)	123	(80)	23	(15)	7	(5)
Experienced threats of violence or abused/attacked	143	(93)	5	(3)	5	(3)

Table III. Negative Acts Experienced Weekly or Daily

Number of Negative Acts Experienced	Count	Percent
0	96	(63%)
1	20	(13%)
2	9	(6%)
3 or more	28	(18%)

actually experienced workplace bullying as defined. These results suggest some participants were being bullied, but were unaware.

One-half of all respondents reported no workplace bullying policy existed in their place of employment and 25% of the respondents stated they were unsure if a policy existed. Of the 24% of respondents who met the criteria for being bullied, slightly less than a third, 32%, reported that their employment setting had a bullying policy, 54% reported no policy existed, and 14% reported they did not know if a policy existed in their employment setting.

Table IV. Comparison of Negative Acts Experiences by All Respondents - Bullying vs. Overall

Negative Acts	Never		Now and Then or Monthly		Weekly or Daily	
	Bullying %	Overall %	Bullying %	Overall %	Bullying %	Overall %
Work Related Bullying						
Been exposed to unmanageable workload	0	(30)	32	(49)	68	(21)
Given tasks with unreasonable/impossible targets/deadlines	18	(63)	27	(27)	55	(10)
Had information withheld that affected your performance	27	(48)	23	(42)	50	(10)
Had your opinions and views ignored	5	(33)	23	(49)	73	(18)
Had your work excessively monitored	18	(52)	14	(34)	68	(14)
Ordered to do work below your level of competence	41	(69)	18	(22)	41	(8)
Pressure into not claiming something to which entitled	32	(80)	41	(16)	27	(5)
Personal Bullying						
Been ignored or faced hostile reactions when you approached	23	(67)	36	(24)	41	(8)
Been ignored, excluded, or isolated from others	14	(58)	41	(32)	45	(10)
Been subjected to practical jokes	55	(81)	23	(15)	23	(4)
Experienced persistent criticism on your work and effort	27	(77)	45	(19)	27	(4)
Had false allegations made against you	36	(76)	41	(21)	23	(3)
Had gossip and rumors spread about you	18	(62)	45	(31)	36	(7)
Had insulting/offensive remarks made about you.	14	(61)	50	(33)	36	(6)
Had key tasks removed, replaced with trivial unpleasant tasks	50	(82)	27	(14)	23	(3)
Humiliated or ridiculed in connection to your work	23	(75)	36	(18)	41	(7)
Received hints or signals from others that you should quit job	45	(84)	23	(10)	32	(5)
Reminded repeatedly of your errors or mistakes	23	(59)	23	(29)	55	(12)
Subjected to excessive teasing and sarcasm	41	(84)	36	(12)	23	(4)
Physical Intimidation Bullying						
Been intimidated with threatening behavior	18	(78)	50	(16)	32	(5)
Been shouted at or targeted with spontaneous anger (or rage)	41	(80)	32	(15)	27	(5)
Experienced threats of violence or abused/attacked	82	(93)	0	(3)	18	(3)

Discussion

Workplace bullying has become a serious and escalating problem that negatively affects a significant proportion of healthcare professionals. As a result of its negative consequences on the overall health and well-being of employees, the importance of understanding its prevalence, as well as factors that contribute to the emergence of bullying is critical.

Study results show that nearly one-quarter (24%) of the respondents reported experiencing workplace bullying over the past 6 months. These findings are similar to other studies in health care with rates ranging from 20% to 27%.^{2,24,27} Results suggest nearly one in four participants in the present study experienced bullying, but only one in seven recognized that workplace bullying was occurring. In order to address

workplace bullying dental hygienists must first identify if bullying exists then develop proactive action plans to counter negative acts of bullying. A significant number of participants were not aware they were bullied suggesting that awareness, education and policies are needed. The psychological and physical stressors associated with bullying can take a negative toll on victims leading to dissatisfied employees who may be prone to make patient care mistakes, call in sick, as well as leave the work setting and even the profession.²⁸ Therefore, the dental hygiene profession should advocate for bullying education and policies that promote zero tolerance in the workplace.

As a profession of predominately women, dental hygienists may be particularly vulnerable to the effects of workplace bullying. The most likely victims of workplace bullying are frequently women associated with differing positions of power held between men and women. Notably, in 2014, the Workplace Bullying Institute polled a national sample of 1,000 adults demonstrating that 62% of the bullies were men and 58% of the targets were women.²⁹ Another study in a medical school setting reported that 50% of participants had been bullied and of these, 70% were women.³⁰ Moreover, Townsend et al., found young women who experienced bullying were more likely than men to use tobacco or illicit drugs, be obese and be at risk of poor physical health, psychological distress, suicidal thoughts and self-harm.³¹

Leymann identified four factors contributing to workplace bullying: low morale, deficiencies in work design, poor behavior of leaders and socially exposed position of the target.³² Individuals in positions of power who are cognizant of these factors may be more adept at preventing and managing workplace bullying. Dental personnel need to be educated in how to identify bullying, manage conflict and handle grievances. Bullies are toxic to the work environment and hold the team back from achieving goals and positive outcomes. An employee creating an unhealthy work environment, no matter how great their clinical expertise, is detrimental to the practice. Education to ensure identification and management of bullying may promote greater self-advocacy and a healthier work environment for dental professionals. Professional associations could offer seminars or CE related to the topic. Furthermore, dental hygiene students could benefit from the addition of curriculum on bullying in practice management courses.

Dental professionals should learn to eliminate bullying from their own behavior and promote a culture of safety and respect. In the present study, the majority of dental hygienists who indicated bullying occurring at their place of employment were over the age of 40. It is possible that

older participants are more aware and better able to identify and manage bullying behaviors through increased life and work experiences; however, these results could also indicate that younger employees may be more likely to bully older employees. Since the researchers relied on respondents' self-reporting, individuals may have been hesitant to express their true opinions. Results of the present study differ from those of Simons et al., which found increased bullying affecting younger, newly graduated nurses.⁶ Effective role modeling will help minimize negative behaviors and acts, foster better individual health, as well as promote a positive work culture.²³

Most respondents were not aware if their employment setting had a workplace bullying policy or stated none existed. A well thought-out, written bullying policy plays an important role in fostering a collaborative, healthy workplace and should be communicated to all employees. Policies should outline steps to prevent bullying, protect staff that report bullying and/or cooperate in investigations and have clear consequences and repercussions for perpetrators. Additionally, policies should be visible, reviewed, and regularly updated by all employees. Without written policies, dental hygienists may be fearful of retaliation if they report workplace bullying. Policies must be implemented and enforced, otherwise victims may not feel comfortable reporting incidents of bullying.³³ Dental professionals can employ questionnaires such as the NAQ-R when developing policies and prevention plans to provide an ongoing analysis of negative behaviors and work to proactively target the most frequently reported negative behaviors. Most importantly, the root cause of bullying should be identified and steps put in place to remedy this behavior.²⁰ All members of the dental team need to be treated with respect and focus on collaboration and teamwork, which ultimately promotes higher quality patient care. A clearer understanding of the manifestation of bullying can lead to a reduction or elimination of negative workplace behaviors.

Study Limitations

Intrinsic methodological limitations of this study should be recognized. The incidences of bullying were measured through self-report, which might have impacted findings causing one to assume a corresponding bias in the key variables. There is a risk of over or under estimating the prevalence of bullying as reported by a convenience sample of dental hygienists in the same geographic location. Future research should focus on identifying the specific perpetrator of the bullying and identify whether it is vertical or horizontal bullying in addition to the role of patients in workplace bullying. The survey was only available for a 3-day period which may have affected response rate. Study replication

with a national sample of dental hygienists is warranted to determine which factors in dental practice settings contribute to workplace bullying. Results should be assessed cautiously as they represent only the viewpoint of the victim of the bullying, not the perpetrator. This partial perspective of this phenomenon should be considered in future research.

Conclusion

Approximately 24% of the study participants experienced workplace bullying on a daily or weekly basis. The most common negative behaviors revealed were having their views and opinions ignored, receiving unmanageable workloads, and having their work excessively monitored. Over half of the respondents meeting the criteria for bullying reported that their employment setting had no bullying policy and 14% did not know if a policy existed. Study findings support the need for additional research on the prevalence and impact of workplace bullying, as well as the need to develop effective strategies and policies to eliminate these behaviors. Workplace bullying can take many forms and is a problem that can have detrimental effects on the overall well-being of those targeted by this behavior and the culture of the organization. Proactive strategies through intra and inter-collaborations with dental and other health professionals could help effectively address the broader issue of workplace bullying.

Gayle B. McCombs, RDH, MS, is an emeritus faculty professor; **S. Lynn Tolle, RDH, MS** is a university professor; **Tara L. Newcomb, RDH, MS** is an associate professor and director of clinical affairs; **Ann M. Bruhn, RDH, MS** is an associate professor and interim program chair; **Amber W. Hunt, RDH, MS** is a visiting lecturer; all at the School of Dental Hygiene, Old Dominion University, Norfolk, VA

Lanah K. Stafford, MA is a senior research associate, Office of Institutional Effectiveness and Assessment, Old Dominion University, Norfolk, VA.

Corresponding Author: Gayle McCombs, RDH, MS;
gmccombs@odu.edu

References

1. Giorgi G, Mancuso S, Fiz PF, et al. Bullying among nurses and its relationship with burnout and organizational climate. *Int J Nurs Pract.* 2016 Apr;22(2):160-8.
2. Carter M, Thompson N, Crampton P, et al. Workplace bullying in the UK NHS: a questionnaire and interview study on prevalence, impact and barriers to reporting. *BMJ Open.* 2013 Jun; 3(6): e002628.
3. Norton P, Costa V, Teixeira J, et al. Prevalence and determinants of bullying among health care workers in Portugal. *Workplace Health Saf.* 2017 May;65(5):188-96.
4. Askew DA, Schluter PJ, Dick ML, et al. Bullying in the Australian medical workforce: cross-sectional data from an Australian e-Cohort study. *Aust Health Rev.* 2012 May;36(2):197-204.
5. Simons S. Workplace bullying experienced by Massachusetts registered nurses and the relationship to intention to leave the organization. *ANS Adv Nurs Sci.* 2008 Apr-Jun;31(2):48-59.
6. Simons SR, Mawn B. Bullying in the workplace--a qualitative study of newly licensed registered nurses. *AAOHN J.* 2010 Jul;58(7):305-11.
7. Erikson T, Høgh A, Hansen A. Long-term consequences of workplace bullying on sickness absence. *Lab. Econ.* 2016 Dec; 43:129-150.
8. D'Cruz P, Paull M, Omari M, et al. Target experiences of workplace bullying: insights from Australia, India and Turkey. *Empl. Rel.* 2016 Aug 1;38(5):805-23.
9. Etienne E. Exploring workplace bullying in nursing. *Workplace Health Saf.* 2014 Jan;62(1): 6-11.
10. Lahari A, Fareed N, Sufhir K. Bullying perceptions among post graduate dental students of Andhra Pradesh India. *J of Ed and Ethics in Dent.* 2012 Jan-Jun;2(1):20-24.
11. Yildirim D. Bullying among nurses and its effects. *Int Nurs Rev.* 2009 Dec;56(4):504-11.
12. Khubchandani J, Price JH. Workplace harassment and morbidity among US adults: results from the national health interview survey. *J Community Health.* 2015 Jun;40(3):555-63.
13. Aquino K, Lamertz K. A relational model of workplace victimization: social roles and patterns of victimization in dyadic relationships. *J Appl Psychol.* 2004 Dec;89(6):1023-34.
14. Birks M, Cant RP, Budden LM, et al. Uncovering degrees of workplace bullying: a comparison of baccalaureate nursing students' experiences during clinical placement in Australia and the UK. *Nurse Educ Pract.* 2017 Jul; 25:14-21.
15. Cleary M, Hunt GE, Horsfall J. Identifying and addressing bullying in nursing. *Issues Ment Health Nurs.* 2010 May;31(5):331-5.

16. Takaki J, Taniguchi T, Fukuoka E, et al. Workplace bullying could play important roles in the relationship between job strain and symptoms of depression and sleep disturbance. *J Occup Health* 2010 Jan;52: 367-74.
17. Reknes I, Pallesen S, Magerøy N, et al. Exposure to bullying behaviors as a predictor of mental health problems among Norwegian nurses: results from the prospective SUSSH-survey. *Int J Nurs Stud*. 2014 Mar;51(3):479-87.
18. Houck NM, Colbert AM. Patient safety and workplace bullying: An integrative review. *J Nurs Care Qual*. 2017 Apr-Jun;32(2):164-71.
19. Laschinger HK. Impact of workplace mistreatment on patient safety risk and nurse-assessed patient outcomes. *J Nurs Adm*. 2014 May;44(5):284-90.
20. Wallace CS, Gipson K, Wallace CS. Bullying in healthcare: a disruptive force linked to compromised patient safety. *Pa Pat Saf Advis*. 2017 Jun;14(2):64-70.
21. Spence HK, Nosko A. Exposure to workplace bullying and post-traumatic stress disorder symptomology: the role of protective psychological resources. *J Nurs Manag*. 2015 Mar;23(2):252-62.
22. Burnes B and Pope R. Looking beyond bullying to assess the impact of negative behaviours on healthcare staff. *Nurs Times*. 2009 Oct;105(39):20-4.
23. Steadman L, Quine L, Jack K, et al. Experience of workplace bullying behaviours in postgraduate hospital dentists: questionnaire survey. *Br Dent J*. 2009 Oct;207(8):379-80
24. Demir D, Rodwell J, Flower R. Workplace bullying among allied health professionals: prevalence, causes and consequences. *Asia Pacific J of HR*. 2013 Oct;51(4):392-405.
25. Rowland ML, Naidoo S, AbdulKadir R, et al. Perceptions of intimidation and bullying in dental schools: a multi-national study. *Int Dent J*. 2010 Apr;60(2):106-12.
26. Einarsen S, Hoel H, Notelaers G. Measuring exposure to bullying and harassment at work: validity, factor structure and psychometric properties of the negative acts questionnaire-revised. *Work & Stress*. 2009 Jan 1;23(1):24-44.
27. Johnson SL, Rea RE. Workplace bullying: concerns for nurse leaders. *J Nurs Adm*. 2009 Feb;39(2):84-90.
28. Wilson JL. An exploration of bullying behaviours in nursing: a review of the literature. *Br J Nurs*. 2016 Mar-Apr;25(6):303-6.
29. 2014 WBI U.S. Workplace bullying survey [Internet]. Clarkston: Workplace Bullying Institute; 2018 [cited 2018 Jan 23]. Available from: <http://workplacebullying.org/multi/pdf/WBI-2014-US-Survey>.
30. Mukhtar F, Daud S, Manzoor I, et al. Bullying of medical students. *J Coll Physicians Surg Pak*. 2010 Dec;20(12):814-8.
31. Townsend N, Powers J, Loxton D. Bullying among 18 to 23-year-old women in 2013. *Aust N Z J Public Health*. 2017 Aug;41(4):394-98.
32. Leymann H. The content and development of mobbing at work. *Eur J Work Organ Psychol*. 1996 Jun 1;5(2):165-84.
33. Murray JS. Workplace bullying in nursing: a problem that can't be ignored. *Medsurg Nurs*. 2009 Sep-Oct;18(5):273-76.

