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

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Editorial

Doctoral Education in Dental Hygiene: From Dream to Reality – Almost!

Rebecca S. Wilder, RDH, BS, MS

There are a couple of times during the year when one tends to set goals. One of those times is on January 1st and the other is the beginning of a new school year. As we start a new academic year, I wonder what your goals are for your professional career.

A goal of our profession has been to create a discipline–specific doctoral degree in dental hygiene. Currently there are several dental hygienists with doctoral degrees, many of whom contribute to the JDH Editorial Review Board. However, each of these dental hygienists has been forced to obtain a doctoral degree outside of the dental hygiene discipline because there was simply no other option. While obtaining a doctoral degree in any discipline is an achievement to which the professional should be applauded, not having a doctoral degree in dental hygiene takes away the opportunity for focused mentoring and learning of extensive discipline specific content in dental hygiene.

Why is a doctoral degree necessary? Several key articles have been written on this subject. Ortega et al noted that "Doctoral prepared dental hygienists will be needed to teach masters-level graduate dental hygiene learners and to engage in administrative and leadership roles in health care organizations with impending changes in health care policies."[1] Gurenlian et al have written about doctoral education in dental hygiene and predict that if dental hygienists want to assume leadership positions in the future, they will need a doctoral degree.[2] These positions include leadership in universities and colleges, state and federal health care agencies, professional or health care organizations, research leadership in universities, corporations, federal agencies, health care administration for school districts, health care management organizations, insurance officer, and hospital administration.[2]

Steps are moving in the direction of a Doctorate in Dental Hygiene. The ADHA published "Dental Hygiene: Focus on Advancing the Profession" in 2005 where a recommendation was made to create doctoral programs in dental hygiene.[3] The International Federation of Dental Hygienists' and American Dental Education Association have discussed the need for a dental hygiene doctoral degree.[4,5] A monumental symposium was held in 2013, a collaboration with ADHA and the Sante Fe Group. The conclusion was change is needed if dental hygiene education is to keep up with the evolving health-care environment.[6]

The dream of having a discipline specific doctoral degree in dental hygiene is here… at least almost! Currently, there is one PhD program in dental hygiene at the University of Namseoul in South Korea.[7] Two other programs are in the planning stages at Idaho State University and the University of Alberta in Canada. As these programs become official and start accepting doctoral students, I predict the demand will soar.

Finally, I would like to highlight one of the papers published in this issue of the JDH. Authors Ursula GM Tumath, RDH, MS, and Margaret Walsh, RDH, MS, MA, EdD, conducted a study of dental hygiene master's degree students to assess their perceptions about doctoral education. They reported that 77% indicated a doctoral degree in dental hygiene is needed to advance the profession and almost half (43%) expressed interest in enrolling in a doctoral program in the next 5 years.[7] It is an exciting time in dental hygiene! The possibilities are endless!

Sincerely,

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

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Lasers and Nonsurgical Periodontal Therapy

Denise M. Bowen, RDH, MS

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

The Bottom Line

Lasers have been increasing in popularity in dental hygiene practice. Although traditional scaling and root planing (SRP) and daily self-care by the patient have been shown to be effective in reducing inflammation and probing depths and increasing clinical attachment, challenges associated with deeper pockets, root morphology and difficult access areas decrease the likelihood of healing following nonsurgical periodontal therapy (NSPT). Adjuncts such as antimicrobials and lasers have been advocated to overcome these limitations. Lasers may be used in the treatment of periodontitis as a monotherapy or as an adjunct to SRP during initial periodontal therapy, surgery, or periodontal maintenance therapy; however, this article addresses their use as an adjunct to SRP in NSPT.

Several types of lasers are used in the treatment of periodontal and peri-implant diseases: diode lasers (DLs) (809 to 980 nm), Nd:YAG (1064 nm), Er:YAG and Er,Cr:YSGG (2940 and 2780 nm, respectively) and the CO_2 laser (10,600 nm).[1] In NSPT, laser therapy is advocated for sulcular debridement, also known as soft tissue curettage, and for bactericidal effects within the periodontal pocket. Unlike other therapeutic procedures used by dental hygienists and dentists, there is no standard accepted protocol for the use of lasers. As a general rule, the performance of a given laser is governed by its absorption, or depth of penetration into the tissues, and the absorption depends on the wavelength.[2] Diode and Nd:YAG lasers are deeply penetrating whereas Er:YAG, Er,Cr:YSGG and CO_2 penetrate superficially. One exception to this general rule is the photodynamic therapy (PDT) diode laser (660 to 810 nm), a low-power laser used in combination with a photosensitizing agent for antimicrobial purposes only; therefore, this article does not address PDT. Also, the research findings presented in this article do not apply to the laser-assisted new attachment procedure (LANAP) using the Nd:YAG laser, as it is a specific protocol trademarked by one company, requiring a full year of training, and reserved as more of a definitive surgical procedure for dentists or dental specialists only.[2] Laser therapy, also known as periodontal phototherapy, used in conjunction with SRP in NSPT, is the focus of this article.

The research studies discussed in this article were designed to evaluate the effectiveness of diode and Nd:YAG lasers used in conjunction with SRP because of their potential to perform soft tissue curettage as well as to reduce periodontal pathogens in the periodontal pocket.[2] Neither of these types of lasers are used for calculus removal. Based on the findings of these 2 studies, the ensuing conclusions can be drawn:

- Clinicians need to distinguish the various types of lasers used in NSPT and consider the evidence regarding each type when evaluating the effectiveness of laser therapy, or phototherapy, in practice.
- Based on the systematic review and meta-analysis by Slot et al, the adjunctive use of the most commonly employed diode laser (809 to 980 nm) as an adjunct to traditional mechanical modalities of periodontal therapy in patients with periodontitis is questionable.
- The evidence analyzed in the Sgolastra et al meta-analysis indicates that Nd:YAG+SRP has potential for benefits beyond SRP alone due to the reduction in PD and GCF; however, the low number of studies eligible for inclusion and the risk of bias for studies included leads to the conclusion that insufficient evidence exists to support the effectiveness of Nd:YAG adjunctive to SRP.
- The findings of both of these studies support the findings of a 2015 systematic review and meta-analysis on the nonsurgical treatment of chronic periodontitis by means of scaling and root planing with or without adjuncts conducted and published by a panel of experts convened by the American Dental Association Council on Scientific Affairs.[3]
    - There was a low level of evidence supporting the non-PDT DL (809 to 980 nm) based on a small gain in CAL (0.21mm) compared with SRP alone, although the ADA found a moderate level evidence supported the use of the PDT DL in conjunction with a pho-

tosensitizing agent (0.53mm gain in CAL). Again, the difference between the non-PDT DL studied by Slot et al. and the DL used in conjunction with a photosensitizing agent for PDT should be noted.
    - Although the ND:YAG laser resulted in a 0.41 mm gain in attachment, compared with SRP alone, the overall level of certainty of the evidence was low. Only 3 studies could be included in the meta-analysis and the risk of bias was moderate to high.
- Moreover, the results of both of these systematic reviews and meta-analyses, as well as the ADA scientific panel's systematic review and meta-analysis, support the Statement on the Efficacy of Lasers in the Non-Surgical Treatment of Inflammatory Periodontal Disease published by the American Academy of Periodontology which states, in part, that there is minimal evidence to support use of a laser for the purpose of subgingival debridement, as an adjunct to SRP.[4]

Slot DE, Jorritsma KH, Cobb CM, Van der Weijden FA. The effect of the thermal diode laser (wavelength 808-980nm) in non-surgical periodontal therapy: a systematic review and meta-analysis. *J Clin Periodontol*. 2014;41(7):681-692.

Focused Question: What is the adjunctive effect of a diode laser (DL) following non-surgical periodontal debridement (SRP) during the initial phase of periodontal therapy on the clinical parameters of periodontal inflammation?

Material and Methods: The MEDLINE-PubMed, Cochrane-Central Register of Controlled Trials and EMBASE databases were searched up to September 2013. Probing pocket depth (PPD) and clinical attachment loss (CAL) were selected as outcome variables. Also plaque scores (PS), bleeding scores (BS) and the Gingival Index (GI) were considered outcome measures. Data were extracted and a meta-analysis (MA) was performed where appropriate.

Results: Independent screening of 416 unique papers resulted in nine eligible publications. The MA evaluating PPD, CAL, PS showed no significant effect. The only significance favouring adjunctive use of the DL was observed for the outcome parameters GI and BS.

Conclusion: The collective evidence regarding adjunctive use of the DL with SRP indicates that the combined treatment provides an effect comparable to that of SRP alone. That is for PPD and CAL. The body of evidence considering the adjunctive use of the DL is judged to be "moderate" for changes in PPD and CAL. With respect to BS, the results showed a small but significant effect favouring the DL, however, the clinical relevance of this difference remains a question. This systematic review questions the adjunctive use of DL with traditional mechanical modalities of periodontal therapy in patients with periodontitis.

Commentary

In this article, Slot et al reported the results of a systematic review and meta-analysis designed to evaluate the effect of the diode laser (DL, 809 to 980 nm) used as an adjunct to SRP during initial nonsurgical periodontal therapy on parameters of periodontitis and periodontal inflammation in patients with periodontitis. A systematic review is a study designed to answer a specific, focused research question by comprehensively collecting and evaluating published studies. All of the studies that meet pre-established criteria for the highest level of evidence are systematically identified, appraised and summarized according to a precise methodology. Meta-analysis adds an additional step by statistically combining results of some or all of the included studies. Studies that are similar enough statistically to combine, synthesize and analyze are merged as if the data were generated from one study. For research questions about therapies or preventive strategies, a systematic review or meta-analysis of randomized clinical trials (RCTs) is considered the highest level of evidence available.

As indicated in the abstract, only 9 of 419 studies reviewed were included in the systematic review and meta-analysis based on the 8 criteria set for quality and inclusion. Only RCTs comparing SRP alone with SRP+DL in initial periodontal therapy for patients with periodontitis were included. Also, only studies judged as having a low risk of bias were included. Seven studies used a split-mouth research design where sides of the mouth receiving each type of intervention are randomized, and 2 used a parallel design in which patients are randomized for assignment to different treatment groups. A separate analysis of these 2 types of designs showed no significant difference in findings. The impact of some of the studies having included smokers could not be analyzed due to inadequate reporting of details regarding tobacco use. The small number of studies (n=9) included in this systematic review and meta-analysis attests to the fact that much information in the literature regarding advantages of the DL as an adjunct to SRP for soft tissue curettage and antimicrobial effects might be based on lower quality evidence than the well-designed RCTs included in this systematic review. Dental hygienists are reminded to seek the highest quality of evidence when making decisions regarding patient care therapies and strategies for disease prevention.

The studies of DL varied in the approach to SRP employing hand, sonic and/or ultrasonic instruments and the DL parameters of energy setting, tip, procedures and contact time. This heterogenicity in the protocols underscores the need to establish clinical

guidelines or a standard, accepted protocol for laser therapy. The evidence included in this review indicates that use of the DL+SRP had no significant effect on probing pocket depth (PPD), clinical attachment loss (CAL) or plaque scores (PS) beyond SRP alone. The focus of this review was not intended to be reduced subgingival microbiota; however, of the 5 studies reporting these outcomes, only 1 showed a statistically significant reduction in bacterial load in favor of DL+SRP. Scores for bleeding (BS) and gingival inflammation (GI), however, did show a small, but statistically significant, advantage of the DL+SRP over SRP alone. These measures represent gingival inflammation. The magnitude of this difference in the means representing the outcomes of the 2 therapies was -5.34%; therefore, the clinical significance of this difference was questioned by the authors. One way clinicians can consider the issue of statistical vs. clinical significance is to think of the latter as clinical importance. Dental hygienists and other health professionals considering the evidence should ask themselves whether the difference reported between the new and old therapy based on the results of a study are large enough to alter their practice? For this reason, Slot et al have concluded, based on the collective evidence, that the adjunctive use of DL with traditional mechanical modalities of periodontal therapy in patients with periodontitis is questionable.

The findings of this study support the findings of a 2015 systematic review and meta-analysis on the nonsurgical treatment of chronic periodontitis by means of scaling and root planing with or without adjuncts conducted and published by a panel of experts convened by the American Dental Association Council on Scientific Affairs.[3] That study found that, although a moderate level evidence supported the use of the PDT DL (0.53 mm gain in CAL), there was a low level of evidence supporting the non-PDT DL (809 to 980 nm) based on a small gain in CAL (0.21 mm) compared with SRP alone. Again, the difference between the non-PDT DL studied by Slot et al and the DL used in conjunction with a photosensitizing agent for PDT should be noted.

Sgolastra F, Severino M, Petrucci A, Roberto Gatto, Annalisa M. Nd:YAG laser as an adjunctive treatment to nonsurgical periodontal therapy: A meta-analysis. *Lasers Med Sci*. 2014;29:887–895.

Abstract: A meta-analysis was conducted to investigate whether the use of Nd:YAG laser adjunctive to scaling root planing (SRP) could provide additional benefits compared to SRP alone in patients with chronic periodontitis. The meta-analysis was performed according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analysis) statement and the recommendations of the Cochrane Collaboration. A literature search was performed on seven databases, followed by a manual search. Weighted mean differences and 95% confidence intervals were calculated for the clinical attachment level (CAL), probing depth (PD), and changes in plaque index (PI) and gingival crevicular fluid (GCF). Inter-study heterogeneity was assessed by the I2 test, and publication bias was analyzed by the visual inspection of the funnel plot for asymmetry, Egger's regression test, and trim-and-fill method. All outcomes were evaluated from baseline to the end of follow-up. Significant differences in PD and GCF reduction were observed in favor of SRP+Nd:YAG; no significant differences were observed in CAL gain or PI change. The findings of this meta-analysis suggest that use of the Nd:YAG laser as an adjunctive therapy to conventional nonsurgical periodontal therapy could potentially provide additional benefits. However, all included studies were not at low risk of bias, and only three studies were included in the meta-analysis. As a result, the evidence is insufficient to support the effectiveness of adjunctive Nd:YAG to SRP. Future long-term well-designed parallel randomized clinical trials are required to assess the effectiveness of the adjunctive use of Nd:YAG laser. These trials should also include microbiological and adverse events analyses.

Commentary

This study was a well-designed systematic review and meta-analysis conducted to evaluate the use of a Nd:YAG laser as an adjunct to SCP in nonsurgical periodontal therapy for patients with chronic periodontitis. In addition to measuring clinical outcomes, the researchers also assessed the level of bias of the studies included in the review. Ten criteria were used for inclusion and exclusion in 2 phases to determine eligibility of studies included in the systematic review. Of 438 studies evaluated, only 3 studies could be included in the analysis. All of these studies were RCTs that used low-intensity Nd:YAG (1064 nm) laser therapy with fiber tips ranging from 0.2 to 0.6 mm; however, contact time, frequency, laser dosages and energy settings varied. Differences in the protocols for NSPT, variability in the definitions of chronic periodontitis, and the inclusion of smokers also contributed to heterogenicity of data included. The authors determined the risk of bias to be moderate for one study and high for 2 studies of the three studies analyzed.

All studies included in this review and meta-analysis used a split-mouth design. This design has the advantage of controlling for individual variations between subjects and allows for lower numbers of subjects in the clinical trial without a loss of statistical power. Within-patient comparisons made in split mouth designs, however, might be affected by differences in disease patterns on one side of the mouth versus the other unless randomized or controlled. Effects of the 2 treatments may also carry over from one side of the mouth to the other. A split-mouth design should

only be used when it is known that no such crossover exists. A lack of effect has been presumed for laser therapy.

A significant reduction in mean PD was found (0.55 mm) in favor of Nd:YAG+SRP compared to SRP alone; however, no significant difference was found for gain in CAL. The adjunctive use of Nd:YAG significantly reduced the amount of GCF, although no significant difference was observed in PI. GCF is a reflection of inflammation; thus, these results may support the ability of laser therapy adjunctive to SRP to reduce inflammation in periodontitis, like the outcomes of the Slot et al review for DL+SRP which indicated a difference in GI and bleeding. None of the studies included in the review by Sgolastra reported microbiological outcomes, although this claim is frequently made for laser therapy. As stated in the abstract, the evidence indicates, although the reduction in PD and GCF with Nd:YAG+SRP shows that this approach has potential for benefits beyond SRP alone, there is insufficient evidence to support the effectiveness of adjunctive Nd:YAG to SRP due to low number of studies eligible for inclusion and the risk if bias for studies included in the systematic review and meta-analysis.

This finding agrees with the findings of the 2015 systematic review and meta-analysis on the nonsurgical treatment of chronic periodontitis by means of scaling and root planing with or without adjuncts conducted and published by a panel of experts convened by the American Dental Association Council on Scientific Affairs.[3] The ADA review concluded that, although the ND:YAG laser resulted in a 0.41 mm gain in attachment, compared with SRP alone, the overall level of certainty of the evidence was low.

Summary

Dental hygienists are preventive professionals responsible for providing NSPT to address treatment needs of patients with periodontitis. Laser therapy used alone or as an adjunct to SRP has been increasing in popularity based on reported benefits in healing following NSPT. In fact, the evidence presented in these articles indicates that insufficient evidence exists to support use of DL+SRP or Nd:YAG+SRP when compared to SRP alone. Although laser therapy may show some promise in reducing inflammation in periodontitis, standard protocols for use in practice and research are needed. Robust, parallel studies are needed with consideration given to accepted definitions of the extent of periodontitis and the potential impact of smoking on treatment outcomes. Microbiologic outcomes also need to be evaluated in relation to clinical outcomes.

Denise M. Bowen, RDH, MS, is Professor Emeritus in Dental Hygiene at Idaho State University. She has served as a consultant to dental industry, as well as numerous government, university and private organizations and presently is a member of the National Advisory Panel for the National Center for Dental Hygiene Research in the U.S. She has served as Chair of the American Dental Hygienists' Association Council on Research and Chair of the Research Committee for the Institute for Oral Health and has received national awards for excellence in dental hygiene. Professor Bowen is widely known through her published articles and textbook chapters and dynamic continuing education programs related to nonsurgical periodontal therapy, preventive oral self-care, research methodology, and dental hygiene education.

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Perceptions of Dental Hygiene Master's Degree Learners About Dental Hygiene Doctoral Education

Ursula GM Tumath, MS, RDH; Margaret Walsh, MA, MS, EdD, RDH

Abstract

Purpose: To determine perceptions about dental hygiene doctoral education among dental hygiene master's degree program enrollees.

Methods: In this cross-sectional national study, all dental hygiene master degree program directors were sent an email requesting they forward an attached consent form and online-survey-link to their graduate learners. The 29-item online survey assessed their perceptions about need for, importance of and interest in applying to proposed dental hygiene doctoral degree programs. A second-request was sent 1 month later to capture non-responders. Frequencies and cross-tabulations of responses were analyzed using the online software program, Qualtrics.™

Results: Of the 255 graduate learners enrolled in 2014 reported by dental hygiene program directors, 159 completed the survey for a 62% response rate. The majority of respondents (77%) indicated that doctoral education in dental hygiene is needed for the advancement of the dental hygiene discipline and such programs are important to the dental hygiene profession (89%). Although most respondents supported both the PhD in dental hygiene and the Doctor of Dental Hygiene Practice (DDHP) degrees, more were interested in applying to a DDHP program (62%) than to a dental hygiene PhD program (38%). In addition, 43% expressed interest in enrolling in a doctoral degree program in the next 1 to 5 years and most preferred a hybrid online/onsite program format. The most frequently reported reasons for pursing a doctoral degree were: to become a better teacher, to expand clinical practice opportunities, to become a better researcher and to increase salary.

Conclusion: Most dental hygiene master degree learners in this study believed doctoral dental hygiene education is needed and important to the dental hygiene discipline and profession, and were interested in applying to such programs. Future research is needed in this area.

Keywords: doctoral dental hygiene education, doctorate of dental hygiene practice, master's degree in dental hygiene, dental hygiene graduate education

This study supports the NDHRA priority area, **Professional Education and Development:** Assess how educators are socializing students to research.

Introduction

Nursing, physical therapy and audiology have developed doctoral programs to prepare graduates to engage in discipline-specific research, education and practice (Table I).[1-4] However, to date there are no dental hygiene doctoral programs in the U.S. Several dental hygiene scholars maintain dental hygiene doctoral programs are needed to prepare dental hygienists to conduct rigorous research to address the discipline's unique perspectives.[5-8] They posit dental hygiene doctoral programs are critical to prepare dental hygiene researchers to ask questions related to oral disease prevention and health promotion central to the dental hygiene discipline.[9] Such research questions not only would increase the discipline's knowledge base, but also would bring dental hygiene's unique perspective to interdisciplinary problem solving to improve the public's oral health.[4-7,10-12] At present, dental hygienists who wish to pursue a doctoral degree must do so outside the dental hygiene discipline as exemplified by the 29 dental hygienists with doctoral degrees who serve on the Editorial Review Board of the Journal of dental hygiene.[4-7,9,13] It is important to applaud these academically-motivated dental hygienists and recognize that the lack of dental hygiene doctoral programs did not stop them from achieving a doctoral degree in another discipline, from making significant contributions to the scientific literature, or from providing a potential pool of faculty for dental hygiene doctoral programs once established. Nevertheless, it also is important to recognize that if the dental hygiene discipline as a whole does not offer a doctoral degree in dental hygiene, then this omission will limit progress in the discipline by resulting in fewer passionate dental hygiene research scholars who ask and answer dental hygiene discipline-specific questions, and depriving them of a formal focused academic context within which to address discipline-specific problems.[5,6,12] Although one can make a contribution to the scientific literature without holding a doctoral degree, doctoral programs allow time and focused mentoring for the learner to acquire and hone re-

search and grant-writing skills enabling them to conduct research on a larger scale than research conducted by non-doctoral prepared researchers.

Currently, only Namseoul University in South Korea offers a PhD in dental hygiene. Two other dental hygiene doctoral programs are in the developmental stage: one in the U.S. at Idaho State University (Gurenlian, personal communication, September 2014) and one in Canada at the University of Alberta (Compton, personal communication, September 2014). As dental hygiene doctoral programs become established, it is reasonable to expect a significant part of their applicant pool would come from graduate learners enrolled in current dental hygiene master's degree programs. No published research, however, has been reported on perceptions of dental hygiene master's degree learners about dental hygiene doctoral education. Therefore, the research questions for this study are: What are the perceptions of U.S. dental hygiene master's degree learners about the need for, and importance of, dental hygiene doctoral education to the dental hygiene discipline and their interest in pursuing such a degree? To address these questions, we conducted an on-line survey in 2014 of dental hygienists enrolled in dental hygiene master's degree programs in the U.S.

Methods and Materials

Study Design and Population

This cross-sectional study surveyed all graduate learners enrolled in U.S. dental hygiene master's degree programs in 2014 to determine their perceptions of doctoral dental hygiene education. This study was approved by the Institutional Review Board, known as the Committee on Human Research (CHR), at the University of California, San Francisco (UCSF).

The Survey

The 10-minute self-administered confidential on-line survey was developed and delivered using the Qualtrics™ system, a web based software program.[14] The survey was pilot tested for face validity by a panel of 8 dental hygienists and revised based on feedback about clarity and length of survey items, and time required to complete the survey. The final survey consisted of 29 items that included 11 demographic items:

- Current enrollment in a dental hygiene master's program
- Format of their master's program (on-line, on-site or hybrid)
- Age
- Gender
- Race
- Year of graduation from entry-level dental hygiene program
- Type of entry-level dental hygiene credential awarded
- Year received baccalaureate degree
- Type of baccalaureate degree received
- Whether or not currently a dental hygiene educator
- A member of the American Dental Hygienists' Association (ADHA)

Table I: Research and Professional Doctoral Degrees in Other Health-related Disciplines

	Research Doctoral Degree	Professional Doctoral Degree
Nursing	PhD in Nursing	DNP (Doctorate of Nursing Practice)
Physical Therapy	PhD in Rehabilitation Science Program DPTSc (Doctorate of Physical Therapy Science)	DPT (Doctorate of Physical Therapy)
Audiology	PhD in Audiology	AuD (Doctor of Audiology)

All of these items were measured either by yes/no or multiple choice response options.

In addition, 18 items measured attitudes towards doctoral degrees in dental hygiene consisting of declarative statements related to:

- The importance of dental hygiene doctoral programs to the dental hygiene discipline and profession (measured on a 5-point Likert scale ranging from 1=Extremely Important to 5=Not at All Important)
- The need for dental hygiene doctoral programs for discipline progress
- General interest in applying to a dental hygiene doctoral program
- Interest in applying to a program that would award a PhD in dental hygiene or a Doctor of Dental Hygiene Practice (DDHP when the degree was defined, but not the program orientation and length)
- Perceived support by dental hygienists and dentists overall for PhD in dental hygiene and DDHP degree programs (all measured on a 5-point Likert scale ranging from 1=Strongly Agree to 5=Strongly Disagree)

In addition, later in the survey, 2 items asked about interest in applying to potential dental hygiene programs and related degrees that included the following program descriptions: a 3 to 5 year PhD doctoral dental hygiene program that would prepare dental hygiene researchers, and a 1 to 2 year Doctor of

Dental Hygiene Practice (DDHP) program that would prepare mid-level advanced dental hygiene practitioners able to provide care in a variety of settings under general supervision of physicians or dentists. These latter 2 items were measured on a 5-point Likert scale, ranging from 1=Very Likely to 5=Very Unlikely.

Three additional items were measured by multiple choice response options: 2 asked about format preferences for the PhD in dental hygiene and the DDHP programs, respectively (online, onsite or hybrid), and 1 item asked about when they thought they would apply to a doctoral degree program (in the next year, next 5 years, when a doctoral degree in dental hygiene program became available, never and I do not know).

Recruitment and Informed Consent

Initially, an email was sent to all 16 graduate dental hygiene program directors in the U.S. listed on the ADHA website, requesting the number of graduate learners enrolled in their program. All dental hygiene program directors responded reporting a combined total of 255 graduate dental hygiene learners enrolled in 2014. A subsequent email was sent to the same program directors to explain the study purpose and to request that they forward to their graduate dental hygiene learners an attached "learner recruitment/consent letter" with the survey link to complete the survey.

The "learner-recruitment/consent letter" explained the study purpose, methods, risks and benefits, and included the investigator's contact information to answer any study questions. It also instructed the graduate learner that clicking on the survey link within the letter would indicate their consent to participate in the study and allow them access to the survey.

The learner recruitment email also explained that as a token of appreciation for study participation, the researcher at the completion of the study would hold a raffle for a $100 Starbucks gift card. If they wished to participate in the raffle, the respondents were asked to include their email address in the last survey item.

Data Analysis

Responses to the surveys were tabulated for each respondent using Microsoft Excel, and the mean response frequency for each survey item was calculated. "Strongly Agree" and "Agree" response options were collapsed into one response category for analysis as were the response options "Strongly Disagree" and "Disagree" responses. In addition, "Extremely Important" and "Important" response options, and "Very Likely" and Likely" responses similarly also were collapsed respectively for analysis as were "Extremely Unimportant" and "Unimportant" and "Very Unlikely" and "Unlikely" responses.

Using the online software program Qualtrics™, cross-tabulations of participants s who stated they were "Very Likely" or "Likely" to apply to a specific doctoral degree program when available by respondent demographic characteristics were analyzed. Cross-tabulations of responses with "age" and "when the respondent thought they would apply to a doctoral program" also were analyzed.

Results

Of the 255 eligible graduate learners enrolled in 2014 reported by the program directors, 159 completed the online survey for a 62% response rate. Most respondents were female, Caucasian, ADHA members, received their baccalaureate degree in dental hygiene and attended an online master's program. Less than half were full-time or part-time dental hygiene educators. The largest age group was 24 to 34 years old (Table II).

The majority of respondents strongly agreed or agreed that the establishment of dental hygiene doctoral degree programs is important to the dental hygiene discipline and profession (Table III), that doctoral education in dental hygiene is needed, and they perceived that overall most dental hygienists would support a DDHP program or a PhD in dental hygiene program. In contrast, only 13% of respondents agreed that dentists would support a DDHP degree, and less than half (43%) agreed that dentists would be supportive of a PhD degree in dental hygiene (Table IV).

When asked a global question regarding interest in applying to a DDHP program or a PhD program in dental hygiene, 61% expressed interest in applying to a DDHP program, and 60% also expressed interest in applying to a PhD program. Only 15% of respondents had no interest in attaining any type of doctoral degree (Table IV). Half (50%) of respondents indicated that they would pursue a doctoral degree even if no dental hygiene doctoral degree program became available. Once descriptions of the DDHP programs and PhD in dental hygiene programs were provided later in the survey, however, the percentage of those likely to apply to a DDHP program slightly increased to 62%, but the likelihood of applying to a PhD program dropped to 38% (Table V).

Younger respondents, more recent dental hygiene entry-level graduates, and those with a baccalaureate degree in dental hygiene were more interested in applying to dental hygiene doctoral programs than older respondents, less recent graduates and those

with non-dental hygiene baccalaureate degrees respectively (Table VI). In addition, when asked reasons for pursuing a dental hygiene doctoral degree (Table VI), about one third of those "Very Likely or "Likely" to apply to the dental hygiene PhD program stated, "to become a better teacher" (31%) and "to become a better researcher" (27%). Reasons stated by almost half of those "Very Likely or "Likely" to apply to the DDHP program stated "to become a better teacher (44%), "to expand my clinical practice opportunities" (43%), and "to increase my salary" (39%). One-third stated "to become a better researcher" and to become a dental hygiene program director (31%).

For PhD in dental hygiene programs, most respondents (47%) preferred a hybrid online/onsite format; whereas for DDHP programs, two thirds (76%) of all respondents preferred a hybrid online/onsite format with clinical experience in a variety of settings (Table VII).

When asked about when respondents would apply to some type of doctoral degree program, 10% stated in the next year, 33% stated in the next 5 years, and 17% stated they would wait until a doctoral program in dental hygiene was established. Half (50%) of respondents indicated that they would pursue a doctoral degree even if no dental hygiene doctoral degree program became available. Of those interested in applying to a doctoral program in the next year to 5 years, 15% were between the ages of 24 to 34, 12% were between the ages of 35 to 44, 12% were between the ages of 45 to 54, and 3% were between the ages of 55 to 64 (Table VIII).

Discussion

In this study, the majority of U.S. dental hygiene master's degree learners enrolled in graduate programs in 2014 agreed that dental hygiene doctoral education is needed and is important to the dental hygiene profession. Moreover, over half of the respondents were interested in applying to a dental hygiene doctoral degree program when one became available, and almost half were interested in applying to such a program in the next 1 to 5 years. This interest in pursuing a doctoral degree was not limited to a specific age group since those interested ranged in age from 24 to 64 years. Although 17% of respondents reported willingness to wait until a dental hygiene doctorate degree program became available, 50% stated they would seek doctoral level education in another discipline if the dental hygiene discipline did not offer a doctoral degree.

Recently Namseoul University in Korea established the first PhD in dental hygiene program with 6 dental hygiene doctoral students currently enrolled.[15] With so many other professions moving to-

Table II: Percent and Number Related to Characteristics of Study Population

	Percent	n
Age (years) (n= 150)		
24 to 34	34	51
35 to 44	30	45
45 to 54	30	45
55 to 64	6	9
Gender (n=150)		
Male	3	5
Female	97	145
DH Educator (n=150)		
Yes	37	56
No	63	94
Race (n=149)		
White/Caucasian	87	130
African American	1	2
Hispanic	2	3
Asian	5	8
Native American	0	0
Pacific Islander	1	1
Other*	3	5
ADHA (n=150)		
Member	81	122
Non-Member	19	28
Type of Graduate Program (n=159)		
On-site	8	12
On-line	79	125
Hybrid on-site and on-line	14	22
Entry-level DH Credential (n=150)		
Certificate	3	4
Associate	63	94
Bachelors	35	52
DH entry-level graduation (year) (n=149)		
1970 to 1979	1	2
1980 to 1989	11	17
1990 to 1999	25	37
2000 to 2009	46	69
2010 to 2013	16	24
Year of Baccalaureate Degree (n=137)		
1980 to 1989	3	4
1990 to 1999	18	24
2000 to 2009	37	51
2010 to 2013	42	58
Type of Baccalaureate Degree (n=146)		
DH	66	97
Non-DH	27	39
No Baccalaureate Degree**	7	10

n values may vary due to missing data.
*Other included: Bi-racial, Arab, Asian Indian.
**One graduate program is a bridge program, which bypasses a baccalaureate degree.