Dental Hygienists' Knowledge, Attitudes, and Comfort Level in Treating Patients with Dental Anxiety

Lauren Kanzigg, RDH, MS; Ceib L. Phillips, PhD; Margot B. Stein, PhD;
Lynne C. Hunt, RDH, MEd, MS; Rebecca S. Wilder, RDH, MS;

Abstract

Purpose: Fear of dental treatment is a significant problem in the United States, impacting patients as well as oral health care providers. The purpose of this study was to identify the already-acquired knowledge, attitudes, and level of confidence of practicing dental hygienists with respect to the treatment of patients with dental anxiety.

Methods: A paper survey was developed, pilot tested, and administered at a state-wide annual dental hygiene continuing education (CE) course in North Carolina. The survey domains studied included demographics, practice setting, practice behaviors, dental anxiety awareness, and opinions and attitudes. Item responses included multiple choice, a Likert Scale ranging from “extremely frequent to never” and “strongly agree to strongly disagree,” and free response questions. Results were tabulated and descriptive statistics were performed.

Results: Of the 157 attendees, 153 met the inclusion criteria (n=153) for a participation rate of 97%. Dental anxiety questionnaires were used “often” or “always” by 20% of the respondents. Less than half (43%) of the respondents stated that they knew the common signs and symptoms of a patient suffering from dental anxiety. However, 92% of the respondents (n=140) indicated confidence in their ability to perceive whether a patient felt stressed. A little more than half (58%) believed their dental hygiene education prepared them for treating patients with mild dental anxiety, 38% with moderate dental anxiety, and 22% with severe dental anxiety.

Conclusion: Although the majority of dental hygienists in this study felt confident in their abilities to perceive stress in patients seeking dental care, they were less knowledgeable in recognizing the full range of signs and symptoms of dental anxiety. Questionnaires designed to specifically identify this population were used infrequently. Dental hygiene curricula and continuing education programs should include content on anxiety management for patients exhibiting all levels of dental anxiety.

Keywords: dental anxiety, dental phobia, dental fear, dental hygienists, dental hygiene education

This manuscript supports the NDHRA priority area: **Professional development: Education** (Evaluation).

Submitted for publication: 7/20/17; accepted: 7/31/18

Introduction

Dental anxiety, or feeling stressed or uneasy at the thought of dental treatment, is a multi-faceted disorder that involves patients' somatic, cognitive, and emotional behavior responses.¹⁻³ Multiple factors may contribute to a patient's susceptibility to developing dental anxiety. Approximately one out of every three adult women become anxious before, during, or after dental treatment in a study conducted by Armfield et al.⁴ Traumatic dental experiences during childhood, family or media influences, certain psychological conditions, higher generalized fear level, low income, poor oral health literacy, and an inadequate perception of one's oral health status have all been associated with dental anxiety.⁴⁻⁸ Dierke et al. reported

that heightened anxiety during dental care can result in delayed wound healing and severe oral inflammatory diseases.⁷ Adults identifying with higher levels of dental anxiety are 30% less likely to visit the dentist regularly and are more likely to avoid any dental procedures until emergency care is needed.⁸ Hmud et al. found that avoidance of dental treatment increased susceptibility of caries morbidity and decayed, missing, filled surfaces (DMFS) scores, decreased number of restored teeth, and significantly more missing teeth, as compared to patients without dental anxiety.⁶

Typically, once seated in the dental chair, anxious patients may appear to be irritable, uncooperative, have higher

blood pressure, experience heightened sensitivities, have impaired social or cognitive function, and provide negative commentary.¹⁻⁶ Anxious patients can also become fearful or cry without warning, become aggressive, have a greater chance of being self-medicated, and frequently cancel, delay, or reschedule appointments.¹⁻¹⁰ Although these characteristic traits are commonly seen in this patient population, they are not evident in every patient with anxiety issues. However, these characteristics may be used a guide in determining whether a patient has an undiagnosed dental anxiety.

The constructs within dental anxiety can be separated into three types: mild, moderate and severe. A patient exhibiting mild dental anxiety experiences an internal sensation that something is different and requires additional attention.¹¹ Moderate dental anxiety is characterized when a patient only focuses on what is happening to them at the moment.¹² Moderately anxious patients may experience a disturbing feeling that something is not right but are still able to learn and process new information.¹¹ Patients experiencing severe dental anxiety are characterized as having a significant reduction in their perceptual ability.^{11,12} Identifying the different levels of dental anxiety allows the practitioner to make the appropriate adaptations to the patient's care.⁴

Dental anxiety questionnaires can provide practitioners with useful information prior to beginning patient care. Corah's Dental Anxiety Scale (DAS), the Modified Dental Anxiety Scale (MDAS), the Oral Health Impact Profile (OHIP), and Kleinknecht's Dental Fear Survey (DFS) are commonly used questionnaires. The DAS is comprised of four questions with a five-scale answering system designed to measure dental fear levels.^{13,14} Similar to the DAS, the MDAS incorporates a fifth question on local anesthesia.¹⁵ The OHIP is composed of forty-nine measures of oral health related quality of life questions, designed to measure patient's perceptions of the outcome of their dental disorders on their overall health and well-being.¹³⁻¹⁶ The DFS uses a five-point Likert scale to survey patients regarding their anxieties with twenty-seven specific situations.¹⁷ While use of an anxiety questionnaire does not guarantee the identification of all patients suffering from a dental anxiety, they can assist clinicians to better understand their patients' needs.

Options for treating patients with dental anxieties include rapport building, voice and movement modulation, distraction, modeling, guided imagery, environmental change, and enhancing the patient's sense of control.¹⁸ Distraction techniques can be performed by simply taking the patient's attention away from the cause of the symptoms.^{4,18} Modeling allows the patient to observe similar treatments prior to their own treatment appointment.^{4,18} Guided imagery consists of directing the patient into a dream-like state of mind and utilizes all of their senses to create an overall

state of relaxation.^{4,18} Enhancing control allows the patient to feel more "in control" of what is happening during their dental appointment. This technique often includes the "Tell-Show-Do" method of first explaining each of the steps of the procedure, showing the procedure being performed, and then completing it on the patient.^{4,18}

Additional treatment methods for patients with moderate dental anxiety include biofeedback, acupuncture, systematic desensitization, cognitive behavioral therapy (CBT), and hypnosis. Biofeedback utilizes instruments to measure, amplify and provide feedback on the patient's physiological status.¹⁸ Systematic desensitization, or exposure therapy, consists of encouraging the patient to talk about their dental anxiety; teaching basic relaxation techniques; and gradually exposing the patient to the source of the anxiety.^{4,18,19} CBT is the combination of cognitive therapy and behavioral therapy and utilizes the individual's ability to change negatively configured thoughts, or conditions, and their actions, or behaviors.^{4,18,19} Hypnosis is a non-invasive form of treatment that can promote deep relaxation in patients with dental anxiety. Hypnotherapy has been shown to demonstrate decisive, long-lasting effects on a patient's dental anxiety status.²¹

Pharmacological management, conscious sedation, and general sedation have been used successfully on patients with severe dental anxiety.²² Benzodiazepines are well suited for use in dentistry due to their anxiolytic, sedative, and amnesic qualities.²² Nitrous oxide gasses produce anxiolytic, amnesic, and analgesic effects and are frequently used for conscious sedation during dental treatment.^{23,24} Most treatment techniques for patients' suffering from severe anxiety are considered to be temporary solutions to the deeper underlying problem of dental anxiety.²³⁻²⁵

Fear of dental treatment is a significant problem in the United States with up to 80% of the population reporting having dental anxiety and about 5% of the population so fearful that they avoid dental care completely.^{1, 4-6, 25} Dental anxiety is also a burden on dental professionals with nearly 70% reporting that treating a patient with dental anxiety is a difficult challenge to their daily practice⁶ and the source of extensive physical, mental and emotional stress.^{4,25}

Limited opportunities exist within either dental or dental hygiene education programs for students to gain clinical experience in identifying, assessing, and utilizing effective treatment measures for patients with dental anxiety.²⁵ Hill et al. found that 46% of the dentists surveyed indicated interest in further training and believe that psychological treatment approaches could be successful in treating patients with dental anxiety.²⁵ With 85% of dentists recognizing their responsibilities in treating all types of dental anxiety, clinicians need experience with multiple approaches to provide care

for this population.²⁵ While there is data on the level of knowledge, attitudes, and comfort level in treating patients with dental anxiety of dentists, data is lacking in regards to dental hygienists. The purpose of this study is to identify the already-acquired knowledge, attitudes, and level of confidence of practicing dental hygienists with respect to their treatment of patients with dental anxiety.

Methods

This study was deemed exempt by the Biomedical Institutional Review Board of the University of North Carolina, Chapel Hill (IRB #16-0992). A paper survey was developed by the authors included the following domains: demographics (6 questions) included certificates and degrees earned; practice setting (7 questions) included types of patients commonly seen and percentage of patients seen with mild, moderate and severe dental anxiety; practice behaviors (17 questions) included whether patients were screened for dental anxiety, types of questionnaires used, and dental anxiety treatment methods; dental anxiety awareness (17 questions) included common signs and symptoms of dental anxiety and knowledge -based questions; opinions and attitudes (13 questions) included confidence in treating patients with dental anxiety and educational preparation.

The survey was pilot tested by six practicing dental hygienists from the University of North Carolina School of Dentistry and revisions were made to the wording and on the face validity of each domain. Time required to complete the survey was reported by the pilot testers. The survey took approximately ten minutes to complete.

Dental hygienists attending a North Carolina state-wide annual continuing education course who were over the age of 18, had an active dental hygiene license and were currently practicing dental hygiene, were invited to participate in the study. The purpose of the paper-based survey was explained verbally prior to the start of the course and participants were asked to return the surveys at the end of the program. There were no personal identifiers on the survey and respondents were given the opportunity to include open-ended responses regarding the treatment of patients with dental anxiety.

Survey responses to the Likert scale, multiple choice and free response questions were entered by the principal investigator into an excel spreadsheet. All knowledge-based questions were captured based on the percentage of participants who answered each question correctly; confidence levels were recorded in the same manner. Descriptive statistics were used to identify any frequencies and to report distributive findings. For each respondent, the number of correct identification of symptoms was calculated (range = 0 to 6) as well as the correct number of knowledge items (range = 0 to 10). Bivariate analysis using

the Mantel Baenszel row mean score test was used to assess whether the total number of correct responses to the list of symptoms and the total number of correct responses to the knowledge items differed among the level of education groups or among the years of experience groups. Probability was calculated using the data analysis.

Results

Demographics

Of the 157 surveys distributed, 153 met the inclusion criteria (n=153), yielding an overall response rate of 97%. The majority of the participants (68%) had an Associate's degree in dental hygiene, 25% a Bachelor's and 6% a Master's degree. Approximately one-third, (30%) of the participants had been practicing for less than ten years and about one-quarter, 24% for over 30 years. A majority of the participants indicated a desire to learn more about treatment options and wanted to have more information regarding referral options for patients with dental anxiety.

Practice Setting

The majority,(84%) of participants worked in private practice. Slightly more than a third reported working in a small-town and another third were employed in mid-sized city. When asked to respond regarding specific types of patients treated in a typical week, 96% reported working with adults and 68% included geriatric patients. A little more than two-thirds worked with pediatric populations, 50% with special needs patients, 24% with terminally-ill patients, and 32% with immunocompromised patients.

Practice Behaviors

All respondents (n=153) reported treating patients with some type of dental anxiety. Over one third (34%) of respondents indicated that over 30% of their patients exhibit mild dental anxiety.

Patients exhibiting moderate or severe dental anxiety were treated less frequently by the respondents. Table I shows the various types of dental anxiety treated on a weekly basis. Fewer than one-fifth (19%) reported screening patients for dental anxiety issues. Of these, 17% utilize the DAS. (Table II). Eighty-percent of participants answered "Never" or "Rarely" to using dental anxiety questionnaires and over half (60%) of the participants stated that they were unfamiliar with dental anxiety questionnaires. Data regarding the rationale for not using a dental anxiety questionnaire is shown in Figure 1.

The most frequently reported service or counseling method offered by the participants was patient control (80%). The least frequently used methods of treatment were hypnosis, (1%), and acupuncture (3%). One participant indicated

Table I. Dental Anxiety Levels Treated on a Weekly Basis

	0 Percent (n)	0 Percent (%)	1-10 Percent (n)	1-10 Percent (%)	11-20 Percent (n)	11-20 Percent (%)	21-30 Percent (n)	21-30 Percent (%)	Over 30 Percent (n)	Over 30 Percent (%)
Mild Dental Anxiety	0	0%	27	18%	32	21%	41	27%	51	34%
Moderate Dental Anxiety	9	6%	62	41%	47	31%	16	10%	17	11%
Severe Dental Anxiety	33	22%	92	61%	14	9%	6	4%	6	4%

interest in learning more about hypnosis as an option for treating an individual with dental anxiety. Figure 2 illustrates the range of services and strategies used while caring for a patient with a dental anxiety.

Dental Anxiety Awareness

Table II. Dental Anxiety Questionnaire Usage and Type Reported by Participants (n=35)

Type of Questionnaire:	(n)	(%)
Dental Anxiety Scale	6	17%
Modified Dental Anxiety Scale	1	3%
Oral Health Impact Profile	2	6%
Dental Fear Survey	3	9%
Other	23	66%
Total (N=153)	35	23%

Fewer than half (43%) of the participants identified all the possible signs and symptoms of dental anxiety correctly. While the average number of correct responses was not statistically significantly different among the 4 experience categories ($p=0.98$), all participants agreed that shortness of breath and fidgetiness/physical restlessness are symptoms of dental anxiety. Over 95% of respondents agreed, “Dental anxiety affects oral health care;” “Anxiety disorders can significantly impair daily functioning;” and “One of the leading causes of delayed dental care is dental anxiety.” Fewer than one-third (31%) of participants were aware that females experience more dental anxiety than males and a little more than on-half (60%) understood the impact of dental anxiety on wound healing (Table III).

Level of dental hygiene education, Associate, Bachelor and Master’s degree, was not demonstrated to be significant in regards to knowledge of dental anxiety symptoms ($p=0.92$). Several participants shared that, “Not enough information is available to students in their dental hygiene curriculum.” However, level of education was demonstrated to be significantly different ($p=0.03$) among the three groups in regards to general knowledge score.

Figure 1. Reasons for not Utilizing Dental Anxiety Questionnaires (n=118)

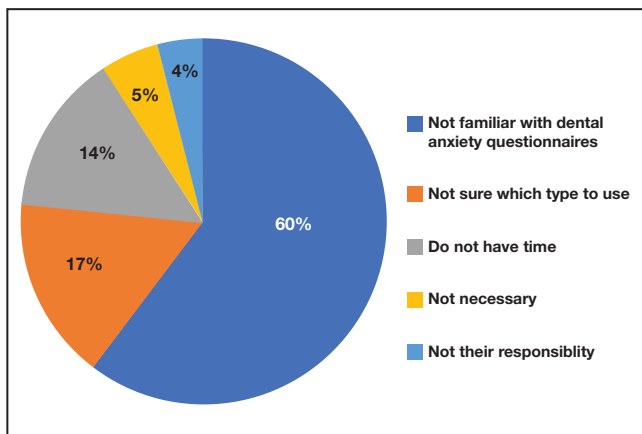


Figure 2. Frequency of Services Offered for Dental Anxiety Patients

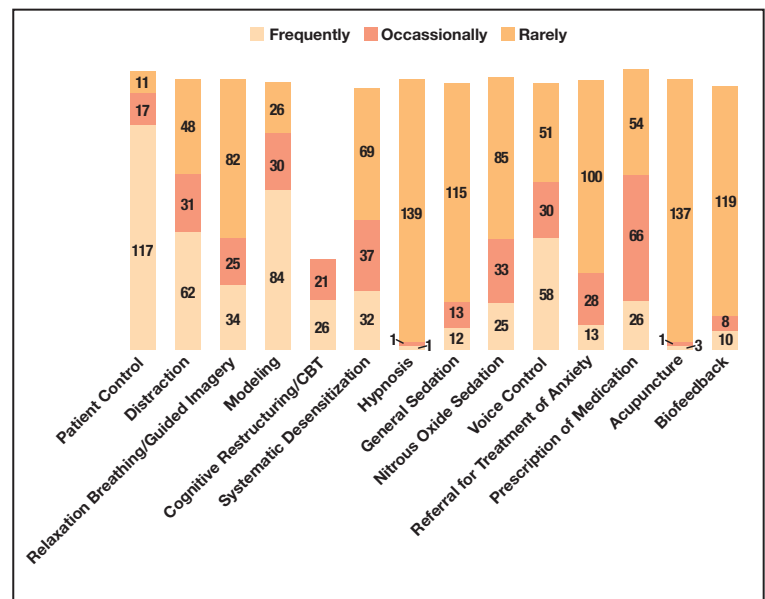


Table III. Participants' Awareness of Dental Anxiety

Statement	Correct response (n)	(%)
Females experience dental anxiety more than males.	47	31%
Prevalence of dental anxiety decreases with age.	52	34%
Red-haired patients may be more sensitive to pain, harder to anesthetize, and more anxious than other patients.	53	35%
Inflammatory diseases are more severe in dental anxiety patients.	58	38%
Patients with dental anxiety express higher levels of pain perception compared to patients without it.	65	43%
Wound healing is impacted by high anxiety levels.	89	58%
Anxiety disorders typically surface in adolescence or early adulthood.	89	58%
Anxiety disorders commonly run in families.	94	62%
Patients who suffer from untreated anxiety disorder often suffer from other psychological disorders.	103	68%
Dental anxiety and pain perception vary with education and income levels, smoking, and oral health status.	104	68%
Patients who suffer from dental anxiety have a higher tendency to abuse alcohol and other drugs.	106	70%
Patients with dental anxiety are nearly five times more likely to need immediate treatment and are missing more teeth than the average patient.	113	74%
Dental anxiety can affect a patient's physical, mental, and emotional status.	144	95%
Anxiety disorders can significantly impair daily functioning.	147	96%
One of the leading causes of delayed dental care is dental anxiety.	150	98%
Dental anxiety affects oral health care.	150	98%

Years of experience did not significantly impact knowledge scores ($p=0.36$).

Opinions and Attitudes

The vast majority of respondents, 98%, agreed with the statement, "Anxiety about dental treatment is a challenge for both the patient and the dental clinician." One participant added, "Anxiety in patients can cause anxiety in clinicians. Managing dental anxiety can help us treat patients better; we just need to know how to best treat these patients." Over 95% of participants agreed that dental hygienists are in a key position to screen and identify patients with dental anxiety (Table IV).

A little more than half (58%) of the participants believed that their dental hygiene education prepared them for treating patients with mild levels of anxiety; 38% felt prepared for moderate levels of anxiety; and 22% felt prepared to care for patients suffering from severe dental anxiety. Over three-quarters (78%) of the participants were specifically interested in learning more about dental anxiety questionnaires and 79% expressed interest in additional continuing education courses on treating patients with dental anxiety. A majority of the participants (82%) would like to learn more about treatment options for patients with severe dental anxiety as where to refer them for more specialized care. The majority of the respondents (92%) indicated confidence in their abilities to perceive stress in their patients and 98% were confident in their ability to work with patients experiencing mild anxiety. Over three-quarters (77%) expressed confidence in their ability to work with patients experiencing moderate to high levels of dental anxiety.

Discussion

The majority of the respondents in this study believed that treating patients with dental anxiety is a stressful experience for both the patient and the provider; a significantly higher affirmation of the challenges of dental anxiety than previously identified by Dierke et al.⁷ In the Dierke et al. study, 19% of the German dentists surveyed regarding their knowledge of psychosomatic medicine, indicated that treating a patient with dental anxiety was difficult. Preferred treatment options from the German study included reduced patient waiting times, shorter appointments, the use of local anesthesia, patient control techniques, and communication on fear.⁷ Relaxation techniques and hypnosis were used with the lowest frequency.⁷ The majority (95%) of the dentists surveyed in the Dierke et al. study believed that dental fear "strongly" or very "strongly" affected pain perception but only 20% believed that levels of anxiety impacted wound healing.⁷ Furthermore, fewer than half of the dentists in the Dierke et al. study participated in continuing education courses focusing

Table IV. Opinions and Attitudes Regarding Dental Anxiety (n=153)

Statement:	Agree (n)	(%)	Neutral (n)	(%)	Disagree (n)	(%)
I am confident in my ability to work with patients who may be experiencing mild levels of dental anxiety.	148	98%	2	1%	1	0.7%
Anxiety about dental treatment is a challenge for both the patient and dental clinician.	146	98%	3	2%	0	0%
Dental hygienists are in a key position to screen and identify patients with dental anxiety.	145	95%	6	4%	1	0.7%
I am confident in my ability to perceive that my patient feels stressed.	140	92%	11	7%	1	0.7%
I would like to learn more about treatment options for patients with severe dental anxiety as well as where to refer them.	125	82%	25	17%	2	1%
I would like to take additional continuing education courses on treating patients with dental anxiety.	120	79%	27	18%	5	3%
I am interested in learning more about dental anxiety questionnaires for screening dental patients.	118	78%	31	20%	3	2%
I am confident in my ability to work with patients who may be experiencing moderate to high levels of dental anxiety.	117	77%	22	15%	13	9%
My dental hygiene education prepared me for treating patients with mild dental anxiety.	88	58%	32	21%	31	21%
The number of patients with dental anxiety seems to be increasing.	60	40%	54	36%	38	25%
My dental hygiene education prepared me for treating patients with moderate dental anxiety.	57	38%	39	26%	56	37%
My dental hygiene education prepared me for treating patients with severe dental anxiety.	33	22%	34	22%	85	56%
All degrees of dental anxiety respond to the same intervention.	5	3%	8	5%	137	91%

on dental anxiety.⁷ In contrast, 60% of the participants in this study recognized the impact of anxiety on wound healing and 82% were interested in learning more about caring for patients with dental anxiety through continuing education courses. While there were significant differences in knowledge areas and interests in more education, some of these differences may be attributed to cultural influences between the two populations.

Educational training and experiences may play a role in a clinician's confidence and comfort levels when caring for the anxious dental patient. Hill et al. surveyed practicing dentists to determine their views and experience levels regarding the use of dental anxiety management techniques along with what was taught during dental school.²⁵ While over half (51%) of the dentists indicated that they had received some training in treating patients with dental anxiety, 75% of the respondents indicated inadequate knowledge in the area of hypnotherapy and 65% indicated inadequacies in psychological techniques.²⁵ A majority (85%) of the dentists in the Hill et al. study also felt a professional responsibility to treat the anxious patient.²⁵ The majority (85%) of the dental hygienists in current study felt well prepared by their education to treat patients with mild anxiety issues, however they were less confident to treat moderate anxiety (57%) and severe anxiety (33%). Similar to the Hill et al., the majority of the dental hygienists in this study expressed feelings of responsibility towards treating patients with dental anxiety.

Respondents in this study indicated a need for more educational preparation in treating

patients with moderate to severe dental anxiety. The American Dental Education Association (ADEA) Compendium on Curriculum Guidelines for Allied Dental Education Programs states that dental hygiene programs should teach students to assess the pain management needs of patients and apply appropriate pain and anxiety management strategies.²⁶ Commission on Dental Accreditation (CODA) Standard 2-12 states that graduates must be competent in assessing the treatment needs of patients presenting with special needs.²⁷ Competency in this area requires patient experiences that include individuals whose medical, physical, psychological and social situations may require additional treatment strategies; patients struggling with dental anxiety issues come under this category. Knowledge in the areas of psychology and mental health are critical in identifying and treating a patient presenting with a dental anxiety. The majority of the dental hygienists in this study indicated the belief that dental anxiety impacts oral health and presents challenges for both the patient and clinician. Participants also indicated the need for more information on treating dental anxieties during their dental hygiene education experience. Curricular changes in dental hygiene programs specific to dental anxiety issues may assist future clinicians in playing a leadership role in the management of anxious patients.

Validated dental anxiety questionnaires provide clinicians with a useful means to identify patients with anxiety issues, however only about 20% screened for dental anxiety and over half (60%) of the respondents were unaware of dental anxiety questionnaires. When questioned regarding the rationale for not using a questionnaire, respondents indicated a lack of knowledge in how to select a questionnaire, not having the time or not feeling it was their responsibility. In regards to time management concerns, it should be noted that the newly created Current Dental Terminology (CDT) codes address some of the issues related to providing additional levels of care for patients with dental anxiety.²⁸ Dental care management-core coordination code, D9992, assists in the billing for additional time required to coordinate oral health care services with multiple interdisciplinary providers. A code for dental case management – motivational interviewing, D9993, was created to assist the oral health care provider in giving patient-centered, personalized counseling to identify and modify patient behaviors that can impact treatment outcomes.²⁸ The dental case management-patient education to improve oral health literacy code, D9994, was created to establish an individualized approach to patient education with the goal of informed health care decision making.²⁸ All three codes can be applied towards the additional time required to coordinate and plan for care of the patient with dental anxiety.

While the high response rate (97%) was a strength of this study, it is also limited by its small sample size from one state

in the Southeastern United States. The validated, pilot tested, survey could be used in future studies in larger populations. The survey is useful for identifying anxiety management techniques of practicing dental hygienists as well as identifying areas that could be addressed in dental hygiene education programs and continuing education courses.

Conclusion

Dental hygienists are well positioned to play a key role to screen and care for patients with dental anxiety. Although the majority of dental hygienists in this study felt confident in their abilities to perceive stress in patients seeking dental care, they were less knowledgeable in recognizing the full range of signs and symptoms of dental anxiety. The majority of dental hygienists surveyed did not use validated questionnaires to identify the various degrees of dental anxiety and did not feel that their dental hygiene education had prepared them to treat patients experiencing severe dental anxiety. Increased curricular content and continuing education courses may be needed to provide practitioners with the necessary skills to treat patients with all levels of dental anxieties.

Lauren Kanzigg, RDH, MS is a graduate of the master's in dental hygiene education program; *Ceib L. Phillips, PhD* is a professor and associate dean for graduate/advanced education; *Margot B. Stein, PhD* is a clinical associate professor; *Lynne C. Hunt, RDH, MEd, MS* is a clinical assistant professor; all in the School of Dentistry, University of North Carolina, Chapel Hill, NC.; *Rebecca S. Wilder, RDH, MS* is a professor and assistant dean for professional development and faculty affairs

Corresponding author: Rebecca S. Wilder, RDH, MS;
Rebecca_Wilder@unc.edu

References

1. Gordan D, Heimber RG, Tellez M, Ismail AI. A critical review of approaches to the treatment of dental anxiety in adults. *J Anx Dis.* 2013 May; 27 (4):365-78.
2. Guzeldemir E, Toygar HU, Cilasum U. Pain perception and anxiety during scaling in periodontally healthy subjects. *J Periodontol.* 2008 Dec; 79 (12):2247-55.
3. Colgate Palmolive. What is dental anxiety and phobia? [Internet]. New Jersey: Colgate Palmolive; c2002-2017 [cited 2017 Sept 18]. Available from: <https://www.colgate.com/en-us/oral-health/basics/dental-visits/what-is-dental-anxiety-and-phobia>
4. Armfield JM, Heaton LJ. Management of fear and anxiety in the dental clinic: a review. *Aus Dent J.* 2013 Dec; 58 (4):390-407.

5. Gisler V, Bassetti R, Mericske-Stern R, et al. A cross-sectional analysis of the prevalence of dental anxiety and its relation to the oral health-related quality of life in patients with dental treatment needs at a university in Switzerland. *Gerodontology* 2010 Sep;29(1):e 290-96.
6. Hmud R, Walsh LJ. Dental anxiety: causes, complications and management approaches. *J Minim Interv Dent*. 2009; 2(1):67-77.
7. Diercke K, Burger GD, Bermejo JL, et al. The management of dental anxiety and impact of psychological factors on dentistry: is recent scientific research translated into German dental practices? *J Health Psychol*. 2013 Dec; 18(12):1519-28.
8. Sohn W, Ismail AI. Regular dental visits and dental anxiety in an adult population. *J Am Dent Assoc*. 2005 Jan; 136(1):58-66.
9. Rubin JG, Slovin M, Kockak M. The psychodynamics of dental anxiety and dental phobia. *Dent Clin N Amer*. 1988 Oct; 32(4): 647-56.
10. Gow, M. Dental anxiety, fear and phobia. *Dentistry* [Internet]. 2011 Jun 1 [cited 2017 Sep 18]; 15(1):37-40. Available from: <http://www.dentalanxiety.net/media/dentalphobia.pdf>
11. Viedebeck SL. *Psychiatric Mental Health Nursing*. 5th ed. Philadelphia:Lippincott Williams & Wilkins; c2010. Chapter 13, Anxiety and stress-related illness; 239-66.
12. Stuart, Gail W. *Principles and practice of psychiatric nursing*. 10th ed. St. Louis: El Sevier; c2013. Chapter15, Anxiety responses and anxiety disorders; 217-40.
13. Corah, NL. Development of a dental anxiety scale. *J Dent Res*. 1969 Jul 1; 48(4):596.
14. Corah NL, Gale EN, Illig SG. Assessment of a dental anxiety scale. *J Am Dent Assoc*. 1978; 97(1):816-19.
15. Humphris GM, Freeman R, Campbell J, et al. Further evidence for the reliability of the modified dental anxiety scale. *Int Dent J*. 2000 Dec; 50(6):367-70.
16. Kleinknecht R, Klepac R, Alexander L. Origins and characteristics of fear and dentistry. *J Am Dent Assoc*. 1973; 86(1):842-8.
17. Slade GD, Spencer AJ. Development and evaluation of the oral health impact profile. *Commun Dent Heal*. 1994 Mar; 11(1):3-11.
18. Newton T, Asimakopoulou K, Daly B, et al. The management of dental anxiety: time for a sense of proportion? *Brit Dent J*. 2012 Sept; 213(1):271-4.
19. McMaster R, Garisto GA. Practical considerations for treating the anxious dental patient. *Oral Heal* [Internet]. 2012 Feb 1 [cited 2017 Sep 18]; 102(2): e8. Available from: <http://www.oralhealthgroup.com/features/practical-considerations-for-treating-the-anxious-dental-patient/>.
20. Glaesmer H, Geupel H, Haak R. A controlled trial on the effect of hypnosis on dental anxiety in tooth removal patients. *Patient Educ Couns*. 2015 Sep;98(9):1112-5.
21. Allidin A. The wounded self: new approach to understanding and treating anxiety disorders. *Am J Clin Hyp*. 2014; 56(4):368-88.
22. Abdeslahi SK, Hashemipour MA, Mesgarzadeh V, et al. Effect of hypnosis on induction of local anaesthesia, pain perception, control of haemorrhage and anxiety during extraction of third molars: a case-control study. *J Craniomaxillofac Surg*. 2013 Jun; 41(4):310-5.
23. Donaldson M, Gizzarelli G, Chanpong B. Oral sedation: a primer on anxiolysis for the adult patient. *Anesth Prog*. 2007 Fall; 54(3):118-29.
24. Berge TI. Acceptance and side effects of nitrous oxide oxygen sedation for oral surgery procedures. *Acta Odontol Scand*. 199 Aug; 57(4): 201-6.
25. Hill KB, Hainsworth JM, Burke FJ, Fairbrother KJ. Evaluation of dentists' perceived need regarding treatment of the anxious person. *Brit Dent J*. 2008 Apr 26; 205(8):e13; discussion 442-3.
26. American Dental Education Association. Compendium of curriculum guidelines [Internet]. Washington, DC: American Dental Education Association. 2016-16 May [cited 2017 Sep 18]. Available from: <https://www.adea.org/cadpd/toolkit/>
27. Commission on Dental Accreditation. Accreditation standards for dental hygiene education programs. Chicago: American Dental Association. 2018 [cited 2017 Mar 1]. Available from: <https://www.ada.org/en/coda/current-accreditation-standards>
28. American Dental Association. Committee adds 11 new codes to CDT [Internet]. Chicago: American Dental Association. 2017 Jan [cited 2017 Feb]. Available from: <https://www.ada.org/en/publications/ada-news/2016-archive/march/eleven-new-codes-added-to-cdt-2017>

Blood Pressure Recording Practices Among Dental Hygiene Students

Julie D. Sutton, RDH, MS; Sally A. Elledge, RDH, MS; JoAnna M. Scott, PhD; Chris D. Rice, DDS, EdS

Abstract

Purpose: The purpose of this study was to compare three different types of blood pressure (BP) recording devices (an automated arm cuff, an automated wrist cuff, and a manual cuff / stethoscope combination) for accuracy, patient comfort, and ease of operation.