Table III: Percent, Number and Mean Responses related to Respondents' Level of Perceived Importance* of Dental Hygiene Doctoral Education to Dental Hygiene Profession

Statement	Extremely important		Somewhat important		No opinion		Somewhat unimportant		Not important at all		
	Percent	n	Percent	n	Percent	n	Percent	n	Percent	n	Mean
How important to the dental hygiene profession is the establishment of dental hygiene doctoral degree programs? (n=154)	53	81	36	56	6	10	3	4	2	3	1.65

*Measured on a 5-point Likert scale where a score of 1="Extremely Important" and a score of 5="Not Important at All"

Table IV: Percent, Number and Mean Responses Related to Respondents' Level of Agreement** with Statements Related to Doctoral Dental Hygiene-Related Statements

Statement	Strongly Agree/ Agree		No Opinion		Disagree/Strongly Disagree		
	Percent	n	Percent	n	Percent	n	Mean
Doctoral dental hygiene education is needed (n=154)	77	118	14	21	10	15	1.97
If dental hygiene doctoral degree available, I would be interested in applying (n=154)	62	95	19	30	19	29	2.34
Most dental hygienists would support a DDHP program* (n=153)	78	118	13	20	9	15	1.95
Most dentists would support a DDHP program (n=152)	13	19	26	40	61	93	3.66
Most dental hygienists would support a PhD in dental hygiene program (n=151)	83	125	11	17	6	9	1.80
Most dentists would support a PhD in dental hygiene program (n=151)	43	65	26	40	31	46	2.97
If a DDHP program was available, I would be interested in applying (n=151)	61	92	21	31	18	28	2.35
If a PhD in dental hygiene program was available, I would be interested in applying (n=150)	60	91	19	28	21	31	2.35
Not interested in any type of doctoral degree (n=150)	15	23	17	25	68	102	3.87
If dental hygiene doctoral available, interested in doctoral degree other than dental hygiene (n=151)	22	32	26	40	52	79	3.44
If no dental hygiene doctoral available, interested in doctoral degree other than dental hygiene (n=150)	50	75	23	35	27	40	2.66

n values may vary due to missing data
*=Doctor of Dental Hygiene Practice
**Measured on a 5-point Likert scale where a score of 1="Strongly Agree" and a score of 5="Strongly Disagree"

wards doctoral education as their terminal degree, it is gratifying to see that dental hygiene has opened its first doctoral program. The findings support the need and demand for dental hygiene doctoral education in the U.S. and are consistent with published ideas related to the need for advanced education in dental hygiene beyond the master's degree.[4-10,16] For example, the 2005 ADHA report entitled, "Dental Hygiene Focus on Advancing the Profession," concluded that creating a doctoral degree program in dental hygiene was a major goal for dental hygiene education to assist in the advancement of the profession and to help meet the needs of the public.[17] Other reports in the literature have presented curriculum content needed for developing doctoral dental hygiene programs and have recommend that the ADHA create a task force to create such a curriculum, just as it did for the Advanced Dental Hygiene Practitioner (ADHP) model.[10,11,16,18]

Indeed, dental hygiene scholars have pointed out in the literature that dental hygiene doctoral degree programs would benefit the public's oral health not only by providing well qualified mid-level practitioners, but also highly qualified educators and researchers who would contribute to the knowledge-

Table V: Percent, Number and Mean Responses Related to Respondent Level of Likelihood*** of Applying to PhD or DDHP Programs Once Program Description Was Provided

Statement	Very Likely/ Likely		Undecided		Unlikely/Very Unlikely		
	Percent	n	Percent	n	Percent	n	Mean
Application to PhD in DH program* (n=150)	38	57	27	40	35	53	2.95
Application to DDHP program** (n=150)	62	93	20	30	18	27	2.37

*3 to 5 year PhD doctoral dental hygiene program that would prepare dental hygiene researchers, would be research based, and have online and on-site components, and take 3-5 years to complete
**1 to 2 year Doctor of Dental Hygiene Practice (DDHP) program that would prepare mid-level advanced dental hygiene practitioners able to provide care in a variety of settings (medical, dental, public health) under general supervision of physicians or dentists
***Measured on a 5-point Likert scale where a score of 1="Very Likely" and a score of 5="Very Unlikely"

Table VI: Participant Data Regarding Application to an Available Dental Hygiene PhD Program or an Available Doctorate in Dental Hygiene Practice (DDHP)

Characteristic	PhD in dental hygiene Percent (n) Responding "Very Likely/Likely"	DDHP Percent (n) Responding "Very Likely/Likely"
Age (n=150)		
24 to 34	15 (23)	25 (37)
35 to 44	11 (16)	17 (26)
45 to 54	10 (15)	15 (23)
55 to 64	2 (3)	5 (7)
Current dental hygiene Educator (n=150)		
Yes	15 (22)	23 (34)
No	23 (35)	39 (59)
Year of dental hygiene entry level Graduation (n=149)		
1970 to 1979	0 (0)	.6 (1)
1980 to 1989	4 (6)	7 (11)
1990 to 1999	10 (15)	13 (19)
2000 to 2009	17 (25)	29 (43)
2010 to 2013	7 (10)	12 (18)
Type of Baccalaureate Degree (n=150)		
dental hygiene	25 (37)	41 (61)
Non-dental hygiene	13 (19)	20 (29)
Reasons for pursuing a doctoral degree in dental hygiene*		
To become a better Teacher	31 (45)	44 (65)
To become a better Researcher	27 (39)	31 (46)
To increase my salary	21 (31)	39 (57)
To become employed in the oral health product industry	9 (13)	13 (19)
To become a dental hygienists program director	22 (33)	31 (46)
To expand my clinical practice opportunities	23 (34)	43 (63)

*Respondents were allowed to select more than one answer (n=147)

base related to oral disease prevention and health promotion.[9] In addition, by virtue of their advanced degree, dental hygienists with a doctoral degree in dental hygiene may have greater opportunity to participate on oral healthcare policy development committees at the local, state and national level. Bringing the doctoral-level dental hygiene perspective to the decision-making table would provide salient information to assist with addressing oral health care challenges associated with oral health disparities.

Study participants were asked about their perceptions in general of dentists' and dental hygienists' support of the proposed dental hygiene doctoral degree programs to explore potential perceived barriers. Although over half of the respondents believed dental hygienists would support both PhD in dental hygiene and DDHP programs, less than half agreed that most dentists would support the PhD in dental hygiene and only 13% agreed that most dentists would support DDHP programs. These findings of perceived less dentists' support for DDHP programs needs to be further explored in future qualitative studies of dentists and dental hygienists. A possible explanation for the finding of respondents' perceived lower support for DDHP programs by dentists may be due to expectations that dentists would perceive dental hygienists with a DDHP degree as unwanted competition. Indeed, the goal of DDHP programs would be to prepare advanced dental hygiene practitioners able to provide care in a variety of settings under general supervision of physicians or dentists. For example, graduates of DDHP programs could be educated to act as liaisons between medicine and dentistry in medical settings and thus could function as a source of new referrals to dentists. The literature supports profitability for dentists as a result of collaborating with dental hygienists in clinical practice.[19] It is important to note that about a quarter of respondents had no opinion about whether or not most dentists would support either the PhD or the DDHP programs suggesting a lack of an opportunity to discuss dental hygiene doctoral education with the dentists they know.

Findings from the current research also showed that most respondents were more interested in applying to a DDHP program than a research-focused PhD program once each type of degree program was described later in the survey. This finding might be explained by the fact that the DDHP would take less time than the PhD, and is consistent with our findings that almost half of the respondents reported pursuing a dental hygiene doctoral degree to expand their clinical practice opportunities.

The findings support the literature on the need to expand the role of dental hygienists and on the ever increasing need for evidence-based mid-level oral health care providers to help meet the oral health needs of the public.[4,6,8,16,18] The potential of a DDHP program to provide a new highly qualified midlevel oral health care provider is promising and is consistent with the need posed by the ADHA in 2008 for some type of midlevel provider, which they called the ADHP.[18] Since 2008, Minnesota and Maine both have approved midlevel oral health care provider categories, which require education beyond a basic preparation dental hygiene program required for a RDH license.[16,19] Yet each of these mid-level oral health care licenses is very different. Creating a DDHP program could help standardize mid-level provider educational standards for ADHP programs. Having both the PhD and the DDHP degrees available is consistent with research-oriented and applied degrees awarded in other disciplines such as the PhD and EdD in Education, the PhD and the Doctor of Nursing Practice (DNP) for Nursing, and the PhD and the Doctor of Physical Therapy (DPT) in Physical Therapy.

Table VII: Percent and Number of Responses Related to Participants' Preferences for Format of PhD in Dental Hygiene and DDHP (n=159)

	PhD in Dental Hygiene (n=152)	DDHP (n=152)
Program Formats*	Percent (n)	Percent (n)
On-line only	40 (61)	10 (15)
On-site	7 (11)	10 (15)
Hybrid on-line/on-site	47 (72)	76 (115)
I do not support	3 (4)	3 (5)
No opinion	3 (4)	1 (2)

*Measured by multiple choice items

Indeed, the ADHA has provided workshops such as "Dental Hygiene in a Changing World," that focus on expanded roles for dental hygienists requiring advanced education to augment their scope of clinical practice.[20] Others have described the need to develop a scholarly identity through doctoral dental hygiene programs that would provide more time for mentoring to develop skills and experiences needed to evolve into independent researchers, and leaders required for the continued development of the dental hygiene discipline.[10] Others also have highlighted potential roles for doctoral prepared dental hygienists to contribute to the advancement of the profession and the public's oral health by exercising leadership skills in research, education, private industry, health care administration and policy development.[4-6,8,9]

These study findings add to the current literature regarding doctoral education in dental hygiene and

Table VIII: Percent, Age and Number of Participant Responses to the Question "When Do You Think You Might Apply to a Doctoral Degree Program?" (n=150)

	Age (years) of Respondents									
	24 to 34		35 to 44		44 to 54		55 to 64		Total	
Statement	Percent	n	Percent	n	Percent	n	Percent	n	Percent	n
In the next year	2	(3)	3	(4)	3	(5)	2	(3)	10	(15)
In the next 5 years	13	(20)	9	(14)	9	(13)	1	(2)	33	(49)
When a doctoral program in DH becomes available	6	(9)	5	(8)	4	(6)	1	(2)	17	(25)
I am not planning on applying to a doctoral degree program ever	4	(6)	6	(9)	7	(10)	1	(1)	17	(26)
I don't know	9	(13)	7	(10)	7	(11)	1	(1)	23	(35)

contribute to the rich context that informs the doctoral education discussion moving forward. To add to this on-going discussion, future qualitative research is needed to explore reasons dental hygiene masters degree students would be interested in applying to either a PhD in dental hygiene or DDHP program. Our findings indicate that about a quarter of the respondents were undecided about applying to any doctoral program; and when asked why they would apply to a dental hygiene doctoral program, less than half (48%) stated "to become a better researcher." Moreover, future research is needed among current dental hygienists with doctoral degrees in other disciplines to explore their perceptions about doctoral dental hygiene education.

In the current study, most respondents preferred a hybrid on-line/on-site format for both the PhD in dental hygiene and DDHP programs. This finding is interesting because most respondents were enrolled in on-line masters degree programs. Additional research is needed to identify program formats that would be appropriate.

Limitations: There are several limitations. First, although the entire population of U.S. learners in dental hygiene master's degree programs enrolled in 2014 were surveryed, the findings are limited to that specific group and cannot be generalized to other dental hygienists who may have very different thoughts about doctoral dental hygiene education. In addition, although there was a 62% response rate, individuals who responded may have been more positively disposed toward dental hygiene doctoral education than those who did not respond. These findings also may be limited by the methodology that relied on the master's degree program directors to forward the study survey to their learners. The biggest challenge to conducting the study was not being able to have direct e-mail contact with the population attempting to be surveyed. The authors relied on the master's program directors to forward the survey twice and may have added to the burden of the program directors such that some may have not had time to send out the survey especially for a second time. Finally, although the survey was pilot tested for face validity and clarity of the items, it was not measured for reliability and therefore is unable to account for the effects of fatigue or guessing related to responses.

Conclusion

The findings indicate that dental hygiene master's degree learners enrolled in 2014 were interested in and supported dental hygiene doctoral education and thought it is very important to progress in the dental hygiene discipline. These findings also suggest that DDHP programs may be more popular than PhD programs since many study participants were interested in expanding clinical practice through doctoral education. Future qualitative research is needed to explore reasons dental hygiene masters degree learners would apply to either a PhD in dental hygiene or DDHP program, and to explain their perceptions of dentists support for these programs. Moreover, future research is needed among current dental hygiene educators, clinicians and dental hygienists with doctoral degrees to explore their perceptions about doctoral dental hygiene education.

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Knowledge, Perceived Ability and Practice Behaviors Regarding Oral Health among Pediatric Hematology and Oncology Nurses

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Abstract

Purpose: Oral complications are common in children undergoing head and neck radiation and chemotherapy. The purpose of this study is to examine the knowledge, perceived ability and practice behaviors of pediatric oncology and hematology nurses in assisting with the various oral health care needs of pediatric oncology patients and to identify pediatric oncology nurses' previous training/education, practice types and other demographic characteristics that are related to their oral health competencies.

Methods: A survey of a convenience sample of Pediatric Oncology and Hematology Nurses was conducted during the Association of Pediatric Oncology and Hematology Nurses' (APHON) 36th Annual Conference and Exhibit. Descriptive analysis and the exploratory factor analyses were performed using SAS version 9.2 (SAS Institute, Inc., Cary, NC).

Results: Among the 300 surveys that were distributed, 235 surveys were completed (78% response rate) by pediatric oncology or hematology nurses who provide direct patient care in the U.S. Approximately 75% reported receiving less than 3 hours of oral health related education/training. Sixty percent did not have a clinical requirement regarding the assessment of the teeth and gums during their nursing school education. Bivariate analyses indicated that nurses who had clinical requirements regarding oral health assessment during nursing education/training presented greater overall oral health competencies including having greater confidence in examining oral complications than those who did not.

Conclusion: Pediatric oncology nurses' knowledge, perceived ability and practice in assisting patient's oral hygiene care, preventing and managing oral complications vary by topic and might reflect their educational preparedness. This study may provide valuable information pertaining to the need and opportunity for interprofessional oral health care education and collaboration with nursing and dental professionals, in order to increase access to comprehensive oral care for pediatric cancer patients.

Keywords: knowledge, nurse, oral health, pediatric oncology, perceived ability, practice behaviors

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

Introduction

Information gathered from the National Cancer Data Base (NCDB) and the Surveillance, Epidemiology, and End Results (SEER) registries, both of which collect data relating to the diagnosis and treatment of individuals with cancer, reveal that there were an estimated 13.7 million Americans with a history of cancer alive on January 1, 2012. The population of cancer survivors is projected to increase to nearly 18 million by January 1, 2022.[1] Although childhood cancers, from birth to age 14, are considered rare, affecting less than 1% of all new cancer diagnoses, nearly 59,000 Americans are survivors of childhood cancers.[1] Improved survival rates are largely due to newly implemented aggressive treatment strategies.[2] It is predicted that nearly 80% of children diagnosed with cancer in 1990 will survive into adulthood due to these treatment modifications.[2-4] But, these new cures may be associated with long-term effects that have adverse effects on the quality of life of survivors.[2]

Oral complications, such as mucositis, herpes simplex virus (HSV) infections, erythematous or pseudomembranous candidiasis, xerostomia, dental caries, and dental anomalies are common in children undergoing head and neck radiation and chemotherapy due to compromised immune systems, damage to salivary glands and/or developing dentition.[2,5-8] As oral complications persist with chemotherapy or radiation therapy and worsen with prolonged treatment, patients may experience debilitating pain when performing simple tasks, such as eating, drinking and/or talking.[5,9] Secondary to this debilitating pain in the mouth and compromised nutrition, patients may also

experience delayed wound healing, decreased treatment effects and diminished quality of life.[5,10,11]

It is widely accepted throughout the literature that basic oral hygiene practices, such as brushing, flossing and using mouth rinses help in reducing the oral microbial flora in the mouth and preventing oral complications associated with the treatment of cancer.[12,13] Furthermore, early and radical professional dental intervention reduces the frequency of problems, minimizing the risk for oral and associated systemic complications.[14-18] Therefore, it is recommended that all newly diagnosed pediatric oncology patients seek early dental consultation to allow adequate time for necessary dental care to be completed prior to initiating cancer therapy and continue to place emphasis on preventive interventions.[14]

Nurses are often frontline clinicians who triage outpatient's conditions and needs and spend more time with inpatients and their families than do physicians. In the pediatric oncology unit, nurses may firsthand see the incidence of oral complications that may affect patients' quality of life and treatment success.[10] Baseline surveys from 2 demonstration projects, whose purpose was to eventually develop an oral care protocol for use in cancer care units in the U.S., indicated that nurses were capable of identifying simple oral complications, such as mucositis and oral candidiasis, but were not able to diagnose more severe oral complications, such as xerostomia.[19,20] These studies also found that the nurses lacked current knowledge on oral care recommendations for pediatric oncology patients and were not performing oral assessments and referrals on a regular basis.

It is important to determine the need and opportunity for interprofessional oral health care education and collaboration in order to increase access to comprehensive oral care for pediatric cancer patients. Therefore, the purpose of this study was to examine the knowledge, perceived ability and practice behaviors of pediatric oncology and hematology nurses in assisting with the various oral health care needs of pediatric oncology patients and to identify their training/education, practice types and other demographic characteristics that are related to their oral health competencies.

Methods and Materials

This cross-sectional survey research study was approved by the Biomedical Institutional Review Board of the University of North Carolina at Chapel Hill (UNC-CH). The survey instrument was developed with input from questionnaires used in 2 previous studies,[19,20] input from 3 committee members (1 pediatric dentist, 1 general dentist and 1 dental hygienist), a survey methodology consultant from the H.W. Odum Institute for Research in Social Science at UNC-CH, and the recommendations set forth by the American Academy of Pediatric Dentistry (AAPD).[21] The survey included 21 questions that solicited demographic and practice information; knowledge, practice behaviors, and their reported confidence to assist with the oral health care needs of pediatric oncology patients, which were intended to measure the nurses' oral health competencies. The survey instrument was pilot tested by 2 pediatric oncology nurses and their suggestions were incorporated in the final survey. A scannable TeleForm questionnaire was developed by the UNC School of Dentistry Data Coordinating and Statistical Consulting Unit to reduce potential entry errors.

Three hundred surveys were distributed to a convenience sample of nurses at a booth in the exhibit hall during the Association of Pediatric Hematology and Oncology Nurses' (APHON) 36th Annual Conference and Exhibit on October 4 to 6, 2012 in Pittsburgh, Pennsylvania. The APHON is a professional organization for pediatric hematology/oncology nurses and allied health care professionals, and it currently has approximately 3,381 active members. By the last day of the conference, 272 surveys were returned.

Data Analysis

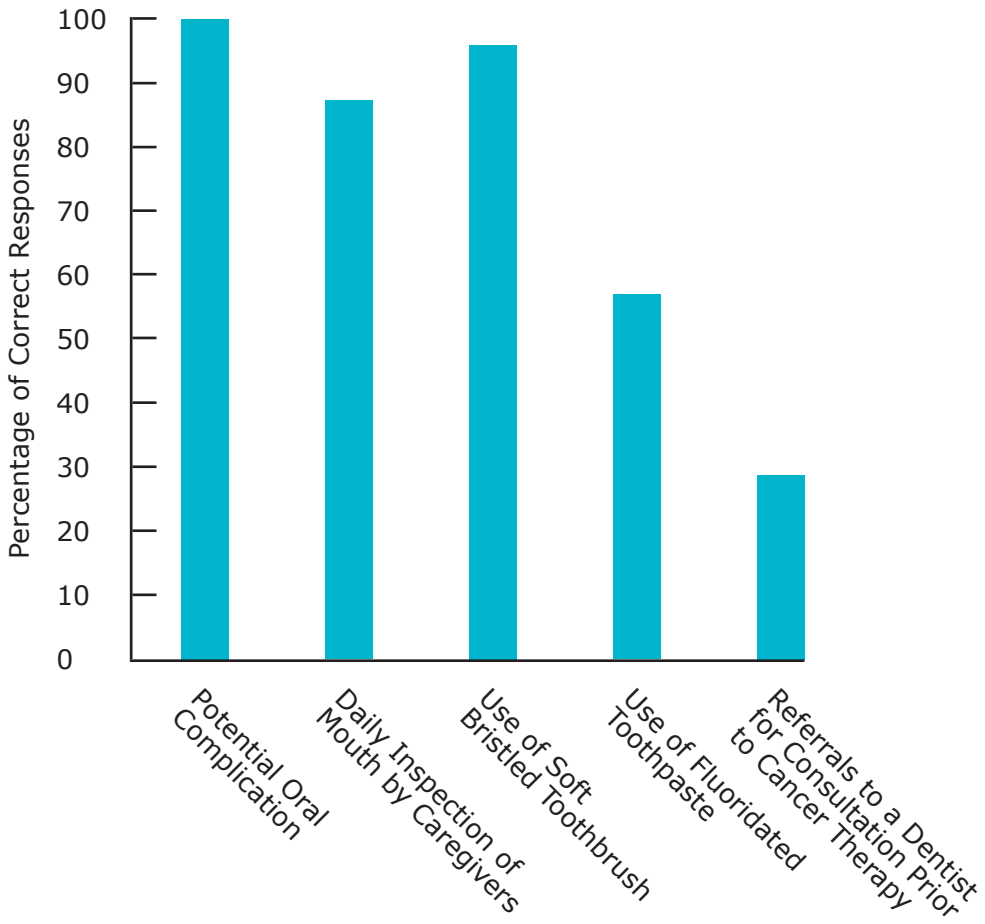
The data were analyzed using SAS version 9.2 (SAS Institute, Inc., Cary, NC). Frequencies were computed to summarize demographics and practice characteristics as well as knowledge, confidence and practice behaviors of pediatric oncology nurses with regard to oral health. Exploratory factor analysis was used to identify the factor pattern and domain of question items measuring the nurses' oral health competencies. Chronbach's alpha ranged from 0.7 to 0.95 for the 6 domains identified for nurses' perceived ability and practice behaviors. Among 5 oral health related knowledge questions shown in Figure 1, the knowledge items listed as "daily inspection of mouth by caregivers," "use of fluoridated toothpaste" and "referrals to a dentist prior to cancer therapy" appeared to form a domain, thus included in the further analysis. Bivariate analyses were conducted with the Mantel-Haenszel test to identify the pediatric oncology nurses' previous training/education, practice types and other demographic characteristics that were associated with the 7 domains of oral health competencies, with statistical significance set at $p<0.05$.

Results

Of the 272 surveys that were returned, 235 surveys were completed by those who are currently employed as a pediatric oncology, pediatric oncology or hematology nurse, giving a response rate of 78%. The demographic and professional characteristics of the survey respondents are summarized in Table I. The majority of the respondents were women (97%) and reportedly work 36 hours or more a week (70%). Slightly more than half of respondents work as certified pediatric oncology/hematology nurses and have

been employed as a pediatric oncology nurse for 10 or more years (54% and 53%, respectively). Approximately 75% of the respondents reported receiving 3 hours or less of education and/or training related to oral health care in nursing school, and about 60% did not have a clinical requirement regarding the assessment of the teeth and gums during their nursing school education. While 91% of survey respondents expressed a desire to take continuing education (CE) courses relating the oral health care for pediatric oncology patients in the future, only 25% had taken such a CE course in the last 5 years.

Figure 1: Knowledge of Oral Health Care Recommendations for Pediatric Oncology Patients among Survey Respondents (n=235)



Knowledge

The majority of respondents were aware of potential oral complications related to cancer treatment (100%) and professional oral health care recommendations for pediatric oncology patients such as the use of a soft bristled toothbrush (97%) and daily inspection of the child's mouth by his/her caregivers to determine the presence or absence of oral complications (87%) (Figure 1). However, the use of fluoridated toothpaste and referrals to a dentist for consultation prior to cancer treatment received lower rates of correct responses (57% and 29%, respectively). Overall, only 14% of survey participants responded correctly to all informative questions that assessed their knowledge of oral health care recommendations for pediatric oncology patients undergoing cancer treatment.

Perceived Ability

The majority of the respondents reported that they are comfortable performing oral procedures on patients (77%), and are adequately trained to provide oral health care instructions/education to patients (72%) and to perform oral care procedures (84%). When asked about their level of confidence in performing various oral health related tasks for pediatric oncology patients, more than 70% of survey respondents were reportedly very confident in examining for the presence of oral pain, providing oral hygiene instructions, and discussing the importance of seeking routine professional dental care (Figure 2). However, less than half of respondents reported that they were very confident in their ability to examine the health of teeth and gums for complications of trismus, dysphagia, and xerostomia.

Practice Behaviors

While more than 60% of respondents reported examining all of their patients for the presence of oral pathology or oral pain (63% and 69%, respectively), about half of survey participants examine all of their pediatric oncology patients' teeth and/or gums, detect dysphasia, and provide instructions for oral hygiene care and management of oral complications (Figure 3). Only about 40% or less of respondents reported examining all patients for the presence of xerostomia, trismus, and discussing the importance of seeking routine professional dental care.

Figure 4 shows survey respondents' practice of patient referrals to dental professionals. More than one-third of survey respondents reported referring patients to dental professionals prior to the initiation of cancer treatment and/or during cancer treatment (39% and 31%, respectively). Twenty percent

of survey respondents reported never referring patients to dental professionals.

Oncology Nurses' Demographic Characteristics and Oral Health Competencies

Extracted outcomes of bivariate analyses are shown in Tables II to IV. Overall, nurses' characteristics such as having had a clinical requirement regarding oral health assessment during nursing education/training, having taken oral health related CE courses in the past 5 years, and number of years worked as a pediatric oncology nurse were associated with domains of oral health competencies. Survey respondents who had a clinical requirement regarding oral health assessment during nursing education presented greater oral health related knowledge and confidence in examining patient's mouth, detecting oral complications and providing oral care management while they were also likely to provide oral care instructions and examine the patient's mouth more often than those who did not ($p<0.02$). History of having taken an oral health related CE course in the past 5 years was associated with all domains of oral health competencies except for the domains of practice of and confidence in examining for oral complications ($p<0.007$). The level of oral health related knowledge, confidence and practice were greater among survey respondents who worked as a pediatric oncology nurse for a longer time than those with a shorter history of specialty practice ($p<0.05$). However, no difference was observed in the confidence in and practice of examining for oral complications such as xerostomia, dysphagia and trismus with the length of professional work experience as a pediatric oncology nurse ($p>0.1$). More nurses who work full-time in direct patient care and have a source for dental referrals responded to oral health knowledge questions correctly than those who don't work full-time in direct patient care. Job title, such as whether they were a certified oncology nurse or not, as well as hours spent in oral health education/training during nursing school were not associated with oral health competencies.

Discussion

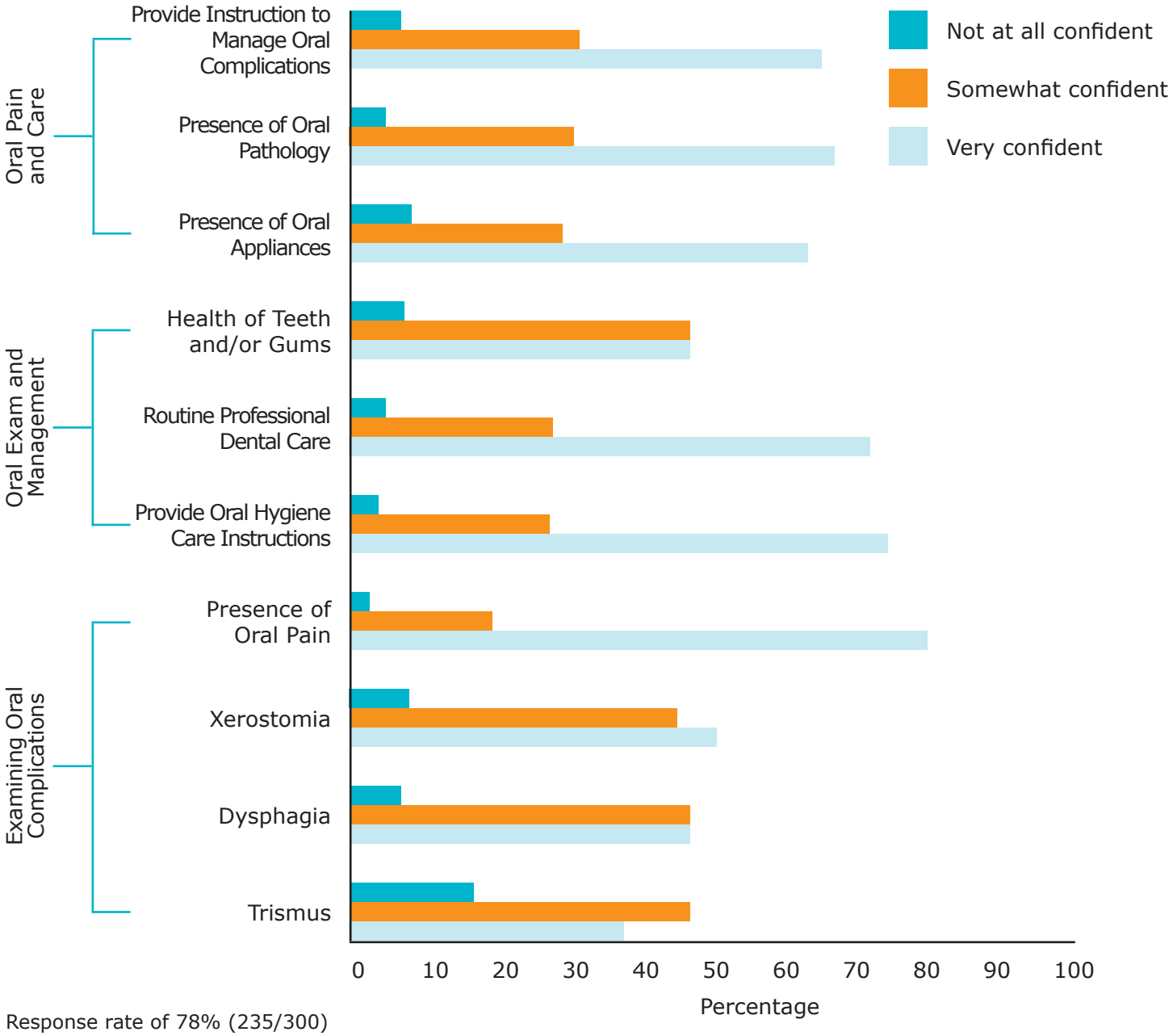
This study identified gaps in pediatric oncology nurses' knowledge, confidence and practice in assisting with the oral health care needs of their patients, depending on the area of oral health topic assessed and the survey respondents' educational background. In conjunction with the findings from previous studies, the data implied that pediatric oncology nurses are learning in the field about oral health and oral complications among pediatric oncology patients as opposed to having been formally trained in this health knowledge area in nursing school. Most of the survey respondents reported having received less than 3 hours of formal training and/or education re-

Table I: Demographic and Professional Characteristics of the Survey Participants (n=235)*

	n**	Percent (%)
Gender		
Male	6	2.6
Female	226	97.4
Job title		
Certified oncology/hematology nurse+	126	53.6
Others++	109	46.4
Years employed as a pediatric oncology nurse		
3 years or less	29	13.4
4 to 10 years	74	34.1
10 years or more	114	52.5
Hours/week worked in direct patient care		
<36 hours	62	30.4
>36 hours	142	69.6
Have a resource of referrals, dentist(s)/dental office(s), for patients with severe oral complications		
Yes	139	59.7
No	94	40.3
Hours of education/training related to oral health care in nursing school		
3 hours or less	169	74.5
>3 hours	58	25.5
Clinical requirement regarding the assessment of the teeth and gums during nursing education and/or training		
Yes	92	39.7
No	140	60.3
Has taken a CE Course relating to oral health care for pediatric oncology patients in the last 5 years		
Yes	58	24.9
No	175	75.1
Desire to take CE Courses relating to oral health care in the future		
Yes	211	90.6
No	22	9.4

- *Response rate 78% (235/300)
- **Total may not add up to N because of missing data
- +Includes certified pediatric oncology nurse (CPON), oncology certified nurse (OCN), and certified pediatric hematology oncology nurse (CPHON)
- ++Includes registered nurse (RN), nurse practitioner (NP), certified pediatric nurse (CPN), certified pediatric nurse practitioner (CPNP), certified family nurse practitioner (CFNP)

Figure 2: Perceived Ability in Performing Oral Health Related Tasks on Pediatric Oncology Patients among Survey Respondents (n=235)



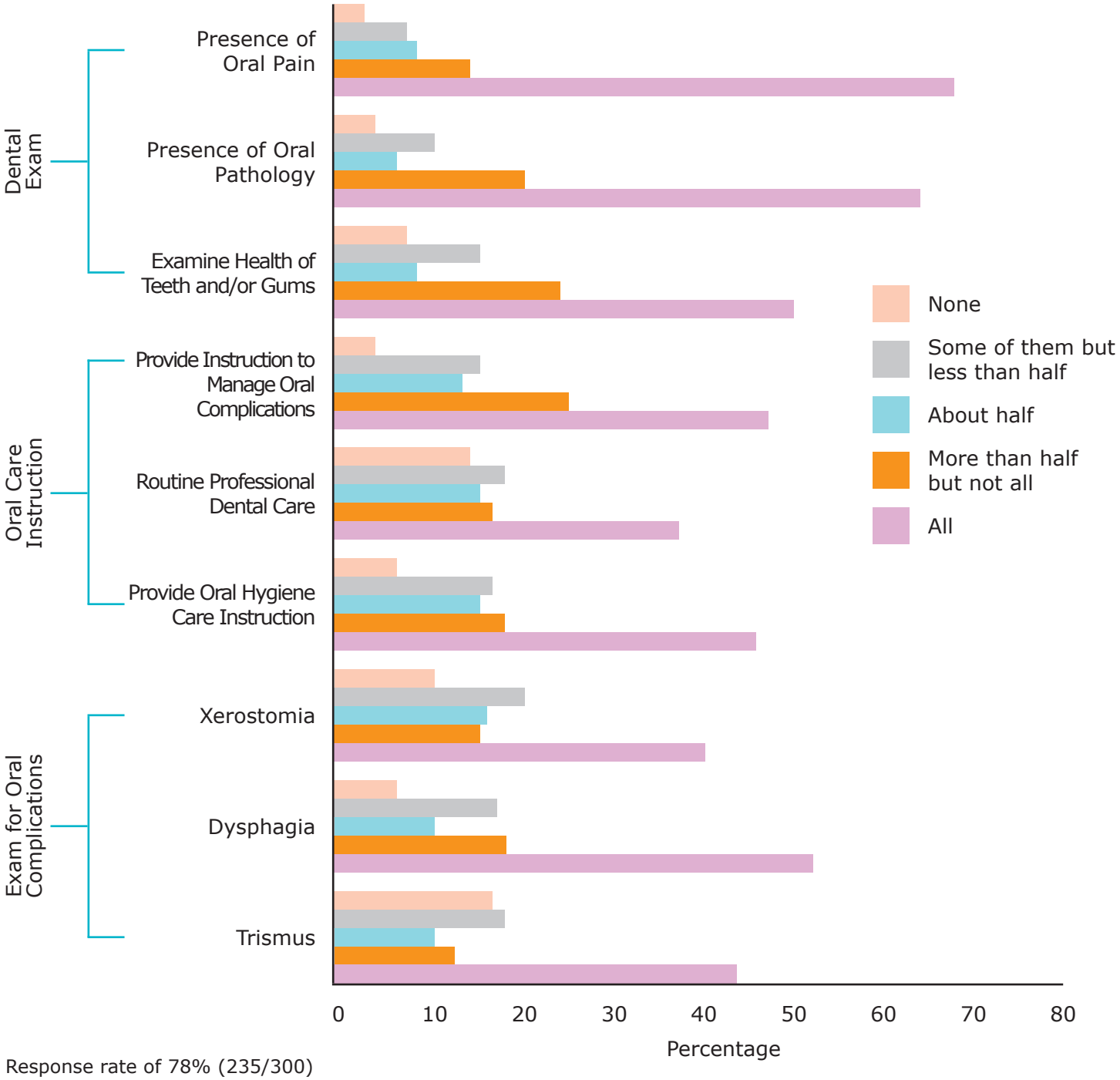
Response rate of 78% (235/300)

lating oral health care, nor did they have a clinical requirement regarding the assessment of the teeth and/or gums, while in nursing school. This study revealed that overall oral competencies were greater among individuals who had worked longer as an oncology nurse.