Methods: Three types of sphygmomanometers were tested on 150 study participants (n=150) obtained from the patients presenting for dental hygiene services at an urban dental school in the Midwest. Descriptive statistics were calculated for all variables of interest by cuff type. Repeated measures ANOVA using the Greenhouse-Geisser adjustment were used to test for differences in means in BP and rating measure by cuff type. Post-hoc comparisons using Tukey's procedure were calculated to determine pair-wise differences. An association between the cuff type and convenience rating was evaluated using the Chi-square test, and between cuff type and convenience rating using the Fisher's exact test.

Results: There was a significant difference in systolic BP recording by cuff type ($p < 0.001$). The automatic wrist cuff recorded an average of 11.30mm and 8.76mm HG higher systolic BP than the standard cuff and the automatic arm cuff respectively ($p < 0.001$ for both). There was no significant difference in the systolic BP readings between the standard and automatic arm cuff ($p = 0.226$) nor was there a significant difference in diastolic BP by cuff type ($p = 0.137$).

Conclusion: Blood pressure cuff readings with traditional sphygmomanometer and stethoscope or an automated brachial cuff are comparable while wrist cuff BP readings deviated significantly. For consistency in blood pressure readings, the three different cuff types are not interchangeable.

Keywords: blood pressure determination, accuracy and precision, sphygmomanometers, validation, hypertension

This manuscript supports the NDHRA priority area: Professional development: Education (Evaluation).

Submitted: 10/24/17; accepted 6/16/18

Introduction

Hypertension is characterized by excessive pressure on arterial walls as blood travels to and from the heart¹. It is a leading cause of both stroke and kidney disease and is often accompanied by obesity, diabetes, kidney disease or other problems affected by lifestyle and/or genetics. Increased systolic variability is associated with a higher risk for mortality and cardiovascular disease,² while greater variability in diastolic pressure increases the risk of cardiovascular events and adverse events in patients who have chronic kidney disease.³ A link between hypertension and periodontal disease has been suggested due to the observable alterations in localized inflammatory mechanisms such as tumor necrosis factor-alpha and C-reactive proteins⁴. Accurate blood pressure measurements are essential for recognizing a rising or elevated blood pressure, as well as monitoring a patient's compliance to prescribed treatment.⁵

The American Heart Association (AHA) in conjunction with the *Journal of Hypertension* previously defined hypertensive categories ranging from normal to hypertensive crisis.⁶ Based on those criteria, approximately one-third of all adults in the United States have hypertension⁷ and of those, only an estimated 54% are considered to be well controlled.^{8, 9} Recently, the American College of Cardiology (ACC) and the AHA released new guidelines for the detection, prevention, management and treatment of high blood pressure.¹⁰ The new guidelines further lower the definition of hypertension to allow for earlier intervention. Under the new guidelines, normal blood pressure is *less than* 120/80 mmHg while elevated blood pressure includes a systolic pressure between 120-129 with a diastolic still below 80. The increments continue to increase in 10mm Hg steps, ending in hypertensive crisis characterized by systolic pressure of 180 and/or diastolic pressure over 120 mmHg.¹⁰ According

to these updated guidelines, 46% of all adults in the U.S. are now considered to have hypertension.¹⁰ The guideline authors stress “the importance of using proper technique” and the use of validated devices to measure blood pressure.

Accurate assessment of a patient’s blood pressure is considered the standard of care for all initial and periodic diagnosis appointments in dentistry. Additionally, patients who have a history of hypertension should have their blood pressure evaluated before every appointment¹¹. In large part, this practice has resulted due to the frequency of visits in dentistry as compared to other healthcare settings. All health professionals are urged to aid in screening patients for hypertension.^{10, 12}

Blood pressure readings are obtained several ways. The standard sphygmomanometer cuff applies pressure around the upper arm and uses an analog dial to indicate the pressure (in mmHg) exerted by the cuff. It requires a stethoscope placed in the antecubital region to hear the heart beat as the sounds appear and disappear while the cuff is slowly deflated (Korotkoff sounds). This method is called both the auscultatory and the manual method. Common errors include not inflating the cuff adequately, deflating too rapidly, improper placement of the stethoscope, and an inability to hear the sounds clearly. This method has long been considered the “gold standard” of measuring blood pressure.¹³

Around 1981, automated sphygmomanometers for use on the upper arm were introduced into the market. These devices had a steady rate of cuff deflation and were not affected by a noisy environment as they did not require a stethoscope and were not based on auscultation. Automated devices employ an oscillometric measurement which utilizes the arterial cycles associated with the pumping of the heart.¹⁴ The cycles are then evaluated by an empirical algorithm to deliver a systolic and diastolic pressure reading¹⁵. More recent advances in some models include a memory bank for recent readings and an alert for an irregular heartbeat.

Wrist blood pressure cuffs were introduced around 1992. Wrist cuffs had all the advantages of the automated arm cuffs but also generally don’t require the patient to remove any clothing and are less affected by obesity.^{14, 16, 17} These devices also use oscillometric technology, but with the limitation of being further from the strength of the brachial pulse. All three types have been utilized in dental clinic settings.

Some studies have questioned the accuracy of automated sphygmomanometers.¹⁸⁻²¹ Wonka, and colleagues²¹ found wrist cuffs have issues with accuracy, Wan et al.²² conducted a systematic review of various devices, and found 81% of the 31 tested units passed the British Hypertension Society

protocol.²² However, validation procedures analyzed the data on a population basis and are not specific to individual factors such as how correctly the device protocol is followed.¹⁵ Additionally, several recordings were required to achieve acceptable accuracy.^{20, 22, 23} A systematic review conducted in 2011 found automated units varied widely when compared to the traditional mercury sphygmomanometer;¹⁸ two out of 16 studies were in direct contradiction with one another, and three out of 16 reporting an overestimated pressure with oscillometric cuffs. The cumulative result of the review was a cautionary statement regarding using oscillometric devices reserving their use for “special circumstances” such as those surrounding hypertension, preeclampsia, arrhythmia or post trauma.¹⁸

Inconsistencies in previous research motivated the authors to develop this cross-sectional study to directly compare representative samples of the three most common blood pressure measurement recording devices. The purpose of this study was to compare an automated arm cuff, an automated wrist cuff, and a traditional manual cuff /stethoscope combination for accuracy, patient comfort, and convenience/ease of operation in a dental setting among dental hygiene students.

Methods

This study was approved by the University of Missouri, Kansas City (UMKC) IRB (protocol #15-203). A sample of three types of sphygmomanometers were tested. The Accura Plus Sphygmomanometer/Stethoscope Kit, McC98002 (McCoy Health Science Supply, Maryland Heights, MO 63043) served as the traditional manual sphygmomanometer device. Automated arm units used were the ADC Advantage 6021N (American Diagnostic Corporation, Hauppauge, NY 11788), and the Veridian Model 01-5021 (Veridian Healthcare, Waukegan, IL 60085). The automated wrist cuff was the Veridian Model 01-516 (Veridian Healthcare, Waukegan, IL 60085). The Veridian Model 01-516 automated cuffs was the most frequently purchased model sold in the university book store to dental and dental hygiene students and was considered to best represent the current clinical environment. According to the literature obtained from the manufacturer, all sampled automated cuffs have been tested, validated, and approved by the Association for the Advancement of Medical Instrumentation, the British Hypertension Society, and the by the International Protocol for the Validation of Automated BP Measuring Devices.

Senior dental hygiene students who had successfully passed competency examinations in medical history review and vital data collection, approached, consented, and collected data from all participants. Participants were recruited from

the population of patients presenting for routine recall prophylaxis, scaling and root planing, or periodontal maintenance at the UMKC School of Dentistry. Collection of the data took place during the period of October 15, 2015 to July 21, 2016 (the close of the summer session). Informed consent was obtained verbally, after information documents were offered to patients. Patients verbally declining were excluded from the study, as were any patients who were not comfortable in the average sized upper arm and wrist cuffs by their own report. While larger cuffs exist for both the standard and automated arm cuffs, they were not utilized in this study, in order to keep the measurement process as straightforward as possible.

Standard, automatic arm and automatic wrist cuff measurements were taken on each participant. Prior to the beginning of the study, the cuffs to be used were made available in the dental hygiene treatment area for students to practice with. Additional instruction and coaching was not provided in an effort to simulate using new technology in practice, outside of the school setting. Before beginning the data collection, instructions were given verbally to students, including consulting the manufacturer's instructions for the automated cuffs. Data were collected on 150 participants (n=150) and recorded on a data collection form. During data collection, patients were seated upright in standard dental chairs, with blood pressure readings taken on their right arms. Care was taken to collect all three blood pressure recordings together before treatment, starting with the manual cuff stethoscope combination. There were fewer automated arm cuffs and wrist cuffs than there were participating student providers, therefore, devices were shared between patients and were

utilized as they were available by the student clinicians. Sharing the devices also allowed for a pause between readings for arterial circulation to return to normal. In the event that an error message was observed while using one of the automated cuffs, students attempted to complete the recording once more. If that was unsuccessful, they replaced the automated device's batteries. If no recording could be made using those two strategies, the data were omitted for that device.

The data collection form included systolic and diastolic measures for all three devices, as well as two Likert scales: clinicians evaluated convenience and patients evaluated comfort. The clinician evaluated the instruments for convenience (with a rating of one being "very inconvenient" and five being "very convenient") independently and silently, then recorded their patient's evaluation of the instrument for comfort (with a rating of one being "very uncomfortable" and five being "very comfortable"). The form concluded with a section for comments from both patients and clinicians. Data sheets were identified only by a sequential study number to monitor the number of participants. Data sheets were locked in a file cabinet in a locked office between clinic days.

Descriptive statistics (means and standard deviations) were calculated for all variables of interest by cuff type. Repeated measures ANOVA using the Greenhouse-Geisser adjustment and Eta-squared statistics were used to test for differences in means in blood pressure and rating measures by cuff type. Post-hoc comparisons using Tukey's procedure were calculated to determine pair-wise differences. The significance level was set to 0.05 and statistical analyses were performed using the software program Stata 14.1 (StataCorp LP, College Station, TX, USA). A sample size of 150 was considered by the authors to be adequate to obtain some measure of statistical accuracy.

Results

One hundred fifty participants were enrolled in the study. Participants had mean systolic and diastolic blood pressure of 128.99 ± 18.49 mmHG and 78.01 ± 11.33 mmHG respectively (Table I). There was a significant difference in systolic blood pressure by cuff type ($p < 0.001$). The automatic wrist cuff recorded an average 11.30 and 8.76 mmHG higher systolic blood pressure than the standard cuff and the automatic arm cuff respectively ($p < 0.001$ for both) (Table II). There was no significant difference in systolic blood pressure between the standard and automatic arm cuff ($p = 0.226$), nor was there a significant difference in diastolic blood pressure by cuff type overall ($p = 0.137$) (Table II). Cuff type explains 16% of the variability in systolic

Table I. Means and standard deviations of blood pressure variables by cuff type

	Cuff Type			Overall
	Standard	Automatic Arm	Automatic Wrist	
	N = 147	N = 149	N = 135	
	Mean (SD*)	Mean (SD*)	Mean (SD*)	Mean (SD*)
Systolic Blood Pressure	127.09 (17.03)	124.52 (10.86)	136.00 (23.99)	128.99 (18.49)
Diastolic Blood Pressure	78.20 (11.88)	76.94 (8.23)	78.99 (13.45)	78.01 (11.33)

*SD = Standard Deviation

Table II. Associations between blood pressure variables and cuff type using repeated measures ANOVA with Tukey post-hoc comparisons and Eta-squared statistics.

	Mean Difference	95% CI*	Eta- squared (η^2)	95% CI*	p-value
Systolic Blood Pressure			0.16	(0.09, 0.24)	< 0.001**
Standard vs Automatic Arm	-2.53	(-6.15, 1.08)			0.226
Automatic Wrist vs Automatic Arm	8.76	(5.01, 12.52)			< 0.001
Automatic Wrist vs Standard	11.30	(7.56, 15.03)			< 0.001
Diastolic Blood Pressure			0.01	(0, 0.05)	0.137**
Standard vs Automatic Arm	-1.23	(-3.57, 1.11)			0.433
Automatic Wrist vs Automatic Arm	0.83	(-1.60, 3.26)			0.702
Automatic Wrist vs Standard	2.05	(-0.36, 4.47)			0.113
Comfort Rating			0.12	(0.06, 0.19)	< 0.001**
Standard vs Automatic Arm	0.67	(0.39, 0.94)			< 0.001
Automatic Wrist vs Automatic Arm	0.60	(0.32, 0.88)			< 0.001
Automatic Wrist vs Standard	-0.06	(-0.34, 0.21)			0.845
Convenience Rating			0.04	(0.01, 0.09)	0.004**
Standard vs Automatic Arm	-0.35	(-0.62, -0.09)			0.005
Automatic Wrist vs Automatic Arm	-0.04	(-0.31, 0.23)			0.945
Automatic Wrist vs Standard	0.31	(0.05, 0.58)			0.016

*CI = Confidence Interval

**Greenhouse-Geisser calculation used for ANOVA p-value

blood pressure and 1% of the variability in diastolic blood pressure (Eta-squared=0.16, 0.01 respectively).

There was a significant difference in patient comfort rating by cuff type ($p < 0.001$). The comfort rating averaged 0.67 and 0.60 higher (more comfortable) in the standard and automatic wrist cuff (respectively) on the 5-point Likert scale than in the automatic arm cuff ($p < 0.001$ for both). There were no significant differences in comfort rating between the automatic wrist cuff and the standard cuff ($p = 0.845$) (Table II). Cuff type explains 12% of the variability in comfort rating and 4% of the variability in convenience rating (Eta-squared= 0.12, 0.04 respectively).

There was also a significant difference in clinician convenience rating by cuff type ($p = 0.004$). Dental hygiene students rated the automatic arm and wrist cuff higher (more convenient) than the standard cuff by an average of 0.35 and

0.31 respectively ($p = 0.005$ and 0.016 respectively) on the 5-point Likert convenience scale. There was not a significant difference in convenience rating between automatic wrist cuff and the automatic arm cuff ($p = 0.945$)

Discussion

Clinicians have many options among traditional sphygmomanometers, automated arm cuffs, and automated wrist cuffs when selecting an optimal blood pressure cuff. This study sought to compare three types in an academic dental hygiene setting and help illustrate the best options for use by both students and clinicians. Reviewing the findings of the three types of blood pressure cuffs compared in this study, readings from the automated arm cuff and standard sphygmomanometer were the most consistent with each other, while readings from the automated wrist cuff were significantly less consistent.

Previous studies have demonstrated limitations regarding the calibration, ease of use, and consistency of automated wrist cuffs. Measurements from the more distal locations (further from the brachial arteries) are associated with an increase in systolic and a decrease in diastolic pressure.¹⁵ Eight percent of the dental hygiene students in this study made comments about a “distrust” of the wrist cuff’s readings. They questioned the methods for correct wrist cuff reading and usage when they differed from those used in the other two devices, and mentioned patient discomfort with the wrist cuff. It is possible that results were impacted by improper use, fit, or application of the wrist cuff, despite the verbal instructions the students received to read the manufacturer’s instructions. Reading and applying the manufacturers’ instructions could limit these errors. New technologies are often adopted in practice, and without personal diligence in following their instructions for use, a lack of accuracy could occur.

In this study, some patients and clinicians reported being skeptical of the automated arm cuff. Comments on data sheets indicated a general “dislike” of the automated arm cuff by 9% of the patients, citing the tightness of the cuff, with one patient reporting discoloration of his/her hand during measurement. Similar to a traditional sphygmomanometer, brachial arm circumference can differ significantly from one patient to the next.²⁴ Outfitting an automated arm cuff with the appropriate attachment for larger brachial arm circumference could improve patient and clinician perception of the devices. Further, the automated arm cuff is not governed by the presence or absence of the Korotkoff sounds, meaning the maximum pressure may be more standardized than customized, leading to more pressure than the patient is accustomed to with an automated arm cuff from the standard cuff.

Future studies should collect the opinion of the clinician separately and discretely from the opinion of the patients and vice versa. The automatic component on both the automated devices (wrist and arm) is both a convenience and a possible detriment. On several occasions, data were missing due to the cuff’s inability to compute, usually because of an internal error or an expired battery. When an error message was observed, the students made another attempt and if that was not successful, the batteries were changed. This could be considered a lack of dependability of the device, or an inconvenience which could add time to an appointment or potentially result in a lack of willingness to take blood pressure with the device. Automated arm cuff data was missing on three patients, while 15 readings were missing for the automated wrist cuff. This suggests the wrist cuff was harder to use than the standard or automatic arm cuffs despite some favorable clinician comments on efficiency, fit or ease of use.

A limitation in this study was that blood pressure measurements were taken by multiple students (n = 59) who had different levels of skill and experience with blood pressure measurement. This could have resulted in missing data due to operator error and lack of familiarity with the equipment. It could have also resulted in the variability across the three cuff types that was higher in some of the students. Future studies should focus on calibration of the examiners which should reduce errors and address examiner variability.

Another study limitation was a lack of protocol for the length of time that must elapse between blood pressure measurements. A delay occurred between readings however a timer was not used to standardize the pause. According to the AHA,^{26,27} five minutes of quiet rest should elapse between readings to prevent a falsely high blood pressure reading. Future studies should standardize this pause in the protocol. Lastly, the order of the cuff selection was not randomized. Cuffs were used depending on their availability in the dental hygiene clinic, although in most cases the manual cuff was used first. Cuff selection order could have led to biases in determining the differences between the cuff types. Future studies should randomize the cuff order for each subject.

Despite the limitations, the results of this study help inform the health care provider. The results of this study confirm those of others^{21,22} linking the use of automated wrist cuffs with decreased accuracy. When technology advances, it is likely that techniques need to change in order to ensure best practice. The importance of provider’s reading and following the manufacturer instructions is emphasized. Providers should continue to rely on the skills they have developed in evidence-based decision making, rather than limiting their selection of blood pressure devices based on convenience and proximity.

Conclusion

Blood pressure readings obtained with a traditional sphygmomanometer/stethoscope combination were comparable to those obtained with an automated brachial arm cuff, while blood pressure readings taken from a wrist cuff deviated significantly. Although convenience of a wrist cuff device is an important factor, accuracy should not be compromised. Some deviations in the data captured between cuff types may be explained by the student operators failing to follow the manufacturers’ instructions, highlighting the need for adherence to manufacturer instructions for any new clinical equipment. When electing to adopt a new device for blood pressure measurement, clinicians and educators should research the device’s validity as published in the literature, and ensure users are guided in proper protocol(s) for use. In

the measurement of consistent and calibrated blood pressure, measurements are not interchangeable with the three different cuff types.

Julie D. Sutton, RDH, MS is an assistant professor in the Division of Dental Hygiene; **Sally A. Elledge, RDH, MS** is a clinical assistant professor in the Division of Dental Hygiene; **JoAnna M. Scott, PhD** is an assistant professor in the Office of Research and Graduate Programs; **Chris D. Rice, DDS, EdS** is an associate professor emeritus in the Department of Dental Public Health and Behavioral Sciences; all at the University of Missouri Kansas City School of Dentistry, Kansas City, MO.

Corresponding author: Julie D. Sutton, RDH, MS;
suttonjd@umkc.edu

References

1. Eisenberg J. Measuring your blood pressure at home: a review of the research for adults. [Internet]. Rockville: Agency for Healthcare Research and Quality; 2012 Feb 22. [cited 2018 Feb 16]. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK91430/>.
2. Muntner P, Whittle J, Lynch AI, et al. Visit-to-visit variability of blood pressure and coronary heart disease, stroke, heart failure, and mortality: a cohort study. *Ann Intern Med*. 2015 Sep 1;163(5):329-38.
3. Mezue K, Goyal A, Pressman GS, et al. Blood pressure variability predicts adverse events and cardiovascular outcomes in chronic kidney disease: a post-hoc analysis of the SPRINT trial. *Am J Hypertens*. 2017 Dec 8; 31(1):48-52.
4. Khocht A, Rogers T, Janal MN, et al. Gingival fluid inflammatory biomarkers and hypertension in African Americans. *JDR Clin Trans Res*. 2017;2(3):269-77.
5. Little JW. Dental management of the medically compromised patient. 8th ed. St. Louis, MO: Elsevier/Mosby; 2013. 659 p.
6. Weber MA, Schiffrin EL, White WB, et al. Clinical practice guidelines for the management of hypertension in the community: a statement by the American society of hypertension and the international society of hypertension. *J Clin Hypertens*. 2014 Jan; 16(1):14-26.
7. Nwankwo T, Yoon SS, Burt V, et al. Hypertension among adults in the United States: National Health and Nutrition Examination Survey, 2011-2012. *NCHS Data Brief*. 2013 (133):1-8.
8. Yoon SS, Carroll MD, Fryar CD. Hypertension prevalence and control among adults: United States, 2011-2014. *NCHS Data Brief*. 2015(220):1-8.
9. Mozaffarian D, Benjamin EJ, et al. Executive summary: heart disease and stroke statistics--2016 update: a report from the American Heart Association. *Circulation*. 2016 Jan 26;133(4):447-54.
10. Flack JM, Calhoun D, Schiffrin EL. The new acc/aha hypertension guidelines for the prevention, detection, evaluation, and management of high blood pressure in adults. *Am J Hypertens*. 2018 Jan 12;31(2):133-35.
11. Merai R, Siegel C, Rakotz M, et al. CDC grand rounds: a public health approach to detect and control hypertension. *MMWR Morb Mortal Wkly Rep*. 2016 Nov 18;65(45):1261-64.
12. US Department of Health and Human Services. Seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure. Bethesda: National Heart, Lung and Blood Institute; 2004 Aug. Report No.: 04-5230.
13. O'Brien E, Waeber B, Parati G, et al. Blood pressure measuring devices: recommendations of the European Society of Hypertension. *BMJ*. 2001 Mar 3;322(7285):531-6.
14. Omron. History of omron's blood pressure monitor [Internet]. Kyoto: Omron Healthcare; 2018 [cited 2018 Feb. 16]. Available from: https://www.omronhealthcare.com.hk/en/article/ins.php?index_am1_id=7&index_id=25
15. Ogedegbe G, Pickering T. Principles and techniques of blood pressure measurement. *Cardiol Clin*. 2010 Nov;28(4):571-86.
16. Irving G, Holden J, Stevens R, et al. Which cuff should I use? Indirect blood pressure measurement for the diagnosis of hypertension in patients with obesity: a diagnostic accuracy review. *BMJ Open*. 2016 Nov 3;6(11):e012429.
17. Leblanc ME, Croteau S, Ferland A, et al. Blood pressure assessment in severe obesity: validation of a forearm approach. *Obesity*. 2013 Dec;21(12):E533-41.
18. Skirton H, Chamberlain W, Lawson C, et al. A systematic review of variability and reliability of manual and automated blood pressure readings. *J Clin Nurs*. 2011 Mar;20(5-6):602-14.

19. Stergiou GS, Christodoulakis GR, Nasothimiou EG, et al. Can validated wrist devices with position sensors replace arm devices for self-home blood pressure monitoring? A randomized crossover trial using ambulatory monitoring as reference. *Am J Hypertens.* 2008 Jul;21(7):753-8.
20. Cuckson AC, Moran P, Seed P, et al. Clinical evaluation of an automated oscillometric blood pressure wrist device. *Blood Press Monit.* 2004 Feb;9(1):31-7.
21. Wonka F, Thummler M, Schoppe A. Clinical test of a blood pressure measurement device with a wrist cuff. *Blood Press Monit.* 1996 Aug;1(4):361-366.
22. Wan Y, Heneghan C, Stevens R, et al. Determining which automatic digital blood pressure device performs adequately: a systematic review. *J Hum Hypertens.* 2010 Jul;24(7):431-8.
23. Topouchian JA, El Assaad MA, Orobinskaia et al. Validation of two automatic devices for self-measurement of blood pressure according to the international protocol of the european society of hypertension: the Omron M6 (HEM-7001-E) and the Omron R7 (HEM 637-IT). *Blood Press Monit.* 2006 Jun;11(3):165-71.
24. Shangguan Q, Wu Y, Xu J, et al. The impact of arm circumference on noninvasive oscillometric blood pressure referenced with intra-aortic blood pressure. *Blood Press Monit.* 2015 Dec;20(6):316-9.
25. Jones D, Engelke MK, Brown ST, et al. A comparison of two noninvasive methods of blood pressure measurement in the triage area. *J Emerg Nurs.* 1996 Apr;22(2):111-5.
26. Association AHA AMA: TARGET: BP [Internet]. American Medical Association; c 1995-2016. Technique quick check. The Johns Hopkins University: The American Medical Association; 2017. Available from: https://targetbp.org/tools_downloads/technique-quick-check/
27. American Heart Association. Conditions: high blood pressure: monitoring your blood pressure at home [internet]. Dallas: American Heart Association; c2018 [cited 2018 May 4]. Available from: <https://www.heart.org/en/health-topics/high-blood-pressure/understanding-blood-pressure-readings/monitoring-your-blood-pressure-at-home#.WuxlsoWc>

A Comparison of Oral Hygiene Products and Professional Care: A six-week randomized clinical trial

Cristina E. Garcia-Godoy, DDS, MPH; Kevin L. Flores, BS, MPH; Malgorzata A. Klukowska, DDS, PhD; Erinn L. Conde, BS; Robert W. Gerlach, DDS, MPH

Abstract

Purpose: To investigate the anti-gingivitis efficacy of a novel oral hygiene routine consisting of a two-step stannous fluoride dentifrice and hydrogen peroxide whitening gel system, an interactive oscillating-rotating electric toothbrush, and expanded polytetrafluoroethylene floss.

Methods: A total of 52 participants (n=52; mean age 35.8±11.23 years) were enrolled in the study and randomized 1:1 to the experimental hygiene group or control (dental prophylaxis followed by use of standard sodium fluoride dentifrice and a manual toothbrush). Participants were instructed to brush twice daily; those in the experimental group were instructed to floss once daily. Oral examinations were conducted at Baseline, Week 2, Week 4, and Week 6.

Results: Both groups experienced significant declines in the mean number of bleeding sites from Baseline at all time points, evident as early as Week 2. Bleeding sites continued to decline throughout the trial in the experimental group, whereas they showed an increasing trend between Weeks 2 and 6 in the control group. The experimental group had 55% fewer bleeding sites at Week 2, 85% fewer bleeding sites at Week 4, and 98% fewer bleeding sites at Week 6 ($p \leq 0.0001$ for all) as compared to the control group. At Week 6, 84% of participants in the experimental group had no bleeding, while all participants in the control group had bleeding.

Conclusion: The experimental oral hygiene group showed significantly greater reductions in gingival bleeding than the control oral hygiene group, with benefits seen as early as Week 2 and increasing over the six-week study.

Keywords: oral health prevention, oral hygiene, chemotherapeutics, electric toothbrushes, gingivitis, gingival bleeding

This manuscript supports the NDHRA priority area: **Client level: Basic science** (Diagnostic testing and assessments).

Submitted for publication: 2/218; Accepted: 8/28/18

Introduction

Gingivitis is characterized by inflammation of the gingival tissues without loss of connective tissue attachment.¹ The disease progresses when oral bacteria present in dental plaque prompt a localized inflammatory response manifesting as gingival redness, swelling, and bleeding.² Persistent gingivitis is one possible risk factor for periodontal attachment loss as well as tooth loss.^{3,4} Considering that over 90% of American adults exhibit signs of gingivitis of at least mild severity,⁵ advancements in treatment are an important public health concern. The correlation between dental plaque and the severity of gingival disease is well understood.^{6,7} Therefore, in addition to regular professional dental prophylaxes, a cornerstone of gingivitis treatment is rigorous daily removal of dental plaque through both mechanical means (e.g.,

brushing, flossing) and chemotherapeutic means (e.g. anti-plaque chemical agents in a mouth rinse or dentifrice).⁸

One advancement in mechanical dental plaque removal for gingivitis prevention is the use of rechargeable electric toothbrushes, which have been shown to reduce plaque accumulation more effectively than manual toothbrushes.⁹ Among the electric toothbrush modes of action, oscillating-rotating toothbrushes have been found to reduce plaque and gingivitis more effectively than side-to-side brushes in short-term trials.^{10,11} Recently, interactive electric toothbrushes that communicate with an application on a smart phone have been shown to be associated with significantly longer brushing times, a greater extent of plaque reduction, and higher compliance rates as compared to manual toothbrushes.^{12,13} This last benefit is of key importance, given that many adolescents and adults are

non-compliant with their recommended oral hygiene routine.¹⁴ Classic studies indicate that adults generally overestimate the time they spend brushing by 50 to 70 seconds.¹⁵ Various factors may influence patient compliance including patient characteristics (beliefs and attitudes, history of noncompliance, mental and physical disabilities); treatment complexity and duration; the relationship between the patient and provider; and behavioral interventions used (praise, education interventions).¹⁶ Interactive electric toothbrushes may increase patient compliance by acting upon several of these factors. For example, an application on a smart phone may cause the patient to feel that the oral hygiene routine is easy to perform, and the positive feedback and education provided by the application may serve as positive behavioral interventions.