Previous studies have surveyed internists and endocrinologists, nurse practitioners and nurse midwives, and diabetes educators to determine their knowledge, opinions and behaviors regarding periodontal disease and adverse health outcomes.[22-24] Owens et al found that internists and endocrinologists knowledge about periodontal disease was high, but they lacked training and education relating to periodontal disease and oral health care.[22] Wooten et al found that nurse practitioners and certified nurse midwives had limited knowledge about periodontal disease and oral health care.[23] Lopes et al found that the majority of diabetes educators had no formal education and/or training related to oral health care, nor did they have any continuing education once they began their careers.[24] All 3 studies suggested that a collaborative effort between health care providers and dental professionals would positively benefit patients in various areas of the healthcare system.[22-24]

While on-the-job training or taking CE courses may improve oncology nurses' confidence and practice behavior of providing oral exams and oral care

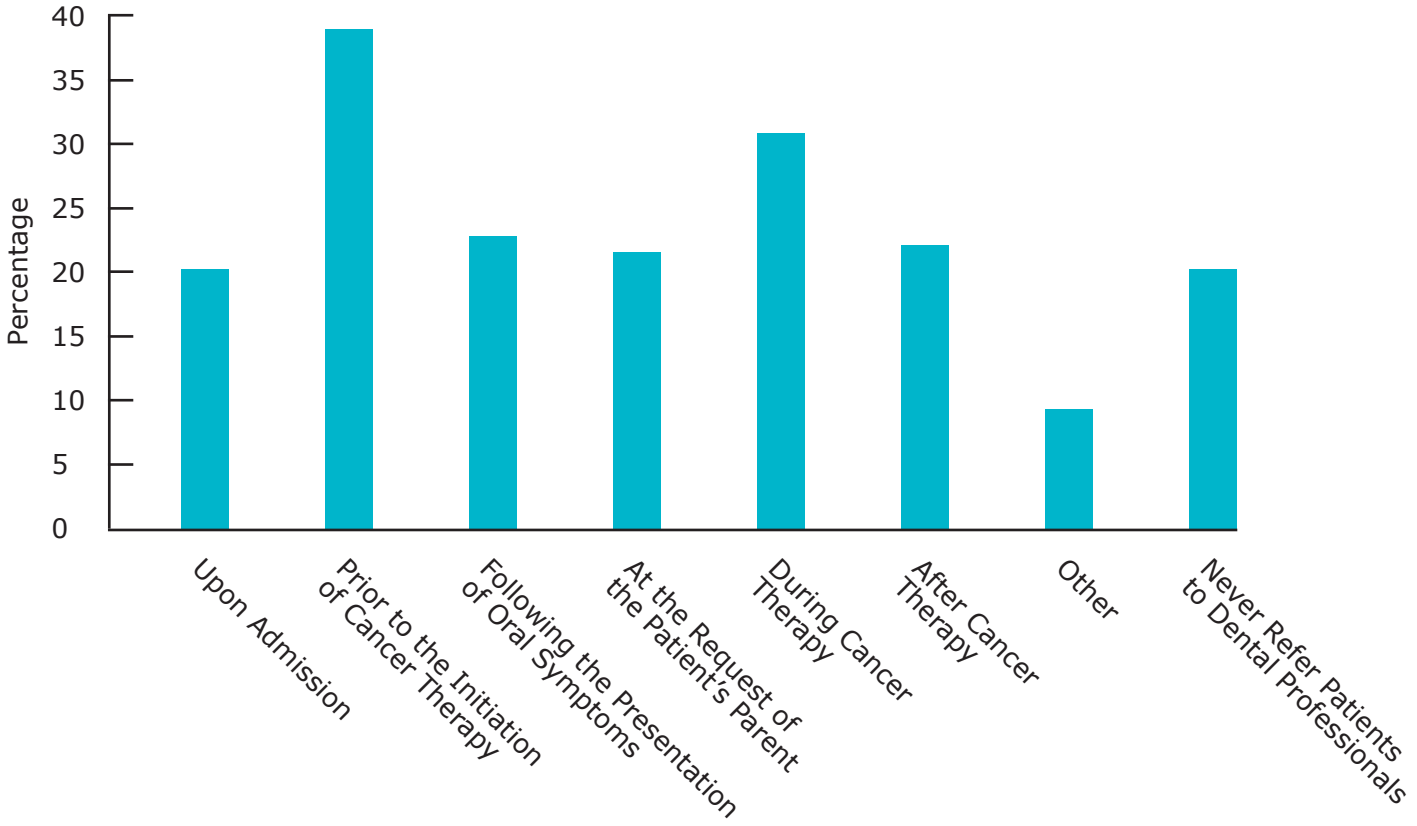
Figure 3: Frequency of Performing Oral Health Related Tasks on Pediatric Oncology Patients among Survey Respondents (n=235)



Response rate of 78% (235/300)

instructions over time, the data suggests that these factors may not sufficiently improve confidence and practice related to oral complications among nurses. Confidence and practice behaviors related to examination for oral complications (i.e. xerostomia, dysphagia, trismus) were greater among survey respondents who had oral health related clinical requirements during nursing school than those who did not. Previous studies also found that while nurses could readily identify simple oral complications, they could not diagnose or treat more severe oral complications prior to the implementation of a structured oral health protocol and receiving additional training in children's hospitals.[19] These findings thus indicate the importance of incorporating oral health education and/or training into nursing schools' curricula and finding innovative ways to motivate nurses to adhere to evidence-based oral health care recommendations for pediatric patients who undergo cancer treatment. Although only less than 25% of survey respondents reported having taken a CE course relating to oral health care in the last 5 years, it is encouraging that almost all survey participants (91%) desire to take a CE course relating to oral health care in the future.

Figure 4: Stage in Which Survey Respondents Usually Refer Pediatric Oncology Patients to a Dental Professional (n=235)



Response rate of 78% (235/300)
Percentages do not add up to 100% because multiple choices were given

The Institute of Medicine (IOM) report in 2011, *Advancing Oral Health in America*, states that "Nurses, physicians, and other health care professionals have generally not been trained in providing oral health services or screenings. In addition, dental professionals are generally educated and trained separately from other health care professionals, which reinforces the separation of care as well as lack of training in appropriate referrals between professionals."[25] As the complexity of health care continues to increase, it has been recommended that health care providers learn to work more collaboratively in order to provide quality care.[26] It has been shown that interprofessional collaboration, with nursing and dental professionals, positively affects quality of care, patient satisfaction, effectiveness of health care services, health care costs and communication among health care professionals.[26-28] In order to improve compliance with evidence-based recommendations, perceived abilities and practice behaviors of pediatric oncology nurses as related to oral health care, an interprofessional approach with emphasis placed on implementing an oral health care protocol and continuous staff education and training at each pediatric oncology unit might be important.

Strengths of this study include the broader geographic representation of pediatric oncology and hematology nurses. While 2 similar previous studies

Table II: Quantile for Domain of Oral Health Related Knowledge by Survey Respondents' Background Characteristics (n=235)

	Oral Health Related Correct Knowledge		
	25%	Median	75%
Had a clinical requirement regarding the assessment of teeth and gums during nursing school			p<0.05
Yes	1	2	2
No	1	2	2
Have taken a CE Course relating to oral health care in the past 5 years			p<0.05
Yes	2	2	2
No	1	2	2
Years worked as an oncology nurse			p<0.001
<3 years	1	1	2
4 to 10 years	1	2	2
>10 years	1	2	2

Knowledge was measured as a score for true/false or multiple choice questions: correct answer=1 vs. incorrect answer=0

Table III: Quantile for Domains of Confidence in Performing Oral Health Related Tasks by Survey Respondents' Background Characteristics (n=235)

	Confidence								
	Examining for oral complications			Oral exam and management			Oral pain and oral care		
	25%	Median	75%	25%	Median	75%	25%	Median	75%
Had a clinical requirement regarding the assessment of teeth and gums during nursing school									
			p<0.05						p<0.001
Yes	1	1.67	2	1	1	1.33	1	1.25	1.5
No	1	1.67	2	1	1	1.33	1.25	1.5	1.75
Have taken a CE Course relating to oral health care in the past 5 years									
						p<0.05			p<0.001
Yes	1	1.33	2	1	1	1	1	1	1.5
No	1	1.67	2	1	1	1.67	1	1.5	1.75
Years worked as an oncology nurse									
						p<0.05			p<0.05
<3 years	1.42	2	2	1	1.33	2	1.5	1.5	1.75
4 to 10 years	1	1.67	2	1	1	1.33	1	1.5	1.75
>10 years	1	1.67	2	1	1	1.33	1	1.25	1.75

Perceived ability was measured in 3-point Likert scale ranging from 1=very confident, 2=somewhat confident, and 3=not at all confident

Table IV: Quantile for Domains of Performing Oral Health Related Tasks by Survey Respondents' Background Characteristics (n=235)

	Practice								
	Examinations for oral complications			Dental exams			Oral care instructions		
	25%	Median	75%	25%	Median	75%	25%	Median	75%
Had a clinical requirement regarding the assessment of teeth and gums during nursing school									
						p<0.05			p<0.05
Yes	1	1.67	3	1	1	2	1	1.33	2.67
No	1	2.33	3.67	1	1.67	2.33	1.33	2.33	3.33
Have taken a CE Course relating to oral health care in the past 5 years									
						p<0.05			p<0.05
Yes	1	1.67	3	1	1	1.67	1	1.33	2.33
No	1	2.17	3.67	1	1.67	2.33	1.33	2.33	3.33
Years worked as an oncology nurse									
						p<0.05			p<0.001
<3 years	1.67	2.83	3.67	1.17	2	3.33	1.67	3	4
4 to 10 years	1	2	3.33	1	1.33	2	1.33	2.17	3
>10 years	1	2	3.33	1	1	2	1	1.83	2.67

Frequency of practice was measured in 5-point Likert Scale ranging from 1= all patients, 2= more than half of patients, 3= about half of patients, 4= less than half patients, and 5= no patient

surveyed pediatric oncology nurses in local institutions, the current study was able to capture nurses from various geographic regions, which was identified by the mailing addresses respondents placed on the raffle tickets. Respondents also included those with various certifications and differing educational backgrounds and training. The limitation of this study includes missing data found in various sections of the survey which made performing multivariable analysis infeasible. Furthermore, the attendees of the professional meeting may be more involved in educational activities than those who do not attend. Therefore, the findings of this study may not be representative of all U.S. pediatric hematology and oncology nurses nor all the member of the APHON professional organization. Lastly, although the study identified several domains related to oral health knowledge, perceived ability and practice behaviors in assisting pediatric oncology patients, there was no validated tool available to measure oral health competencies of oncology nurses when we conducted this study. Despite this, we provided initial evidence of the domains of oral health competencies among pediatric oncology nurses and gained insight into the type of demographic characteristics of nurses that may influence their knowledge, confidence and practice behaviors in assisting child patients' oral health needs.

Conclusion

Pediatric oncology nurses' knowledge, perceived ability, and practice behaviors in assisting patient's oral hygiene care and preventing and managing oral complications vary by topic and might reflect their educational preparedness. Interprofessional collaboration between dental and nursing schools in provider training as well as institutional efforts in implementation of evidence-based oral health practices might be needed in order to improve pediatric cancer patients' and survivors' oral health.

Antiana Perry, BSDH, MS, completed this project in partial fulfillment of the Master of Science degree in Dental Hygiene Education at the University of North Carolina Chapel Hill School of Dentistry. Hiroko Iida, DDS, MPH, is currently a director of the New York State Oral Health Center of Excellence and was an assistant professor at UNC Department of Pediatric Dentistry when this study was conducted. Lauren Patton, DDS, is a Professor and Department Chairperson of the Dental Ecology Department. Rebecca S. Wilder, RDH, MS, is a Professor and Director of Graduate Dental Hygiene Education and also Director of Faculty Development at the University of North Carolina Chapel Hill School of Dentistry.

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Oral Care in the Long-Term Care of Older Patients: How Can the Dental Hygienist Meet the Need?

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Abstract

Purpose: It is estimated that the older population, aged 65 and older, will make up over 20% of the U.S. population by the year 2030. Research acknowledges about 4% of the older population resides in long-term care facilities (LTCFs), where the long-term older patient (LTOP) is under the formal supervised care or custody of institutions with skilled nurses. By the year 2040, 4 million geriatric residents are predicted to move into LTCFs in the U.S. In 2000, the Surgeon General reported LTOPs in LTCFs have greater oral hygiene needs than any other segment of the population to include: root caries, periodontal disease, xerostomia, fungal infections and other oral health concerns. Serious systemic health conditions occurring at high incidence rates have been linked to poor oral hygiene in the LTOP. The purpose of this manuscript is to identify systemic health conditions, oral health conditions, barriers to oral care for LTOPs and to offer recommendations for increased access to care within LTCFs through the use of registered dental hygienists (RDHs).

Keywords: geriatric, dental, elderly, dental care, long-term care, dental hygiene, oral health and systemic disease

This study supports the NDHRA priority area, **Health Services Research:** Determine the extent to which dental hygienists' working in collaborative practice settings with other health professionals or organizations improves the cost-effectiveness and quality of health care outcomes.

Introduction

Thirteen percent of the U.S. population is considered older, or over the age of 65, with increases expected to reach 20% by 2030, or 92 million Americans.[1,2] Data from the most recent 2010 census revealed that the older population is increasing 15% more than the overall U.S. population.[3] Currently, about 4% of older Americans reside in long-term care facilities (LTCFs); in 2007 alone, there were 15,827 LTCFs providing 24-hour care by nurses and other staff members to oversee and monitor health care needs.[4] It is estimated that 63% of the total number of patients residing in LTCFs are older, and by 2040, 20% of older Americans will require long-term care.[5-7]

Several limitations exist within LTCFs related to oral hygiene, since many long-term older patients (LTOPs) are medically compromised and are unable to provide oral hygiene self-care.[8] Older adults retain 26 or more teeth throughout their lifetime, typically losing 6 teeth or less; only one-fourth of the older population is fully edentulous.[6,7] Literature confirms that the high incidence of certain systemic conditions in the LTOPs may be linked with poor oral hygiene, which include: diabetes, cardiovascular diseases, nursing home aspiration pneumonia and physical/mental disorders.[9-12] As LTOPs increase, oral health care for this disparaged population must become a priority with registered dental hygienists (RDHs) playing a larger role in the acquisition of care. There is a great need for LTCFs to employ RDHs to provide preventive and therapeutic oral care to these patients with the intent of reducing both oral health disease and systemic health conditions. The purpose of this manuscript is to identify systemic health conditions, oral health conditions, and barriers to oral care within LTOPs and to offer recommendations for increased access to care within LTCFs through utilization of RDHs.

Systemic Health Concerns

Type I and Type II diabetes affects approximately 25% of LTOPs, and researchers predict the greatest increase will occur in the 75 and older age group over the next 40 years.[13,14] Concern for the LTOP with diabetes exists due to age-related complications that affect treatment and comorbidities such as polypharmacy, renal insufficiency, increased fall risk, visual impairment, and cognitive impairment.[14] Unique guidelines have been established for treating LTOPs with diabetes based on life expectancy, cognition, and medication regimens for dental professionals.[13] Medications are a difficult treatment option as they cannot always be prescribed to the LTOP due to compromised metabolism and risk of multiple drug interactions.[13] A recent report stated that diabetics were 28% more likely to become fully

or partially edentulous; 1 in every 5 cases of edentulism is linked to diabetes.[15] Poor glycemic control in those with diabetes also places LTOPs at risk due to the well established direct relationship between blood glucose levels and periodontal disease.[15] Investigators have reported that inflammation resulting from periodontal disease exacerbates chronic systemic inflammation to influence the initiation and progression of diabetes, typically Type II diabetes.[9,11] Increased inflammation, or more severe uncontrolled periodontal disease, is correlated with insulin resistance and more complications.[9,11] In addition, diabetes places the LTOP at a higher risk for oral Candida infections due to the high blood sugar levels promoting the growth of the Candida albicans.[9] Longitudinal studies on patients with diabetes and periodontal disease show those with better controlled glycemic indices had less severe inflammatory responses with their periodontal disease; thus, the diseases reflect one another.[9]

Cardiovascular disease (CVD), including hypertension, heart failure, coronary heart disease, arrhythmias, peripheral vascular disease, and valvular heart disease, affects 38.2% of older adults.[16,17] CVD has been reported to be the number one cause of death in the older population.[15] Forty percent of deaths from CVD occur between the ages of 75 and 85, while 48% occur over age 85.[17] A study by Persson et al evaluated periodontal status by measuring bone loss on the radiograph, vertical defects and furcations localized to the molars; radiographic evidence of periodontitis was found in 48.5% of the subjects, and carotid calcification was detected in 18.6%.[18] Age was determined a primary risk factor for CVD due to increased carotid calcifications detected from panoramic radiographs.[18,19] A systemic review by Lam et al reported that patients presenting with periodontal disease were 1.14 to 2.2 times more likely to develop CVD.[10] Researchers are not in agreement that a correlation between periodontal disease and CVD is associated with systemic inflammation expressed in serum markers: interleukin-6, white blood cell counts, and fibrinogen.[10] LTOPs that have endothelial dysfunction and carotid intima media thickness are also at increased risk for CVD and periodontal disease. This is because chronic microorganisms such as Chlamydophila pneumonia are said to cause atherosclerosis, and the DNA of oral bacteria can be amplified directly from atherosclerotic plaques.[10,11] Providing care to the LTOP with CVD can be challenging since medications are often not realistic due to polypharmacy, and surgery is often contraindicated.[17] When medications are used to treat CVD, they often have a damaging effect on the oral cavity including: xerostomia, gingival hyperplasia, and ulcerations.[10] Due to the correlation between CVD, age, and periodontal disease, it is imperative that LTOPs receive routine preventive and therapeutic oral health services to include evaluation of the gingival pocket depths and alveolar bone loss.[18]

Nursing home aspiration pneumonia (NHAP) is common in the LTOP with existing breathing difficulties, and is defined as pneumonia developing after the collection of colonized oropharyngeal organisms in the lower right lung lobe of the LTOP.[12,20,21,22] Streptococcus aureus and Pseudomonas aeruginosa are the main microbes contributing to NHAP.[20,21,23-25] One of the highest mortality rates for the LTOP is associated with NHAP due to excess gram negative aerobic rods and Staphylococcus aureus collecting in the oral cavity.[11,12] LTOPs breathe them into their lungs and contract the disease.[11,12] Evidence shows risk factors that make the LTOP more prone to NHAP as poor functional status, presence of a nasogastric tube (NG), dysphagia, occurrence of an unusual event, chronic lung disease, presence of a tracheostomy, increasing age, and male gender.[12] When diagnosed, the disease is often in an advanced stage, with few treatment options available.[20,21,25] NHAP should not be mistaken for other types of pneumonias also commonly found among the geriatric. Aspiration pneumonitis is an acute lung injury after inhalation of regurgitated gastric contents, typically while unconscious.[12] In addition, nosocomial pneumonia occurs more than 48 hours after hospital admission, but was not present at admission to the hospital.[12] Hospital acquired pneumonia first appears 3 days after a patient is admitted to the hospital.[12] Finally, ventilator associated pneumonia is defined as pneumonia that occurs after 48 to 72 hours of endotracheal intubation due to dysphagia.[12] While NHAP can be treated with antibiotics, the optimum antibiotic regimen for NHAP is unknown.[12] Since oral biofilm can collect and enter the lungs by gliding down the track of the NG tube, the LTOP on a NG tube is at a higher risk for developing NHAP.[12] Typically, 35% of LTOPs in a LTCF will require a NG tube; often a NG tube is necessary due to dysphagia, or difficulty swallowing.[12]

Sarin et al examined 613 LTOPs, with an average age of 84, to determine direct links between NHAP and 9 common risk factors.[21] The risk factors were inadequate oral care, difficulty swallowing, lack of influenza vaccination, depression, feeding position of less than 90° from horizontal, active smoking, recipient of sedative medication, recipient of gastric-acid reducing medication and use of angiotensin-converting enzyme inhibitors.[21] Results indicated that only 2 risk factors associated with developing NHAP were identified: difficulty swallowing and inadequate oral care.[21] A similar study investigated how preventative oral hygiene treatment could reduce the chance of developing NHAP in the LTGP.[20] In a meta-analysis conducted by Sjogren and colleagues, published literature related to oral hygiene, NHAP, and the LTOP was reviewed.[20] Fif-

teen articles were calculated to include an absolute risk reduction, numbers needed to treat, and positively correlated professional oral hygiene care with reduced cases of NHAP in the LTGP.[20] Results demonstrated that after participants were provided with routine oral care, absolute risk reduction increased from 6.6% to 11.7%, and numbers needed to treat increased from 8.6 to 15.3 individuals.[20]

Table I: Common Medications for LTOP

• Anticholingergics	• Antidepressants	• Antihistamines
• Antihypertensives	• Analgesics	• Sedatives/Tranquilizers
• Diuretics	• Cytotoxics	• Antiparkinson Drugs

Adachi et al evaluated the effect of professional oral care delivery on respiratory disease of LTOPs in edentulous and dentate populations to determine if professional oral hygiene therapy administered by RDHs reduced NHAP.[25] The experimental group consisted of 48 LTOPs who received daily brushing from an RDH using a toothbrush and fluoridated toothpaste, while the control group of 40 LTOPs received daily brushing with water and foam swabs by a certified nursing assistant (CNA) for a 6 month period.[25] Results concluded those patients receiving daily oral health care from a CNA using a foam swab had higher incidences of Staphylococcus species, Pseudomonas aeruginosa and Candida albicans than the experimental patients who were provided oral care by RDHs.[25] The chance of developing NHAP was lower in the experimental group ($p<0.05$).[25] Systematic reviews and experimental studies all conclude that professional daily oral hygiene and a reduced bacterial count in the LTOP will ultimately decrease the chance of NHAP.[12,20-23]

Oral Health Concerns

Oral hygiene is imperative in LTCFs, since, natural teeth are more susceptible to dental caries, periodontal disease, demineralization, and gingival recession due to age, diet, genetic factors, brushing habits, and lifestyle factors over time.[8,13-18,26-32] More than half of older adult patients have enamel and root surface caries, placing them at the highest risk due to gingival recession, heavy consumption of fermentable carbohydrates, poor oral hygiene and decreased fluoride exposure.[32,33] More recurrent caries is evident along the coronal surfaces from marginal breakdown or other failing restorative materials; fermentable carbohydrates can also collect around crowns, bridges, and implants, leading to carious lesions.[34]

Investigators have reported that periodontal disease occurs at a rapid pace for the LTOPs, often worsening with age.[2,34-37] Twenty-three percent of the total older population has severe periodontal disease, with symptoms of inflamed, painful gingival tissue, recession and mobility.[38] Periodontal disease in the LTOP is a result of several factors including: chronic diseases and disabilities, race, gender, medications, income and access to oral care prior to admittance.[38,39]

LTOPs with removable prosthetics are at an increased risk of oral diseases and lesions, including oral candidiasis and denture stomatitis resulting from Candida albicans.[37,40,41] A cross-sectional study, with an average age of 85, aimed to investigate fungal infections on 233 denture wearing LTOPs.[41] Swabs were performed on the participants' buccal mucosa to determine the micro floral status.[41] Results demonstrated that oral candidiasis and higher oral yeast counts are commonly seen in the LTOP and are attributed to lack of daily denture cleaning.[41]

The LTOP is more susceptible to salivary changes and oral lesions because of a decrease in salivary gland function.[32,42] Reports suggest that 15 to 30% of LTOPs experience xerostomia, most likely due to an average of eight daily prescribed medications (Table I).[32,42] Research points to increased xerostomia leading to higher caries rates in the LTOP.[32] Xerostomia also gives way to dysphagia due to an adequate amount of salivary flow needed to help push the food towards the trachea.[43]

Between 15 to 60% of LTOPs may present with a nutritional deficiency due to medication side effects or an overall reduction in appetite.[44,45] Loose dentures or decayed, broken and missing teeth can cause difficulty consuming nutritious food.[44,45] Several studies reported LTOPs with broken, missing and severely decayed teeth had a chief complaint of inability to masticate; the studies also found LTOPs to have poor-fitting dentures.[45] In addition, 6 million older patients are at risk for dysphagia.[43] Dysphagia occurs often with increasing age due to the natural deterioration of the muscle mass and connective tissue elasticity, resulting in loss of strength and range of motion.[43] As a result, many LTOPs have dysphagia and often become malnourished due to the limited choices of food to provide nutrients.[43]

Physical disabilities from falls, deterioration of the body with age, arthritis, stroke, spinal cord injuries and blindness all affect oral hygiene capabilities.[23,30,31] Common cognitive disabilities in the LTOP such as dementia, stroke and Alzheimer's disease make preventive oral care even more difficult.[23,30,31] Descriptive studies where RDHs examined oral hygiene and oral health status confirms LTOPs with both mental and physical disabilities were often

unable to care for the oral cavity without assistance.[23,30,31,40] Furthermore, it has been established, those LTOPs in severe stages of physical and mental disabilities had the worst oral hygiene; as the systemic disease progressed their oral health deteriorated.[23,30,31,40]

Barriers to Oral Care

The Omnibus Budget Reconciliation Act of 1987 (OBRA) addressed many concerns regarding care in LTCFs by establishing new standards better focused towards the LTOP's quality of life. OBRA was also praised for establishing Minimum Data Sets (MDS) to be completed on all LTCFs requiring Medicare and Medicaid reimbursement.[15,23] LTCFs are reimbursed by Medicaid and because Medicaid is an entitlement program, LTCFs must provide the specialized oral care to anyone eligible according to the Federal government.[47] LTCFs must provide routine dental services and emergency dental services to the extent which they are covered under the state, according to Medicaid.[47] Dental bills that are not fully paid with Medicare may also be covered under an incurred medical expense, so that the LTCF can be reimbursed.[48] In as many as 15 states, Medicaid will directly reimburse RDHs providing care to the LTOP.[49]

Nurses are required to complete sections K and L of the MDS that pertain directly to oral health.[42] These sections are supposed to trigger intervention, care planning, and improvements in oral health.[42] Still, there are numerous concerns about the quality of oral care received, since payroll for nurses tends to account for the biggest overhead and funds are limited.[7] Limitations and restraints are also seen as few oral hygiene or health concerns are identified; the MDS simply records what services were completed and cannot effectively enforce suitable care to every patient.[42] It has been shown that nurses can be dishonest about daily routines that have been carried out with the patient, including oral care.[24] Furthermore, MDS scores are taken into account for an LTCFs overall evaluation, and poor marks could jeopardize the facility's funding agencies and regulation records.[24] Since oral hygiene marks on the MDS score are not considered vital to the scoring process, an incomplete record of care often occurs.[24]

Multiple interviews with nursing staff have given the most insight as to why care of the oral cavity is not given more emphasis in LTCFs (Table II).[27,28,42,50] Many nurses found that oral hygiene was minimally covered in their education; only 1 to 3% of the nursing workforce is trained in older adult oral care.[27,28,42,50] The small amount of time spent learning about oral care for the LTOP made it seem less interesting and unimportant, with less than 30 minutes devoted to older adult care in nursing curricula, and even less time is spent in the CNA curricula.[51] Also, nursing staff reported oral care as a challenge for fear of being bitten or forcing care upon the patient, especially those with mental impairments.[26-28] Some CNAs found caring for the oral cavity to be filthy, unnecessary and unimportant, particularly when cleaning dentures or partials.[5,28] CNAs that deemed oral hygiene an important part of the daily routine received little support from other health care staff at the LTCF.[5,24,28] LTCFs are becoming overcrowded - adding oral hygiene care in conjunction with other needs can be difficult and overwhelming for the nursing staff.[7,23,24,29,52] When providing an adequate number of staff and allowing a moderate amount of time to complete the oral care routine, nurses not only found oral hygiene easier to perform, but also felt more responsible for providing these services to their patients.[27,53-55] Interprofessional collaboration between RDHs and nurses of all skill levels needs to be established. Forming a better relationship between health disciplines would allow the RDH to provide the LTCF nursing staff more assistance when it comes to treating the oral cavity of the LTOP. There are several gaps in the importance and recognition of proper care and the relationships between oral health and systemic health that an RDH could address.[56]

Table II: Reasons for the Lack Of Dental Hygiene Care In LTCF for the Older Adult Patient

Lack of professional supplies
Lack of RDH interest in this population group
Long-term geriatric care is not made a priority in dental, dental hygiene, or nursing schools
Caregivers do not see oral hygiene as a priority
Caregivers do not recognize the importance of providing daily oral hygiene
Resident resistance to oral care

Inadequate funding can also greatly impact oral care for the LTOP. Nursing staff have reported they often cannot care for their patient's oral cavity due to inadequate supplies.[27,28,42] More often than not, the nursing staff is provided water instead of a fluoridated toothpaste, and foam swabs instead of a toothbrush, although it has been shown that LTOPs do not receive enough fluoride uptake and that foam swabs cannot effectively remove plaque.[57] An investigational study identified 41 LTOPs who had reductions in gingival bleeding and plaque scores over 3 weeks after receiving oral hygiene aids, while the nursing staff received oral health education from an RDH.[28] The education for the nursing staff consisted of hands-on training in tooth brushing techniques

when using an electric tooth brush and chlorhexidine gluconate 1% gel©.[28]

LTOPs have the right to refuse professional oral hygiene care (Table III).[24,27,28,58] Questionnaires to nurses working in LTCFs revealed that often nurses felt confused and frustrated on proper protocol. The nurses had to make a choice: allow the LTOP to refuse necessary treatment or force dental care upon a resistant LTOP.[58] Research has argued that LTOPs may be reluctant to seek out dental care due to financial restraints as many do not have dental insurance and have limited personal funds.[2,36,59,60] Other research describes some LTOPs not recognizing the severity of their self-care deficit and refusing to have help provided to them for the oral cavity.[56] As many as 83% of LTOPs have health concerns such as sensory problems and intubation tubes, which limit their ability to keep their oral cavity healthy.[56]

RDHs face multiple barriers when it comes to providing increased access to care for the LTOP. Few states are improving the need to provide better access to care for the LTOP. Only 45% of U.S. states and territories have legislative policies working to provide increased access to the LTOP.[61] Currently, governing legislation allows a RDH to practice in an LTCF without direct supervision from a dentist in some states; however, what services are provided and requirements of the RDH vary (Table IV).[62] However, RDHs receive limited specialized education towards working with the LTOP.[63-66] Dental hygiene curricula vary by school programs, and often, students report not receiving enough education in treating the LTOP.[63,64] Most instructive lessons and clinical education for dental hygiene students are focused on caring for the relatively healthy, mobile older adult patient; very few courses offer support focused on the LTOP.[65] None of the over 500 residencies established by the American Dental Education Association (ADEA) specialized in older adult training.[2] The Commission on Dental Accreditation (CODA) requires dental hygiene students to work with the older adult population and community-based programs; however, it is not mandated that they work in LTCFs.[66] Adapting school curriculum is challenging due to limited program funding that must be shared among multiple subject matters and topics; however, faculty within dental hygiene schools need to demonstrate increased interest in regard to oral care for the LTOP.[66]

Recently, the advanced dental hygiene practitioner was established in some states, allowing RDHs to provide access to care, since this model includes a broader range of duties that can be performed.[67] Furthermore, research shows that RDHs are more likely to volunteer based on their level of education, job satisfaction, membership in their professional organization, and sensitivity to underserved patients.[63] Until more direct access becomes available nationwide, many RDHs who are willing to work with the LTOP cannot do so, despite the huge need.