Beyond brushing, interdental mechanical plaque control is an additional strategy for the treatment of gingivitis. Various interdental cleaning devices include dental floss, interdental brushes, and irrigators. One specific device, expanded polytetrafluoroethylene floss, has been shown to provide benefits for gingivitis treatment when used alone, and further incremental benefits seen when used with brushing.¹⁷ More importantly, subjects have been shown to prefer expanded polytetrafluoroethylene floss over nylon waxed floss, which may contribute to improved compliance.¹⁸

The addition of chemotherapeutic agents, such as the antimicrobial chlorhexidine, to the oral hygiene routine is another strategy for gingivitis prevention and treatment.¹⁹ Despite its effectiveness for gingivitis treatment, chlorhexidine has been associated with tooth staining²⁰, making it less acceptable for use. Recently, a two-step stannous fluoride dentifrice and hydrogen peroxide whitening gel system was shown to provide gingival health effects comparable to those seen with a chlorhexidine mouth rinse, with tooth whitening effects.^{21,22} A meta-analysis of 1085 subjects enrolled in 20 prospective trials in which one group was assigned to the two-step system and another group to a standard dentifrice control found the two-step system was associated with significant improvements in plaque measurements and gingival bleeding versus the control.²³

The purpose of this study was to investigate the anti-gingivitis efficacy of a novel oral hygiene routine consisting of a two-step stannous fluoride dentifrice and hydrogen peroxide whitening gel system, an interactive, oscillating-rotating electric toothbrush, and expanded polytetrafluoroethylene floss as compared to a control group.

Methods

This randomized, controlled, examiner-blind, clinical trial evaluated the effect of an experimental oral hygiene routine consisting of a two-step stannous fluoride dentifrice and hydrogen peroxide whitening gel system (Crest® Pro-Health® [HD]; Procter & Gamble, Cincinnati, OH, USA), an interactive rechargeable electric toothbrush (Oral-B® Professional Care SmartSeries 5000 toothbrush with Oral-B CrossAction® toothbrush head, D36/EB50, Procter & Gamble), and an expanded polytetrafluoroethylene floss (Oral-B® Glide® Pro-Health Advanced, Procter & Gamble) as compared to a control group receiving a an oral prophylaxis and using a standard sodium fluoride dentifrice (Crest® Cavity Protection, Procter & Gamble) and soft manual toothbrush (Oral-B® Indicator, Procter & Gamble), on gingival bleeding over a 6-week period in subjects with mild-to-moderate gingivitis. Institutional review and approval was obtained from Nova Southeastern University; approval #2016-209. The study was conducted in compliance with the International Conference on Harmonization's Good Clinical Practice Consolidated Guidelines. All participants provided written, informed consent.

Participants

Eligible participants were 18 years of age or older, in good general health, owned a smart phone to which they were willing to download the Oral-B application. The application provided coaching for the 2-minute brushing time. Subjects were specifically instructed on the pressure alert feature to promote brushing with proper force. Eligible subjects had at least 16 gradable teeth, and at least one anterior and one posterior facial bleeding site. Exclusion criteria included severe periodontal disease; active treatment for periodontitis; fixed facial or lingual orthodontic appliances; or antibiotic use within two weeks of Baseline.

Study Design

Participants were randomly assigned in equal numbers to either the experimental group consisting of 6 weeks of using three marketed oral hygiene products (an interactive rechargeable power toothbrush, two-step dentifrice/whitening gel sequence, and floss) or the control group receiving a full-mouth dental prophylaxis administered within 3 days of Baseline, followed by 6 weeks of using standard oral hygiene products (a regular manual toothbrush and standard anti-cavity dentifrice). Participants were stratified by number of bleeding sites (high ≥ 10 , medium 6-9, low ≤ 5). Within strata, participants were randomly assigned to one of the treatment

groups using an encoded program and randomization schedule supplied by the study sponsor. The treatment code was shared with one of the site staff members to allow for identification of participants that were to undergo dental prophylaxis (control group).

All participants were instructed to use the study products in place of their usual oral hygiene products for the duration of the 6 week trial; all participants were verbally instructed in the use of the study products. The first use of the study products was supervised. Written instructions appropriate to the group assignment were provided to each participant. Experimental group participants were instructed to brush their teeth twice daily using the “Daily Clean” mode on the brush and to floss the whole mouth once daily. Participants were instructed to follow manufacturer’s instructions for the brushing technique. In regards to the toothpaste, participants were instructed to brush with the first step of the 2-step sequence (stannous fluoride dentifrice) for one minute and then brush with the second step (hydrogen peroxide whitening gel) for the second minute, according to manufacturer’s instructions. Control group participants were instructed to brush twice daily according to their customary brushing manner. Participants were instructed not to use other dental hygiene products for the duration of the study.

Investigational Products and Blinding

All study related products and instructions were supplied by the study sponsor in identically sized, blinded kit boxes. The identities of the dentifrices and dental floss in the kit boxes were blinded. The identity of the electric toothbrush provided to the experimental group was not blinded.

Assessments and Outcomes

Dental examinations, including examination of the soft and hard oral tissues and gingival exams, were conducted at Baseline, Week 2, Week 4, and Week 6 by a trained, experienced examiner.²⁴⁻²⁶ Assessment of the oral soft tissue was conducted via a visual examination of the oral cavity and perioral area utilizing a standard dental light, dental mirror, and gauze. Assessment of the oral hard tissues was conducted via a visual examination of the dentition and restorations utilizing a standard dental light, dental mirror, and air syringe.

The primary efficacy outcome was gingival bleeding, which was assessed across the whole mouth.^{26,27} This method used mild provocation of the gingival crevice with a periodontal probe at 2 mm depth passed gently circumferentially around each tooth at approximately a 60° angle. After 30 seconds, each tooth site was assessed for bleeding. Using this clinical method, bleeding sites were derived from using the 4-point

Löe-Silness gingivitis index (LSGI) for sites with LSGI ≥ 2 .²⁸ The full mouth bleeding score was determined by summing the bleeding scores of all scored sites.

Adverse Events

An adverse event (AE) was defined as any unfavorable or unintended sign, symptom, or disease that appeared or worsened in a participant during the study period. AEs were collected from examination and interview.

Statistical Methods

Up to 52 subjects were to be enrolled in the study; 26 per group. Twenty-three subjects per group completing the trial provides at least 85% power to detect a mean difference between Baseline and Week 6 of at least 4 bleeding sites using two-sided testing at a 5% significance level. This estimate assumes the standard deviation of the differences between Baseline and Week 6 is six bleeding sites or smaller. Summary statistics of the demographics and number of bleeding sites were calculated for each treatment group and visit. Group differences for age and baseline number of bleeding sites were compared using Analysis of Variance. A Chi-Square test was used to assess gender balance between the two groups while a Fisher’s Exact test was used to assess ethnicity balance. Comparisons to baseline were investigated using paired-difference t-tests. The treatment groups were compared using the analysis of covariance method with baseline as a covariate and a baseline by treatment interaction. Different variances were modeled for each treatment. Statistical tests were two-sided using a 5% significance level.

Results

Participant Baseline Demographics and Clinical Characteristics

A total of 52 participants were enrolled in the study and randomized 1:1 to the experimental group or the control group (Table I). One subject voluntarily withdrew so 51 subjects (n=51) completed the trial. Participants ranged in age from 19 to 60 years, with a mean age of 35.8 ± 11.23 years. There were more females (n=37) than males (n=15) in this study (71% vs. 29%). There were no significant differences between groups at Baseline for age, ethnicity, sex, or number of bleeding sites.

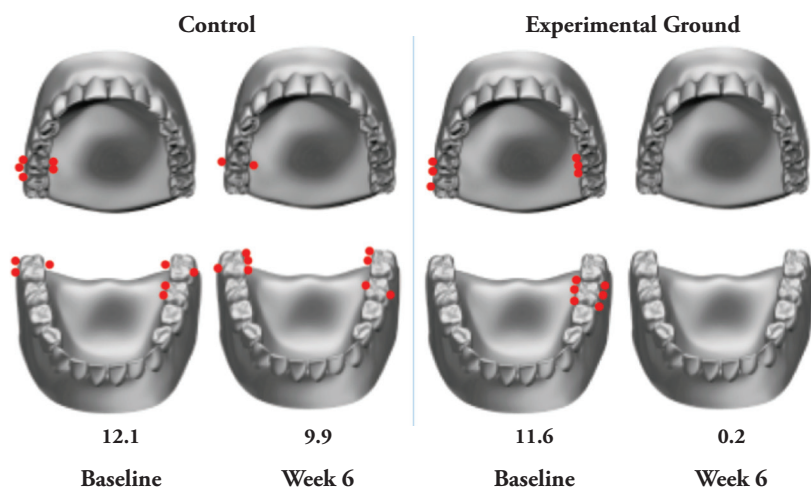
Number of Bleeding Sites

Both groups experienced significant declines in the mean number of bleeding sites from Baseline at all time points, and these declines were evident as early as Week 2 (Figure 1). Of note, the number of bleeding sites in the experimental

Table I. Baseline demographics and clinical characteristics

Demographic/Statistic or Category	Control Group (n=26)	Experimental Group (n=26)	Overall (n=52)	p-value
Age (Years)				
Mean (SD)	34.9 (10.8)	36.6 (11.8)	35.8 (11.2)	0.5918
Min. – Max.	19 - 55	21 - 60	19 - 60	
Ethnicity				
Black	8 (31%)	7 (27%)	15 (29%)	1.0000
Caucasian	6 (23%)	6 (23%)	12 (23%)	
Hispanic	11 (42%)	10 (38%)	21 (40%)	
Other	1 (4%)	3 (12%)	4 (8%)	
Sex				
Female	20 (77%)	17 (65%)	37 (71%)	0.3585
Male	6 (23%)	9 (35%)	15 (29%)	
Number of Bleeding Sites				
Mean (SD)	12.1 (8.7)	11.6 (6.4)	11.8 (7.6)	0.8147
Min. – Max.	2 - 37	4 - 32	2 - 37	

Figure 1. Location of bleeding sites per group at Baseline and Week 6.



group continued to decrease throughout the trial, whereas after Week 2, the control group showed an increasing trend. At Week 2, the change from Baseline in the mean number of bleeding sites and (SD) was -5.0(5.1) in the control group and -8.5(5.9) in the experimental group ($p < 0.0001$ for both compared with Baseline). At Week 4, the change from Baseline in the mean number of bleeding sites (SD) was -4.7(3.9) in the control group, and -10.8(5.8) in the experimental group ($p < 0.0001$ for both compared with Baseline). At Week 6, the change from Baseline in the mean number of bleeding sites (SD) was -2.0(3.7) in the control group ($p = 0.0127$) and -11.4(6.3) in the experimental group ($p < 0.0001$). Bleeding site trends are shown in Figure 1.

The experimental group had statistically significantly fewer bleeding sites than the control group in the direct comparison for number of bleeding sites (Figure 2). Compared to the control group, the experimental group had 55% fewer bleeding sites at Week 2, 85% fewer bleeding sites at Week 4, and 98% fewer bleeding sites at Week 6, which were all highly significant differences ($p \leq 0.0001$).

Percent of Participants with No Bleeding

At Week 2, 29% of the participants in the experimental group exhibited no gingival bleeding, as compared to only 4% in the control group. By Week 4, the experimental group continued to improve, with 54% exhibiting no gingival bleeding, while the control group remained unchanged. After 6 weeks, 84% of participants in the experimental group had no bleeding, while all participants in the control group had gingival bleeding (Figure 3).

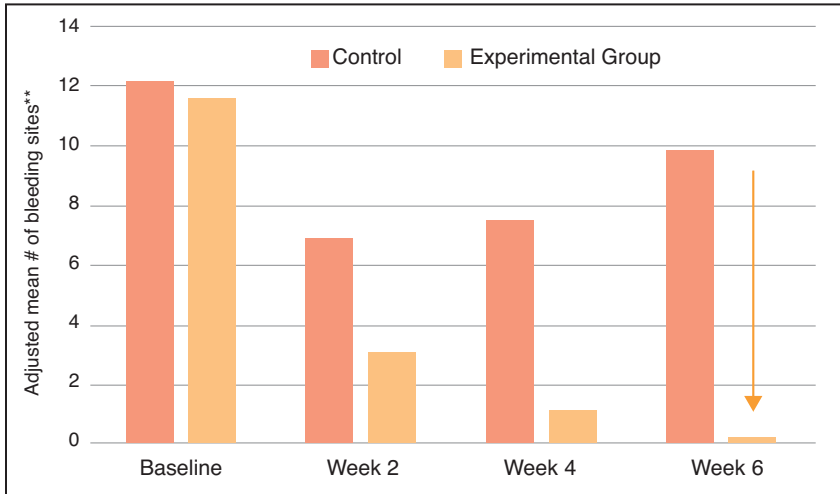
Safety

There were no AEs reported at any time point.

Discussion

Results of this six-week study demonstrate that an experimental oral hygiene routine consisting of a two-step stannous fluoride dentifrice and hydrogen peroxide whitening gel system, an interactive oscillating-rotating electric toothbrush, and expanded polytetrafluoroethylene floss, was significantly more effective at reducing gingival bleeding when compared to a control oral hygiene routine of a professional dental prophylaxis, followed by the use of standard sodium fluoride dentifrice and a soft manual toothbrush. As shown in Figure 1, bleeding sites were most prevalent in the posterior region, an area that can be difficult for patients to access and thereby at higher risk for gingivitis.²⁹ Notably, the reductions in the mean number of gingival bleeding sites seen in the experimental group were evident early in the trial, after only 2 weeks of use, and increased in magnitude over the course of the 6-week study. In the control group, reductions in gingival bleeding were also seen at Week 2, likely due to the dental prophylaxis at Week 0. However, the long-term benefits were not as great in the control

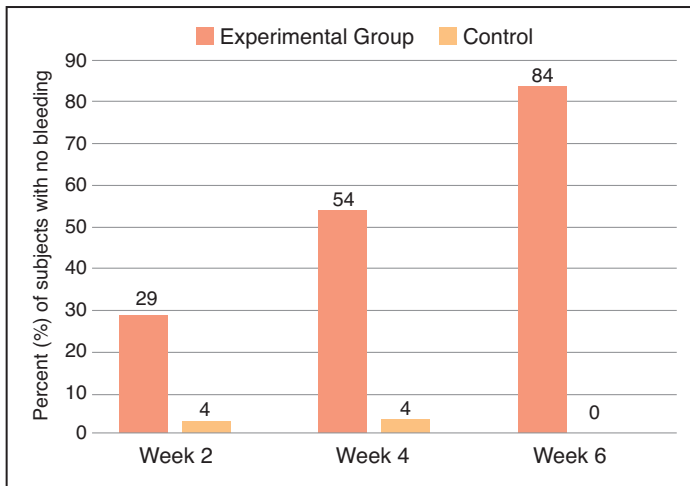
Figure 2. Number of bleeding sites per group.



*Statistically significant difference between groups in favor of the experimental group, $p \leq 0.0001$.

**Based on Analysis of Covariance. Baseline values are means.

Figure 3. Percent of participants with no gingival bleeding.



group. The reduction in the mean number of bleeding sites compared with Baseline was smaller at Week 4 and Week 6 than at Week 2. The greater long-term reduction in gingival bleeding seen in the experimental group versus the control group indicates that effective daily oral hygiene is important to prevent reoccurrence of bleeding.

This trial evaluated the effect of a combination of products, representing typical oral hygiene practices, and therefore conclusions cannot be drawn about the specific contribution of each individual product to gingivitis outcomes. However, previous studies have shown that the addition of a stannous-containing fluoride dentifrice with an power toothbrush significantly increased plaque control compared to a standard

sodium fluoride toothpaste with the same electric toothbrush.³⁰ These findings indicate there is an incremental benefit when effective chemotherapeutics are added to mechanical hygiene. While assessing compliance was not an objective of this trial, the interactive power toothbrush has been shown to increase brushing time relative to a manual toothbrush among adolescents.¹³ It would be an interesting topic for future research to assess compliance of a product combination including the interactive toothbrush.

The most noteworthy limitation of this clinical trial involves the study population. This research was intended to be inclusive, and as such, targeted a general population. Subjects for this study generally presented with mild-to-moderate gingivitis, as evidenced by the overall mean of approximately 12 bleeding sites prior to prophylaxis. Severe disease was underrepresented, and further research may be indicated to ascertain

responses in other patient types. Study duration was 6-weeks post-prophylaxis, and although trends were clear, long term implications may warrant further investigation. Inference is likely most relevant to the short-to-intermediate duration responses seen with regular recall subjects.

When examining the percentage of participants with no bleeding sites, the experimental product combination was again more effective than the control at all time points. After 6 weeks, 84% of participants in the experimental group were completely free of bleeding sites, compared to none of the participants in the control group. These results are clinically relevant given that the control group received a baseline dental prophylaxis, which is considered the 'gold standard' treatment for gingivitis, and by Week 6 all subjects in the control group exhibited gingival bleeding again. Based on these findings, oral healthcare professionals should consider the products in the experimental group for subjects with mild-to-moderate gingivitis to reduce their gingival bleeding and inflammation, thereby improving their periodontal health.

Conclusion

This randomized clinical trial was conducted to investigate the anti-gingivitis efficacy of a novel oral hygiene routine consisting of a two-step stannous fluoride dentifrice and hydrogen peroxide whitening gel system, an interactive, oscillating-rotating electric toothbrush, and expanded polytetrafluoroethylene floss. Study results demonstrated significantly greater reductions in gingival bleeding for the

novel oral hygiene routine as compared to the control oral hygiene routine comprised of a professional dental prophylaxis followed by the use of standard fluoride dentifrice and a manual toothbrush. Benefits for the experimental hygiene group were demonstrated as early as Week 2 and increased over the six-week study. At Week 6, the experimental group had 98% fewer bleeding sites than the control group. Thus, the novel oral hygiene routine was shown to have effective and sustained anti-gingivitis efficacy.

Disclosure

This study was funded by Procter & Gamble. Dr. Klukowska and Ms. Conde are employees of Procter & Gamble and Dr. Gerlach is a retired employee of Procter & Gamble. The other authors have no conflicts to disclose.

Acknowledgements

Editorial assistance to the authors was provided by Jillian Lokere, MS, and was funded by Procter & Gamble Company. Statistical support was provided by Melanie Miner, BS, BA.

Cristina E. Garcia-Godoy, DDS, MPH is a clinical researcher; **Kevin L. Flores, BS, MPH** is a research assistant; both at Nova Southeastern University, Ft. Lauderdale, FL.

Malgorzata A. Klukowska, DDS, PhD is a principal clinical scientist in research and development; **Erinn L. Conde, BS** is a clinical trial manager; **Robert W. Gerlach, DDS, MPH** is a retired research fellow; all at Procter and Gamble, Mason, OH.

Corresponding author: Cristina E. Garcia-Godoy, DDS;
cgarciag@nova.edu

References

- Mariotti A. Dental plaque-induced gingival diseases. *Ann Periodontol.* 1999 Dec;4(1):7-19.
- Khan SA, Kong EF, Meiller TF, et al. Periodontal diseases: bug induced, host promoted. *PLoS Pathog.* 2015 Jul;11(7):e1004952.
- Lang NP, Schatzle MA, Loe H. Gingivitis as a risk factor in periodontal disease. *J Clin Periodontol.* 2009 Jul;36 Suppl 10:3-8.
- Schatzle M, Loe H, Burgin W, et al. Clinical course of chronic periodontitis. I. Role of gingivitis. *J Clin Periodontol.* 2003 Aug;30(10):887-901.
- Li Y, Lee S, Hujoel P, et al. Prevalence and severity of gingivitis in American adults. *Am J Dent.* 2010 Feb;23(1):9-13.
- Loe H, Theilade E, Jensen SB. Experimental gingivitis in man. *J Periodontol.* 1965 May-Jun;36:177-187.
- Haffajee AD, Teles RP, Patel MR, et al. Factors affecting human supragingival biofilm composition. I. Plaque mass. *J Periodontol Res.* 2009 Aug;44(4):511-19.
- Chapple IL, Van der Weijden F, Doerfer C, et al. Primary prevention of periodontitis: managing gingivitis. *J Clin Periodontol.* 2015 Apr;42 Suppl 16:S71-76.
- Yaacob M, Worthington HV, Deacon SA, et al. Powered versus manual toothbrushing for oral health. *Cochrane Database Syst Rev.* 2014 Jun;17(6):Cd002281.
- Deacon SA, Glenny AM, Deery C, et al. Different powered toothbrushes for plaque control and gingival health. *Cochrane Database Syst Rev.* 2010 Dec;8(12):Cd004971.
- Van der Weijden FA, Slot DE. Efficacy of homecare regimens for mechanical plaque removal in managing gingivitis a meta review. *J Clin Periodontol.* 2015 Apr;42 Suppl 16:S77-91.
- Erbe C, Braunbeck F, Ferrari-Peron P. Superior dental plaque removal and compliance of an interactive toothbrush. *J Dent Res.* 2016 Jun;96(Spec Iss B):Abstract 317.
- Erbe C, Ccahuana-Vasquez R, Ferrari-Peron P. Clinical Evaluation of an interactive toothbrush among adolescents. *J Dent Res.* 2016 Mar;96(Spec Iss A):Abstract 464.
- Bray KK. Using brief motivational interviewing to sustain toothbrushing behavior change. Access. 2010 Sep-Oct;(Suppl): 1-4.
- Saxer UP, Barbakow J, Yankell SL. New studies on estimated and actual toothbrushing times and dentifrice use. *J Clin Dent.* 1998 Feb;9(2):49-51.
- Ramsay DS. Patient compliance with oral hygiene regimens: a behavioural self-regulation analysis with implications for technology. *Int Dent J.* 2000;Suppl Creating A Successful:304-11.
- Doyle M, Scarchilli J, Dunavent J. Expanded polytetrafluoroethylene floss on gingivitis alone and with brushing. *J Dent Res.* 2011 Mar;90(Spec Iss A):Abstract 810.
- Ciancio SG, Shibly O, Farber GA. Clinical evaluation of the effect of two types of dental floss on plaque and gingival health. *Clin Prev Dent.* 1992 May-Jun;14(3):14-18.

19. Gunsolley JC. A meta-analysis of six-month studies of antiplaque and antigingivitis agents. *J Am Dent Assoc.* 2006 Dec;137(12):1649-57
20. Bagis B, Baltacioglu E, Ozcan M, et al. Evaluation of chlorhexidine gluconate mouthrinse-induced staining using a digital colorimeter: an in vivo study. *Quintessence Int.* 2011Mar;42(3):213-23.
21. Gerlach RW, Sagel P, Barker ML, et al. Gingivitis, whitening, and plaque imaging of two-step hygiene or chlorhexidine. *J Dent Res.* 2015 Mar;94(Spec Iss A):Abstract 293.
22. Sagel P, Gerlach R, Gurich N, et al. RCT comparing post-prophylaxis use of two-step hygiene or chlorhexidine J Dent Res. 2016 Mar;96(Spec Iss A):Abstract 92.
23. Gerlach RW, Sagel P. Effectiveness and safety of SnF2/H2O2 daily hygiene: inclusive clinical meta-analysis. *J Dent Res.* 2016 Jun;96(Spec Iss B):Abstract 319.
24. García-Godoy F, García-Godoy C, Dunavent JM, et al. Clinical study evaluating 0.454% stannous fluoride dentifrice on established gingivitis. *J Dent Res.* 2008 Jul;87(Spec Iss B): Abstract 0288.
25. García-Godoy C, Rothrock J, Monzon V, et al. Randomized controlled trial of 0.1% CPC rinse on gingival bleeding. *J Dent Res.* 2012 Mar;91 (Spec Iss A): Abstract 1456.
26. Garcia-Godoy C, Rothrock J, Gurich N, et al. Post-prophylaxis gingivitis prevention with two-step stannous fluoride dentifrice plus whitening gel sequence or chlorhexidine gluconate mouthrinse. *Am J Dent.* 2018 Jul; 31 (Sp Is A): 18A-23A.
27. Gerlach RW, Amini P. Randomized controlled trial of 0.454% stannous fluoride dentifrice to treat gingival bleeding. *Compend Contin Educ Dent.* 2012 Feb;33(2):134-6, 138.
28. Løe H, Silness J. Periodontal disease in pregnancy. I. Prevalence and severity. *Acta Odontol Scand.* 1963 Dec;21:533-51.
29. Haffajee AD, Teles RP, Patel MR, et al. Factors affecting supragingival biofilm composition. II. Tooth position. *J Periodontal Res.* 2009 Aug; 44(4): 520–28.
30. Bellamy P, Boulding A, Farmer S, et al. Randomized in vivo trial evaluating plaque inhibition benefits of an advanced stannous-containing sodium fluoride dentifrice used in conjunction with power brush technology. *Int J Dent Hyg.* 2014 May;12(2):89-95

Research Poster Abstracts

The following abstracts are from the participants of the 2018 Annual Dentsply Sirona/ADHA Graduate Student Clinician's Research Program. The purpose of the program, generously supported by Dentsply Sirona for the past 11 years, is to promote dental hygiene research at the graduate level. Dental hygiene post-graduate programs may nominate one student to participate in the program and present their research at American Dental Hygienists' Association Annual Conference. The following posters were presented during the ADHA Annual Conference held in Columbus, Ohio, June 21-25, 2018.

* Indicates poster presenter

+ Indicates award recipient

The Influence of the Mobile Application, ToothSense, on the Oral Health Practices and Behaviors of the Parents of Preschool Children

Carly J. Santi Lozoya, RDH, BS*
Lori Giblin-Scanlon, RDH, MS
Jared Vineyard, PhD
Linda D. Boyd, RDH, RD, EdD
Sara Nolan, RDH, MS
MCPHS University, Boston, MA

Purpose: Many oral health promotion programs are directed at reducing the prevalence of early childhood caries. Mobile applications may be beneficial in oral health promotion. The study purpose was to evaluate the effect of a smartphone application, ToothSense, based on the Theory of Planned Behavior (TPB) on oral health behaviors of the parents of preschoolers.

Methods: A two-phase, sequential embedded mixed methods design explored how ToothSense, influenced the attitude, beliefs, perceived behavioral control, and intentions of parents of preschoolers. Phase 1 was a quasi-experimental, one-group pretest-posttest design. Parents (n=26) of Head Start and preschool children participated in the 4-week intervention. Phase 2 consisted of qualitative interviews with a purposive sample of these parents (n=11).

Results: Parents' behavioral intentions or oral health behaviors with their preschoolers did not significantly change from pre to post intervention ($p > .05$). Social norms (SN) and perceived behavioral control (PBC) predicted behavioral intentions pre-intervention and behavioral change post-intervention. While quantitative results showed minimal change post-intervention, thematic analysis revealed (1) parents' belief in the importance of establishing oral health habits and (2) ToothSense brushing reminders and videos supported efforts to establish oral health habits.

Conclusions: The use of TPB constructs in developing oral health promotions aimed at parents of preschoolers was partially supported. Intention and behavior were not affected post-intervention but SN and PBC emerged as significant predictors of intentions and behavior. ToothSense may aid parents to make good oral health habits part of their preschooler's daily routine.

Head and Neck Flexion Among Dental Hygiene Students and Clinical Faculty Using Two Types of Magnification Loupes: A Comparative Study

Catherine Wilson RDH, MS*
Idaho State University, Pocatello, ID

Purpose: The purpose of this study was to compare head/neck flexion angles among senior dental hygiene students and clinical instructors using first generation through-the-lens (TTL) loupes and third generation vertically-adjustable-front-lens-mounted (VAFLM) loupes during simulated dental hygiene scaling (SDHS) procedures on a mannequin.

Methods: A nonprobability, purposive sample of second-year dental hygiene students and clinical faculty (N=29) from ISU was recruited for this simulation study. A within-subjects, crossover design was employed to identify head/neck flexion angles under two lens conditions, TTL and VAFLM loupes, during SDHS procedures. Three lens conditions (TTL, VAFLM loupes and safety lenses) were compared in a subset of participants (n=10). Static photographs were taken at three, time points during SDHS procedures using each lens condition. Kinovea software was used to calculate head/neck flexion angles from images. Data were analyzed using measures of central tendency and repeated measures ANOVA.

Results: Across-the-board, mean head/neck flexion angles were significantly lower for the VAFLM loupes compared to the TTL condition during SDHS procedures in both the

mandibular and maxillary arches ($p = 0.000$). Additionally, the VAFLM loupe condition showed a significant decrease in forward head posture over the safety lens and TTL conditions in maxillary and mandibular arches ($p < .0001$, $p = .0002$, respectively).

Conclusion: The VAFLM loupe condition greatly reduced head/neck flexion angles and significantly decreased forward head posture over the TTL condition. The magnitude of effect size for VAFLM loupes suggests efficacy for these third-generation magnification lenses to positively impact poor work posture as a risk factor in the development of work-related musculoskeletal disorders.

Dental Utilization Patterns of Children Age 2-3 Years Covered by Medicaid and Residing in Wayne County, Michigan

Elizabeth I. Pitts, RDH, MS*+
Anne E. Gwozdek, RDH, BA, MA
Sarah J. Clark, MPH
Christine M. Farrell, RDH, BSDH, MPA
Janet S. Kinney, RDH, MS
University of Michigan, Ann Arbor, MI

Background: Untreated oral disease is prevalent among underserved and vulnerable populations in the United States. These populations include children, specifically those from lower socioeconomic backgrounds.

Objectives: To examine dental utilization patterns of Medicaid-enrolled children age 2 residing in Detroit, Michigan compared to their counterparts living in Outer Wayne County, Michigan. A secondary objective was to identify those who had an emergency dental visit during age 2 and determine the type of follow-up through age 3.

Methods: This study was a secondary analysis of Medicaid dental administrative claims data for eligible children in Wayne County, Michigan who turned 2 years of age during calendar year 2013. Child-level enrollment and dental utilization data were extracted from the Michigan Department of Health and Human Services Data Warehouse.