Table III: Common Reasons LTOPs Do Not Seek Out Dental Care

Financial concern
LTCF are not equipped to provide dental treatment
Perceive dental treatment is only necessary to eliminate pain
Perceive daily oral hygiene care as unimportant

Discussion

With the first of the baby-boomers turning age 65 recently, literature has begun to focus on what changes will be needed to accommodate this very large segment of the American population.[1-3] Several academic journals all recognize that LTOPs are at an increased risk from the lack of dental care provided when admitted into a LTCF.[8,13-18,27-32] Systemic health conditions commonly found in LTOPs natural deterioration, slowing of the human body and various medications all cause an increased need for oral care in LTOPs (Table I).[32,42] Unfortunately, the LTOP themselves often do not recognize the importance of routine oral care and may refuse treatment for various reasons (Table III).[24,27,28,58] Despite health care providers attending to the LTOPs needs in a LTCF, literature has shown a void in collaboration between providers that could help reduce the lack of routine oral care.[56,67] Attention needs to be brought to this matter in hopes that LTCFs could receive adequate funding to purchase oral hygiene aids, increase staffing, and educate the staff, LTOPs, and family members on the importance of routine oral care (Table II).[27,28,42,50] RDHs could potentially save lives by providing routine oral prophylaxis to the LTOP; thus, reducing heavy levels of bacteria in the oral cavity. Based on what has been conferred about the lack of dental hygiene care and its relationship to the LTOP, the authors believe that the RDH could provide increased access to care for LTOPs in LTCFs by doing the following:

1. Provide professional oral care to screen for carious lesions, fungal infections, oral lesions, periodontal disease, and assess salivary function.[8,13-18,27-32]
2. Perform preventive measures to decrease the incidence of carious lesions in the LTOP, through fluoride applications (varnish) and dental sealants.
3. Perform non-surgical periodontal therapy. Treat an unresponsive periodontal pocket with the administration of localized antimicrobials.
4. Provide education on topics such as nutritional counseling and side effects to commonly pre-

Table IV: States with Direct Access to Care for the Dental Hygienist to work in LTCFs

Alaska	Arizona	Arkansas	California	Colorado
Connecticut	Florida	Idaho	Iowa	Kansas
Kentucky	Maine	Massachusetts	Michigan	Minnesota
Missouri	Montana	Nebraska	New Hampshire	New Mexico
New York	Nevada	Ohio	Oklahoma	Oregon
Pennsylvania	South Carolina	South Dakota	Texas	Virginia
Washington	W. Virginia	Wisconsin	-	-

scribed medications to the LTOP. A LTOP can have their nutritional status evaluated with a Mini Nutritional Assessment (MNA), a subjective assessment of health and nutrition from a questionnaire pertaining to diet.[22]

5. Assess, incorporate and distribute oral hygiene aids better suited for LTOPs with limitations from physical disabilities to reduce high bacterial flora counts.
6. Provide oral care specialized educational courses for long-term older adult care providers.
7. Stay current with literature on best practice for older adults and oral health to keep LTCFs current through oral health education to staff involved in direct patient care.
8. Potentially decrease incidence of systemic health conditions by reducing overall bacterial floral counts intraorally.[12,20-23]
9. Advocate for interprofessional collaboration between RDHs, nursing staff, LTCF administrations and dentists (Table II).[27,28,42,50,52]
10. Expose necessary radiographs to provide dental hygiene diagnoses of oral diseases that cannot be detected clinically.
11. Assess the LTOP's overall health, and refer to a necessary DDS or DMD when oral health may need further treatment beyond the scope of dental hygiene practice.
12. Advocate for specialized educational lectures and off-site clinical experiences in LTCFs within dental hygiene curriculum.[65]
13. Research U.S. dental hygiene schools to determine what specialized education is currently being conducted for LTOPs.
14. Advocate through state legislation to allow more states, over the current 33, to provide direct access to care through integration of RDHs (Table IV).[62]

Conclusion

As LTOPs increase and inadequate oral care is recognized, opportunities for RDHs to become employed in the public health sector will increase.[3] Since retained teeth positively correlates with overall health, RDHs are needed within LTCFs. Adequate oral care for LTOPs and education to administration and nursing staff on the expected positive outcomes of dental hygiene interventions is critical.[8,13-18,26-32] Systemic health concerns commonly seen in the LTOP, with retained dentitions, are often correlated with poor oral care. RDHs can become better prepared to work with the LTOP by taking continuing education courses specializing in geriatric dentistry, public health and institutional facilities. Also, RDHs are encouraged to stay current on legislative movements to find out when more access to care is granted in the state in which they practice. In the near future, government legislation may allow RDHs to work independently in LTCFs nationwide. Employing RDHs within LTCFs would not only provide access to oral care for LTOPs, but would offer support to LTCF staff, who are currently unable to fully meet oral health needs in this growing population.

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Technical Performance of Universal and Enhanced Intraoral Imaging Rectangular Collimators

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Abstract

Purpose: The purpose of this study was to compare the number and type of technical errors between 2 rectangular collimators, time/motion effort and radiographer preference.

Methods: Subjects (n=17) were recruited to expose an 18 projection full mouth series (FMX) using Tru-Align™ (enhanced) and Rinn® (universal) collimator devices. Both FMXs were exposed using photostimulable phosphor (PSP) digital sensors on a DXTTR manikin with an intraoral x-ray unit. A 5-question survey evaluated ease of device use, time required and device preference. Data were analyzed using frequencies, paired t-test, ANOVA and least squares means using a general linear model.

Results: A lower mean number of technique errors per FMX occurred with the enhanced device (9.7) compared to the universal device (12.1). Collimator centering errors occurred 3-times more often with the universal device. The mean numbers of diagnostically unacceptable errors per FMX were similar (Universal=3.2 vs Enhanced=2.9). The least squares means adjusted model showed a statistically significant difference of errors between the 2 devices ($p=0.0478$) and errors by location when comparing posterior to anterior and posterior to bitewing ($p<0.0001$). Subjects (94%) preferred the enhanced device and found it easier to use compared to the universal device. Significantly less time was needed to expose an FMX (4 min) when using the enhanced device ($p=0.0001$).

Conclusion: The enhanced device enabled subjects to expose diagnostically acceptable radiographs more efficiently with fewer collimator centering errors; however, it does so with a 35% greater exposure area and a concomitant increase in patient dose.

Keywords: intraoral radiographic technique errors, rectangular collimator, intraoral radiograph, collimator cut, cone cut, tru-align rectangular collimator

This study supports the NDHRA priority area, **Clinical Dental Hygiene Care:** Assess how dental hygienists are using emerging science throughout the dental hygiene process of care.

Introduction

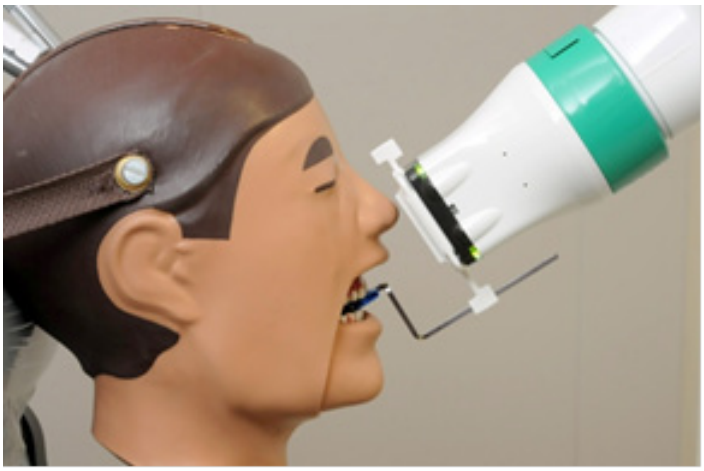
The negative effects of ionizing radiation on human tissues of both patients and operators have been well documented.[1,2] As a result, dentistry has tried to minimize patient dose through the use of patient protective equipment, faster receptors, digital imaging, beam alignment devices, longer source to end distances and collimation of the beam.[1-5] Several decades ago, beam alignment paralleling instruments were introduced on the commercial market to minimize patient dose and improve diagnostic quality. Originally, these were used with circular collimation. In the 1980s, a universal rectangular collimator was developed for use with beam alignment devices to further reduce the dose to the patient. Although successful in reducing dose, studies have shown that rectangular collimation has not been well adopted by the majority of dental practitioners and its use results in more collimator cut errors. The most likely explanation for this occurrence is the reduced margin for error.[5-7]

The American Dental Association (ADA), International Commission on Radiation Protection (ICRP) and National Commission on Radiation Protection (NCRP) strongly recommend the use of rectangular collimation with intraoral imaging.[1-4] A current guideline established by the NCRP states that the x-ray beam should not exceed the minimum coverage necessary, and each dimension of the beam should be collimated so that the beam does not exceed the receptor by more than 2% of the source-to-image receptor distance. Radiographic equipment is either manufactured to incorporate rectangular collimation or universal adapters are available to retrofit existing circularly collimated equipment.[5,6] Continuing concern about long-term and cumulative risks of cancer development from low doses of ionizing radiation has increased interest in the implementation of rectangular collimation.[1]

More recently, a rectangular collimator device has been marketed with enhancement features that may

Figure 1a: Universal Collimator Device (DXTTR Manikin)

Figure 1b: Enhanced Collimator Device (DXTTR Manikin)



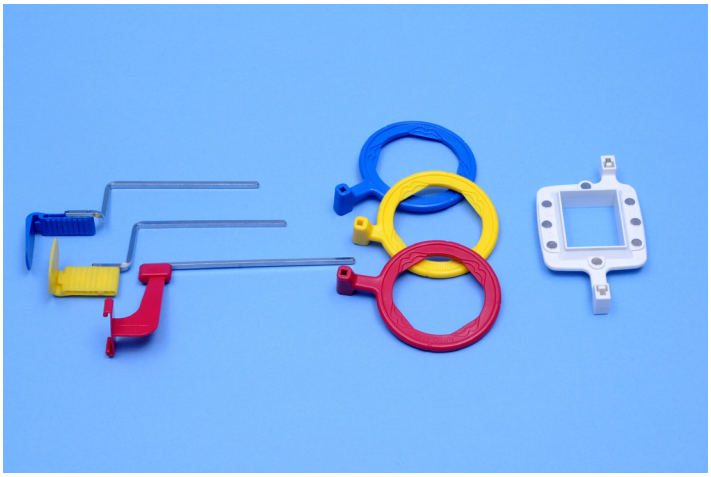
help minimize the collimator cut technique errors created with a rectangular collimated beam. A device composed of a magnetic alignment ring and a positioning-indicator laser beam with a visual light and audible signal was designed to eliminate collimator cuts and retakes. An early study evaluated technical performance using the device prototype and the authors recommended modifications to optimize the diagnostic quality of the image.[5] These modifications allowed for retrofitting the device to circular collimators and an increased size of the rectangular window. This study's authors are unaware of any studies that have evaluated how these design changes affected the ability to produce quality and diagnostic intraoral images with this device. Therefore, the purpose of this study was to evaluate the technical performance of 2 rectangular collimator modalities currently available on the commercial market.

Methods and Materials

The study population consisted of 33 senior dental hygiene students at the University of North Carolina at Chapel Hill School of Dentistry. Criteria for inclusion in the study were successful completion of the preclinical radiology course and 2 semesters of clinical radiology experience prior to enrolling to participate. Participants were asked to enroll voluntarily in the study and sign a consent form. This study was approved by the University of North Carolina Institutional Review Board.

Two device/collimator combinations were used to test for technical performance and diagnostic acceptability. Both device combinations were designed to be used with the Rinn XCP® receptor holding device, although the method for alignment varied depending on the device employed. The Rinn® universal rectangular collimator insert (Rinn Corp, Elgin, Ill) hereafter referred to as "Universal" was fitted over the circular collimator end resulting in a 33 cm source-to-end distance (Figure 1a). The universal collimator produced an exposure area of 46 mm x 36 mm (1,652 mm^2), measured at a distance of 2.5 cm from the collimator end.[8] The IDI Tru-Align™ intraoral rectangular collimating device, hereafter referred to as "Enhanced," was fitted on the opening of the tube head producing a 30 cm source-to-end distance (Figure 1b). The enhanced device produced an exposure area of 56 mm x 45 mm (2,524 mm^2), measured at a distance of 2.5 cm from the collimator end.[8] The universal device was used with the XCP® receptor holding device (receptor holder/bite block with corresponding alignment ring and bar). For techniques used with the enhanced device, the XCP® ring was replaced by a specifically designed ring (Figure 2). The enhanced device's alignment ring was square in shape with the appropriately corresponding append-

Figure 2: Bitewing Bite Blocks, Ring Bars with Color Corresponding Alignment Rings and Enhanced Devices' Magnetic Ring



From left to right: The XCP anterior, posterior and bitewing bite blocks; ring bars with color corresponding alignment rings; enhanced devices' unique magnetic ring (replaces the 3 XCP alignment rings)

ages for anterior/bitewing and posterior projections. The alignment ring was affixed with multiple round flush mounted magnets to secure the collimator to the aiming device (Figure 3).

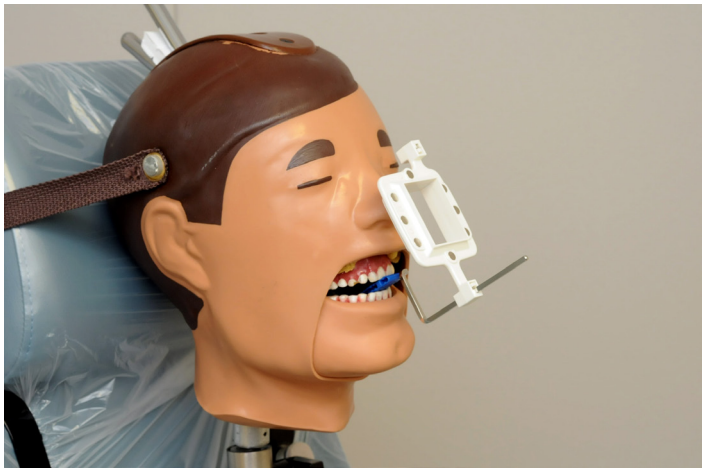
All projections were exposed using DenOptix® (GENDEX, Hatfield, Penn) Photostimulable Phosphor Plate (PSP) receptors for each FMX. Size 1 receptors were used for lateral/canine periapical projections (n=4) and Size 2 receptors were used for central (n=2), premolar (n=4), and molar (n=4) periapical projections and premolar (n=2) and molar (n=2) bitewing projections. A total of 18 projections constituted an FMX for the technical performance segment of this study.

All exposures with both universal and enhanced collimator devices were made using an intraoral Planmeca Prostyle x-ray unit (Intra, Planmeca USA, Roselle, Ill). Two Dental X-ray Teaching and Training Replicas (DXTTRs) (RinnCorp, Elgin, Ill) were identified for use in the study. Each DXTTR was designed with natural teeth and human skulls. Selection of the DXTTRs was based on optimal, mechanical and operational conditions.

A 5-item post-participation survey instrument was designed to solicit information from the subjects regarding their experience using the universal and enhanced devices. All 5 questions were open-ended in design. One asked for any complications or malfunctions that may have occurred with either device. The second asked for the helpfulness of the added features of the enhanced device (visual, audible, magnetic ring). Two of the questions explored the subject's impression of the image quality rendered and ease of use of both collimators. The last question asked the operator overall preference for their choice of device and why.

All study subjects chose a block of time to participate. No more than 2 subjects could participate at the same time. Once a time for participation was established, each subject was required to consent by reading and signing the IRB approved study participation consent form. Upon arrival, subjects were given a brief review on the proper usage of each of the 2 devices and their task. Prior to arrival, the principal investigator set up DXTTR manikins, arranged sensors with a corresponding FMX template and installed both universal and enhanced devices to be ready for use. Each subject was randomly assigned to an operatory, DXXTR manikin and 1 of 2 study devices. When ready to begin, consented subjects exposed 1 FMX using either the universal device or the enhanced device. The principal investigator recorded start and stop times for each study subject during testing of each device. Upon completion of the first FMX with either device, the principal investigator gathered exposed sensors and scanned images into the Training Electronic Patient Record (TEPR). All images were coded to blind the evaluator to the subject and device used. The principal investigator removed the first of the 2 devices tested and installed the remaining device for subject use and start and stop times were again recorded. Subjects were allowed unlimited time to complete the 18 projection series, but were encouraged to treat the radiographic exam as if it were a patient simulation. Both FMX's were exposed using PSP digital sensors on a DXTTR manikin. At the end of their task, each subject completed the post participation survey. Each survey document was coded providing anonymity for the study subject while offering the principal investigator identification of device, DXTTR and operatory used.