Results: Children meeting inclusion criteria numbered 7,359. Only 3,671 (50%) children had at least one dental visit between age 24 and 47 months. A total of 7,481 visits occurred during this time. Four-hundred (5%) visits were categorized as an emergency compared to 5,425 (73%) categorized as preventive. Seventy (69%) children from Detroit had an emergency visit during age two compared to

31 (31%) from Outer Wayne County. Fifty-seven (81%) in Detroit received follow-up care post an emergency, compared to 21 (68%) in Outer Wayne County. Equal proportions (23%) of repeat emergency visits were observed in Detroit and Outer Wayne County.

Conclusions: Earlier preventive dental care may help reduce emergency visits, be more cost effective, and decrease the need for extensive treatment.

Using Simulation to Promote Reflection in Dental Hygiene Education

Lindsay L. Lundquist, RDH, MSDH*
Eastern Washington University, Spokane, WA

Purpose: This research investigated Kalb's Theory of Experiential Learning as an effective method in measuring reflection during a simulation debriefing exercise. Additionally, this study identified the reflective practices used among dental hygiene students in a standardized patient simulation.

Methods: A non-experimental, mixed-methods, sequential explanatory design was used for the study. Utilizing a sample of dental hygiene students enrolled at Eastern Washington University (EWU), a standardized patient simulation was implemented to promote reflection among participants. Results were determined by the debriefing reflection rubric based upon Kalb's Theory of Experiential Learning.

Results: Descriptive statistical data revealed that this tool is successful in determining the level of reflection in these dental hygiene students. Additional results showed dental hygiene students demonstrated reflective observations and concrete experiences; however, dental hygiene students demonstrated limited responses to abstract conceptualism and connecting their experience to future endeavors.

Conclusions: The debriefing reflections rubric was found to be an efficient tool in determining reflection among the dental hygiene students and suggests that the debriefing reflection rubric used could be implemented in simulation practice. Dental hygiene students demonstrate competent skills in reflective observations; however the students' ability to identify conceptual connections and further connect it to future action was limited indicating the need for further research in this area.

Use of Technology to Facilitate Patient Motivation for Improving Oral Health

Holly A. Houck, RDH, MSDH*
Kimberly S. Bray, RDH MS
JoAnna M. Scott, PhD
Marsha A. Voelker, CDA, RDH, MS
Liz M. Kaz, RDH, EdD

University of Missouri, Kansas City, MO

Purpose: To examine the effects of a smartphone application associated with a powered toothbrush on patient motivation and subsequent compliance with oral hygiene care.

Methods: This pilot study utilized a randomized controlled parallel arm design. Patient reported brushing, Dental Self-Efficacy Scale (DSES) and the Treatments Self-Regulation Questionnaire (TSRQ) were collected from surveys given at baseline, completion (30 days) and follow-up (90 days). Adults identified as needing oral hygiene improvement at a routine dental cleaning were recruited to participate. Subjects were randomly assigned to the intervention (utilized smartphone application) or the control (did not utilize smartphone application) groups.

Results: After all data collection, no statistical significance was found between the intervention and control groups for any outcomes compared to baseline data. At baseline, the control had a significantly higher autonomous motivation score than the intervention group (0.54 vs 5.80) ($p=0.019$). Over time, the autonomous motivation appears to stay the same in the control group, while increasing in the intervention group. All subjects reported more confidence in their toothbrushing abilities (16.16-17.11) versus their interproximal cleaning abilities (11.92-13.52).

Conclusion: This study shows the oscillating powered toothbrush with Bluetooth and associated smartphone application has the potential to support patient motivation and confidence in performing homecare. The smartphone application's supportive features could play a role in the long-term maintenance of oral hygiene home care. Further research is warranted to continue to understand the impact of technology on patient motivation in regard to oral health improvement.

Dental Implant Assessment and Maintenance: Attitudes and Practices of Dental

Hygienists in the United States
Ivy H. Zellmer, RDH, MS*+
Elizabeth T. Couch, RDH, MS
Lisa H. Chung, DDS, MPH
Don Curtis, DMD

University of California San Francisco, San Francisco, CA

Purpose: To investigate U.S. dental hygienists' attitudes and practices regarding assessment and maintenance of dental implants.

Methods: A 34-item quantitative, web-based survey was developed and distributed nationally to a randomly selected sample of 10,000 dental hygienists from the American Dental Hygienists' Association (ADHA) email database. All survey responses were analyzed and reported using frequency distributions.

Results: A total of 2033 dental hygienists (21%) responded. Nearly all the respondents (98%) who practiced dental hygiene also provided care to patients with dental implants. Many routinely assessed for bleeding/exudate, mobility, plaque/calculus, and tissue color around implants, however 34% rarely/never checked for cement around implants, 31% rarely/never probed, and 54% rarely/never checked the occlusion. Many respondents (44%) reported they were unable to remove plaque as well from implants as compared to teeth. A majority (60%) reported using plastic/resin scalers, however only 7% felt they were effective. While 5% reported using subgingival air-polishers, 71% felt they were effective. The most commonly recommended hygiene aid for patients with implants was an oral irrigator by 75% of the respondents. A majority (91%) reported continuing education courses as the primary source of implant-related knowledge.

Conclusion: While a majority of dental hygienists reported providing care to patients with dental implants, there was variability in attitudes and practices among respondents regarding the assessment and maintenance care of implants. Curricula and continuing education focused on evidence-based implant care recommendations are needed.

The Functional Status and Oral Health Quality of Life for Seniors in Residential Facilities who Have Direct Access to Care as Compared to Those Without Access

Jennafer Golden, RDH, MS*

University of Minnesota, Minneapolis, MN

Introduction: Residents of senior residential facilities face obstacles to good oral health, as most are medically compromised and cannot provide adequate self-care. Consequently, the oral health status of the population is generally poor and has a negative impact on quality of life.

Purpose: The purpose of this study was to test whether there is a perceived difference in oral health and comfort when residents in long term care facility received periodontal debridement and prophylaxis compared to facility who provide only brushing and flossing assistance.

Methods: The study design was quasi-experimental with hypothesis testing and descriptive statistics used to summarize the data. The study took place in two residential facilities in Sheridan, Wyoming. Fifteen residents from each facility comprised the study sample (n=30). The treatment group received periodontal debridement and prophylaxis and oral hygiene education and the control group received brushing, flossing and oral hygiene education. A pre/post test was conducted using the 5 question Oral Health Impact Profile, shortened version.

Results: Results demonstrated there was a significant difference in pre/post OHIP-5 scores in the treatment group (p=0.0222). The control group had improved scores but it was not significant (p=0.5331). A significant univariate association was found between caries and OHIP-5 scores (p=0.0082).

Conclusions: This study revealed that residents of long-term care facility perceived their oral health quality of life improved as a result of receiving preventive dental services where they reside.

Representation of Diversity on Entry-Level Dental Hygiene Program Websites

Karmeil M. Stepter RDH, MSDH*

Rachel Kearney RDH, MS

Canise Y. Bean DMD, MPH

Brian B. Partido RDH, MS

The Ohio State University, Columbus, OH

Purpose: The purpose of this study was to investigate current entry-level dental hygiene program websites across the United States and evaluate how ethnic and racial diversity is portrayed. The aims of this study were to examine the images and videos used on websites of current entry-level dental hygiene programs and describe the frequency that minorities are represented and the role in which they are characterized.

Methods: A content analysis was used to evaluate a random sample of entry-level dental hygiene program webpages from the American Dental Hygienists' Association (ADHA) list. The 37 entry-level dental hygiene webpages were assessed for diversity. The representation of diversity was evaluated by examining images and videos found on the webpages and then coding the findings by demographics and the roles in which the individuals appearing in pictures or videos were portrayed.

Results: Thirty-seven of the 50 randomly selected entry-level programs met the inclusion criteria. Of these, 32 were associate degree programs and 5 were baccalaureate degree programs. A total of 690 images on the websites of these 37 programs were analyzed. The overall findings reflected Whites being predominately represented in 78.8% of the images followed by Asian (5.2%), Black or African American (4.3%), while American Indian Alaska Native and Native Hawaiian/ Other Pacific Islander were least represented at 0.3% and 0.1% respectively. Race was undetermined in 8.4% of the sample. The Chi-square test of independence showed that there was a statistically significant difference (p=0.004) between associate and baccalaureate degree programs. Associate programs had less representation of underrepresented minorities images on entry-level dental hygiene webpages.

Conclusion: The study evaluated the representation of racial and ethnic diversity on entry-level dental hygiene program webpages. The findings revealed that the entry-level dental hygiene program websites predominately reflected White female as the majority in the images and videos on the webpages. This data was reflective of the profession and the student population; White females outnumbered

underrepresented minorities. There was a statistically significant difference between how associate and baccalaureate programs represented underrepresented minorities on their webpages.

Current Radiation Safety Practices of United States Dental Hygienists

Kimberly Lintag, BSDH, MS*

Ann M. Bruhn, BSDH, MS

Lynn Tolle, BSDH, MS

Norou Diawara, Ph.D.

Old Dominion University, Norfolk, VA

Purpose: The purpose of this study was to determine licensed dental hygienists' current radiation safety practices.

Methods: Data was collected with a 22 item, IRB exempt online survey administered to a sample of 1,500 U.S. dental hygienists who were subscribers of a professional journal. Questions focused on respondents' use of ADA selection criteria guidelines, policies implemented by their dental practices, and hand-held portable x-ray device use and training. A response rate of 38% (N=566) was obtained. Cross tabulations were obtained using logistic regression and general linear models for significance at a 0.05 level.

Results: A majority of respondents had an associate's degree (62%), participated in a radiology course for two semesters or less (84%), and were aged 55 and above (41%) with 31 or more years of experience (38%). Dental hygienists were significantly more likely to select the appropriate criteria for determining radiographic need with more years of experience ($p=0.0340$; $SE=0.1093$). Dental hygienists with a bachelor's degree or higher were significantly more likely to use radiographic techniques that reduce radiation exposure than those with an associate's degree ($p=0.0080$; $SE=0.0169$). Respondents were significantly more likely to wear a clinician lead apron when using a hand-held device if they had recently taken dental radiation safety continuing education (CE) courses ($p=0.0093$; $M=1.571$; $SD=1.222$).

Conclusion: Dental hygienists with more years of experience, a higher level of education, and recent CE course work were more likely to follow the ADA selection criteria guidelines and use the appropriate technique to reduce exposure to ionizing radiation.

Where Do We Go from Here? Extent and Perceptions of Elder Abuse Training In Dental Hygiene Curricula

Rebel L. Chapa, MSDH*

Beatriz M. Hicks, MA, RDH

Thomas J. Prihoda, PhD

Lynn A. Smiley, MEd, RDH

Lisa M. Englehart, MSDH

Melanie V. Taverna, MSDH

UT Health San Antonio, San Antonio, TX

Problem: Previous research revealed insufficient elder abuse training in dental hygiene curricula. Dental hygiene graduates must be prepared to confidently recognize and respond to situations of elder abuse.

Purpose: The purpose of this investigation was to determine the current extent of elder abuse training in dental hygiene curricula and explore educator's perspectives on the topic.

Methods: A twenty-five item online survey was distributed to 361 program directors, coordinators and/or department chairs of Commission on Dental Accreditation (CODA) accredited dental hygiene programs via email invitation in August 2017. Qualtrics® survey platform and SPSS were utilized for survey administration, data collection, and descriptive statistical analysis.

Results: A response rate of 27.15% (98) was achieved. Although 83.33% of the respondents reported inclusion of elder abuse training, the majority of Associate (84.61%), Entry-level BSDH (93.75%), and BSDH completion and MSDH (100%) programs reported less than three hours of instruction on the topic. Various barriers to inclusion were identified. Graduates were perceived as appropriately competent in identification of oral neglect (63.51%), general neglect (48.65%), and documentation of potential signs (43.84%). Less than one-third (32.43%) considered graduates to be appropriately competent at reporting suspected elder abuse and (18.06%) perceived graduates to be appropriately competent at communication with the patient, caregiver, and dentist about possible abuse.

Conclusions: A deficiency in elder abuse training is still evident despite rising awareness and increased incorporation in dental hygiene curricula. To prepare graduates to confidently recognize and respond to elder abuse, educators must be willing to overcome barriers, modify instruction, and embrace interprofessional collaboration.

Oral HPV Cancer Awareness among College Students: A Pilot Study

Sandra Chie, RDH, MS*

Joyce Sumi, RDH, MS

University of Southern California, Los Angeles, CA

Problem: College students can be considered among the highest populations at risk for Human Papillomavirus (HPV) infection and related oropharyngeal cancers (OPC). Yet, studies have shown a low level of perceived susceptibility of HPV infection exists among this group. The level of awareness on HPV-related OPC can be a predictor of interest and intent to pursue health promotional and preventive activities. The focus of this study was to investigate the current knowledge and attitude pertaining to HPV-related oropharyngeal cancer (OPC), HPV vaccine acceptance and linkage to health promotional behaviors of college students.

Methods: Participants were randomly recruited through list-serves of enrolled university college students pursuing non-health related degrees (n=86). A 16-item cross-sectional survey was constructed to identify factors affecting the following: perceived HPV risk, HPV vaccination benefits, HPV-related OPC awareness, and motivation levels to change health promotional behaviors. Data were exported from Qualtrics to Microsoft Excel with additional analysis using SPSS.

Results: Responding participants (n=86) were able to identify factors improving their perception on the severity of HPV (91%), infection susceptibility (71%), and vaccination benefits (81%). Increased awareness led to increased intent to obtain both a HPV vaccination (71%) and an oral cancer examination (93%).

Conclusion: Identifying factors improved awareness on HPV-related OPC and vaccine benefits and contributed as a predictor for participants' intent to pursue health preventive behaviors.

Trends and Determinants of Drinking Water Practices: A Mixed-Methods Study

Uhlee Oh, RDH, MS*+

Jane Weintraub, DDS, MPH

Lattice D. Sams, RDH, MS

Kimon Divaris, DDS, PhD

University of North Carolina, Chapel Hill, NC

Problem: Despite the well-known benefits of fluoridated community water (CW), bottled water (BW) consumption is on the rise. CW avoidance is common in Latino communities, which also experience a disproportionate burden of dental caries. These increasing BW consumption trends imply that vulnerable children may not be receiving the caries-preventive benefits of CW fluoridation.

Purpose: The purpose of this study was to investigate the determinants of BW vs. CW consumption and understand the Latino community's beliefs, experiences and practices regarding drinking water.

Methods: Electronic health record data (demographics, insurance, primary drinking water source) were obtained for all first-time, routine-care UNC-Chapel Hill Pediatric Dentistry patients age 0-16 in 2002-2016. Analyses relied on descriptive and bivariate methods and multivariable log-binomial regression. Second, phone interviews were conducted with Latino parents of young children and key community informants (n=15); transcripts were analyzed qualitatively using Atlas.ti.8 software.

Results: BW consumption increased from 17% in 2004 to 42% in 2016 (n=2,920, P<0.05). Medicaid-enrolled children [prevalence ratio (PR)=2.1; 95% confidence interval (CI)=1.8-2.4] and those living in rural areas (PR=1.3, 95% CI=1.1-1.5) were more likely to consume BW versus CW. Major themes emerging from the interviews included 'ingrained upbringing that devalued CW consumption' and 'lack of knowledge about CW fluoridation and safety.' Participants suggested that Spanish-speaking health professionals are a promising avenue to promote CW consumption.

Conclusions: BW consumption is sharply increasing and most prevalent among low-income families and those living in rural areas. Successful promotion of CW consumption in NC Latino communities requires engagement of both community stakeholders and health professionals.