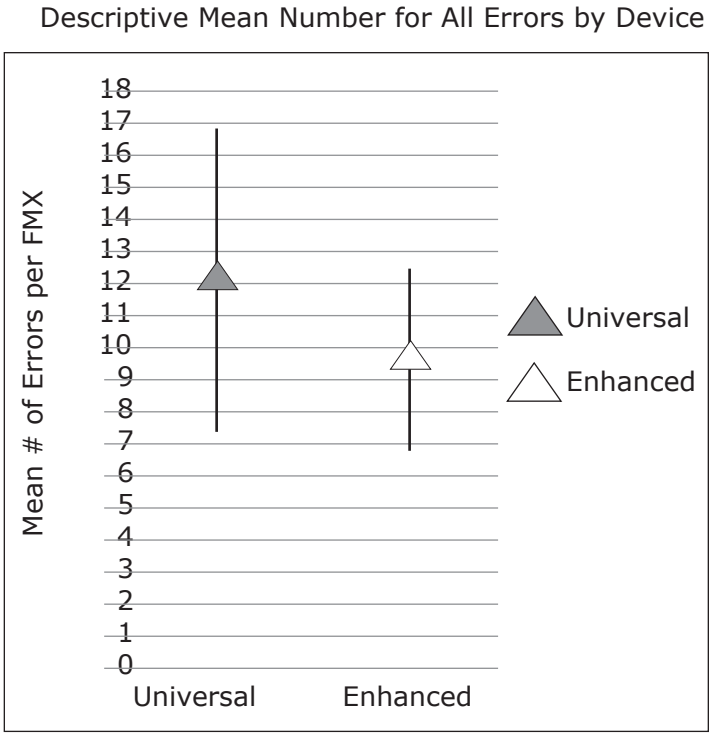
Figure 3: Displays the Enhanced Device Alignment Ring Containing Embedded Magnets



An experienced evaluator (dental hygiene professor with 35 years' experience evaluating radiographic technical performance) assessed the radiographic images for technical and diagnostic quality. Intrarater reliability was determined during the evaluation process by randomly re-grading 10 FMX's (5 with the universal collimator and 5 with the enhanced collimator). Each projection was viewed in a low lit room on a 22" Lenovo monitor with a resolution of 1680 x 1050 dpi. All projections were evaluated over a three hour time frame with periodic (two 10 minute) breaks. Data were collected using a direct data entry system using an EXCEL (Microsoft 2010 Version) statistical application.

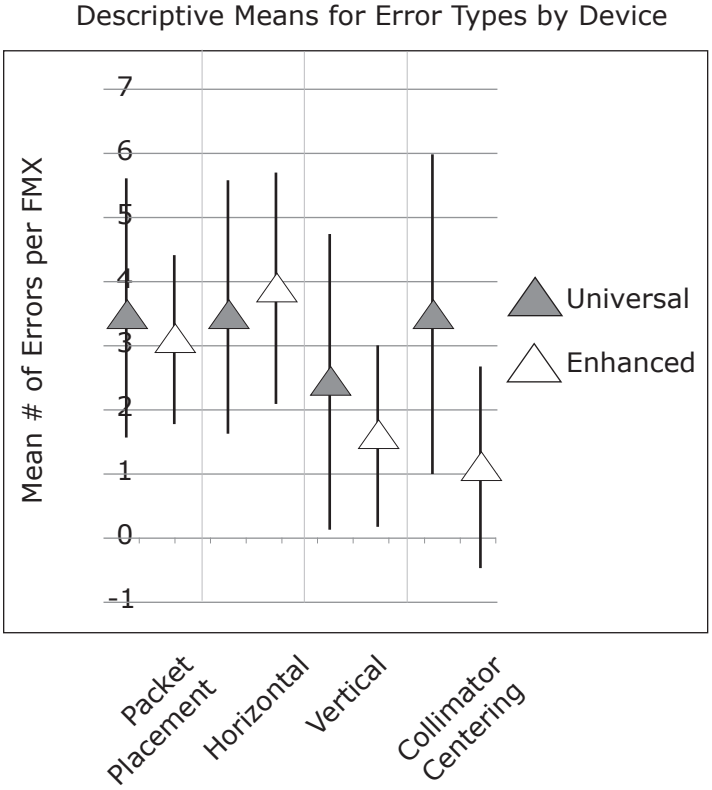
All study images were blinded to the evaluator based on device/collimator combination and radiographer. The images were evaluated based on predetermined criteria assessing the presence and severity of collimator centering (CC), vertical angulation (V), horizontal angulation (H) and packet placement (PP) errors. If the error was present but the projection was diagnostically acceptable, then the error was coded as a "minor" error. If the error was pres-

Figure 4: Displays the mean number of errors per full mouth for all technique errors (PP, V, H, and CC) as a function of the collimator device (universal vs. enhanced)



The mean number of errors per FMX was 12.1 for the universal device and 9.7 for the enhanced device. A statistically significant difference was seen when the data were analyzed using the adjusted model (F=4.35, d.f.=1, p=0.048).

Figure 5: Mean number and type of technique errors per FMX as a function of error type by device



A similar number of errors occurred by device for each error type except for collimator centering. The mean number of collimator centering errors per full mouth series occurred three times more often with the universal device (universal device=3.6 vs. enhanced device=1.1)

ent but rendered the projection diagnostically unacceptable, then the error was coded a "major" error. Minor errors involving packet placement, horizontal angulation, vertical angulation and collimator centering constituted a deduction of one point per error with 4 points being the greatest deduction per projection. Major errors involving any of the 4 criteria were deemed non-diagnostic and automatically resulted in a 4 point deduction for that image. Each of the 18 images of the FMX was graded and an overall score given for that set of images.

Data were analyzed using frequencies, ANOVA and least squares means using a general linear model. The mean number of errors per full mouth series were calculated and then averaged across all full mouth series. A general linear model was used to analyze mean numbers of errors between the 2 devices. ANOVA was used to assess error differences due to location in the mouth (Anterior, Posterior and Bitewing). A paired t-test was used to evaluate the mean time/effort between the two devices. Intra-rater reliability was measured using an Intraclass Correlation Coefficient (ICC).

Results

A total of 17 subjects enrolled in the study comprising a 51.5% participation rate. All subjects completed the technical component of the study and the post-participation survey. The intra-rater reliability was ICC=0.77.

Figures 4 and 5 present the findings of all errors by number and error type. Figure 4 displays the mean number of errors per full mouth for all technique errors (PP, V, H and CC) as a function of the collimator device (universal vs. enhanced). The mean number of errors per FMX for the universal device was 12.1 and 9.7 for the enhanced device. A statistically significant difference was seen when the data were analyzed using the adjusted model (F=4.35, df=1, p=0.048). In Figure 5, the data were evaluated by the mean number of errors per full mouth as a function of error type by device, a similar number of errors occurred by device for each error type except for collimator centering. The mean number of collimator centering errors per full mouth series occurred 3 times more often with

the universal device (universal device=3.6 vs. enhanced device=1.1).

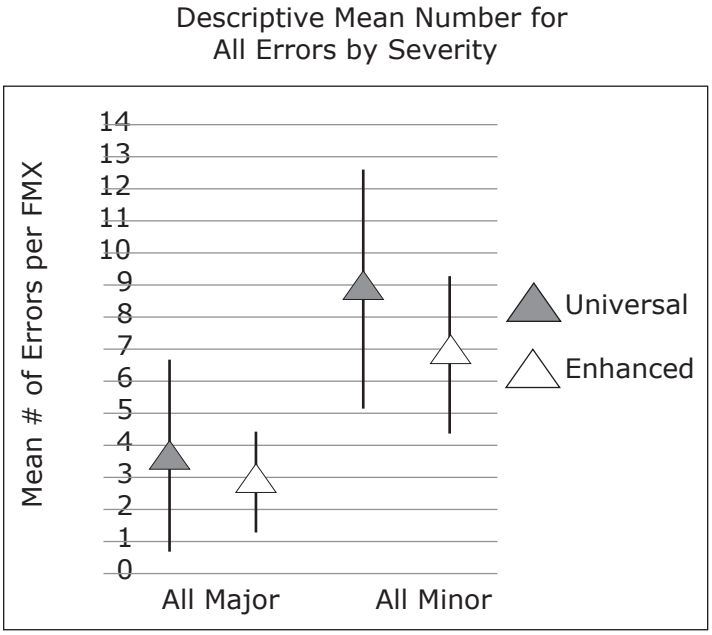
Figure 6 presents the findings based on error severity (major or minor) displaying the average number of errors (PP, V, H, and CC) per FMX. An error scored as a major error indicated that the image did not offer diagnostic value. A minor error indicated that the error was present but did not compromise the diagnostic quality of the image. The mean number of diagnostically unacceptable errors per full mouth series was similar between the devices (Universal device=3.2 vs. Enhanced device=2.9). A greater difference was seen in the reported mean number of minor errors per full mouth between the two devices (Universal device=8.9 vs. Enhanced device=6.8). Minor collimator centering errors occurred three times more often with the Universal device (Universal device=3.5 vs. Enhanced device=1.1).

Figure 7 shows the error rates based on location. The average number of all errors that occurred was evaluated based on location in the mouth (Anterior, Posterior, Bitewing) and by device (Universal vs. Enhanced). There was a difference in the average number of errors when comparing posterior (Universal device=6.5 vs. Enhanced device=5.4) to anterior locations (Universal device=2.5 vs. Enhanced device=2.0) and posterior to bitewing locations (Universal device=3.1 vs. Enhanced device=2.3). The model showed a statistically significant difference in the average number of errors per FMX when comparing posterior to anterior locations and posterior to bitewing locations ($p<0.0001$). There was not a significant difference when comparing anterior to bitewing locations ($p>0.38$).

Time required to complete a FMX by device was evaluated. Average time required to complete a FMX using the universal and enhanced device was 21 minutes and 17 minutes respectively. Significantly less time was needed (4 minutes) to expose a FMX when using the enhanced device ($p=0.0001$) (Figure 8).

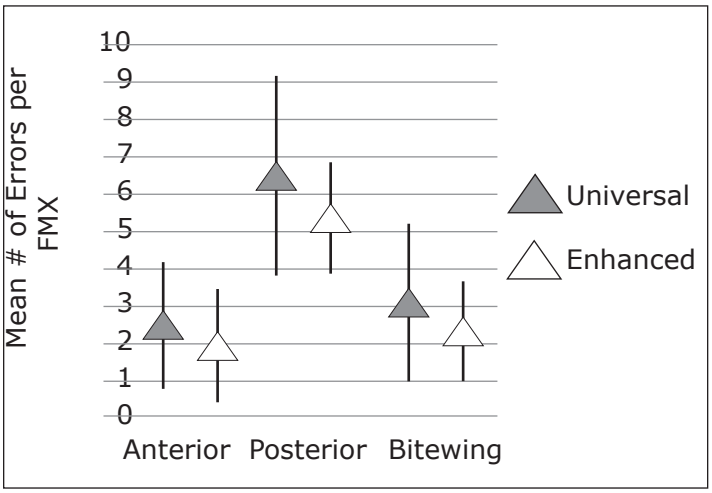
Table I displays the subject responses to each of the five questions of the post-participation survey. Question #1 asked the subjects (n=17) to state any complications/malfunctions of the device/collimator combinations that were experienced when exposing the projections. Regarding the universal device, four subjects (24%) reported x-ray unit tube head instability or drifting and one subject (<1%) reported experiencing a malfunction with the collimator. Regarding the enhanced device, 8 subjects (47%) reported that the weight of the device was an issue and 6 subjects (35%) reported that the lighted signal feature produced inaccuracies.

Figure 6: Mean number of all errors (major and minor) per FMX between the 2devices



The mean number of diagnostically unacceptable errors per full mouth series was similar between the devices (Universal device=3.2 vs. Enhanced device=2.9). A greater difference was seen in the reported mean number of minor errors per full mouth between the two devices (Universal device=8.9 vs. Enhanced device=6.8). Minor collimator centering errors occurred three times more often with the Universal device (Universal device=3.5 vs. Enhanced device=1.1).

Figure 7: Mean number of all errors (PP, VA, HA, CC) by device as a function of projection location



There was a statistically significant difference in the average number of errors per FMX when comparing posterior to anterior locations and posterior to bitewing locations ($p<0.0001$). There was not a significant difference when comparing anterior to bitewing locations ($p>0.38$).

Question #2 asked the subjects (n=17) to list which enhancement features (audible and visual signals, magnetic ring), if any, were helpful to them as the operator. Eighty-two percent chose the visual (lighted) signal, 71% listed the magnetic positioning ring, and 35% listed the audible signal as being helpful to them during exposures.

Questions 3 and 4 explored the choices of subjects regarding impact on image quality and ease of use. Responses to Question 3 indicated that fifteen subjects felt that using the enhanced device would produce better quality images. One subject chose the universal device and one subject remained undecided. Question 4 asked the subjects (n=17) to make a choice as to which of the two devices they found easier to use. Sixteen chose the enhanced device while 1 remained undecided. No subjects chose the universal device.

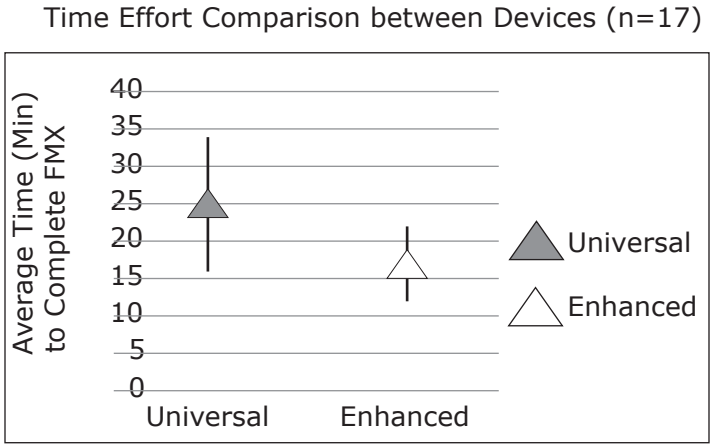
Question 5 asked the subjects (n=17) to choose a device based on their overall preference and to elaborate as to why. Sixteen responses were in favor of the enhanced device while one subject preferred the universal device. Explanations that subjects provided for preference of the enhanced device were that it provided confidence to the operator regarding exposure of a quality image, less time and ease of use. The one subject that preferred the universal device made this decision based on familiarity with the device.

Discussion

A primary goal of radiography is to render a diagnostic image while keeping the dose to the patient as low as reasonably achievable. This study compared the technical outcome of 2 rectangular collimators: one with technique enhancement features that retrofitted to the tubehead and one that inserted into a circular collimator. In addition, subject feedback was solicited on the use and preference of the collimators.

When the devices were compared based on technical performance there was not a consistent pattern seen where one device outperformed the other with respect to packet placement, vertical angulation or horizontal angulation errors. However, the enhanced device produced significantly fewer overall errors when compared to the universal device. The type of error that was primarily reduced with the enhanced device was collimator cutting. This finding is in contrast to that reported by Zhang et al.[5] Zhang's study reported an increase in collimator cuts and suggested that the device may be modified to increase the aperture opening in the device.[5] Interestingly, the current study discovered that there was minimal difference between the devices in the number of errors requiring a retake to render a diagnostic image.

Figure 8: Average time required to complete a FMX by device



On average, the FMX exposures were 4 minutes longer using the Universal device compared to the Enhanced device (p=0.0001).

Thus, most of the collimator centering errors that were made did not influence the diagnostic quality of the image. In contrast to the current study's results, Parks et al found that use of the Rinn® Snap-on rectangular collimating device resulted in a statistically higher number of retakes when compared to the other devices tested (i.e. snap-a-ray/round, XCP®/BAI paralleling/round, snap-a-ray/rectangular, XCP®/BAI paralleling/rectangular, XCP/BAI paralleling/Rinn® Snap-on, and Precision/rectangular).[7] Although Parks et al did not offer an explanation for this finding, the greater number of retakes might be attributed to the attachment of the rectangular Rinn® Snap-on device to the alignment ring. In addition, Parks et al did not provide a description of the aperture opening for the 16 inch FFD rectangular collimator used in his study, which limits a comparison of his findings to the current study.[7] Although not evaluated in this study, use of the XCP-ORA® may reduce the number of collimator cuts due to the notched aiming ring. This could be tested in future studies.

Additionally, the current study found that more errors occurred in posterior projections compared to anterior and bitewing projections regardless of the device used. The authors of this study believe that this phenomenon is likely due to the presence of anatomical obstacles (i.e. tongue and cheeks) resulting in the lessening of visual confirmation of proper placement regardless of the device used. Parks et al reported that film placement errors were not affected regardless of collimation technique used or operator skill.[6]

One of the major challenges in dentistry regarding adoption of dose reduction techniques is whether the

Table I: Post-Participation Survey Responses

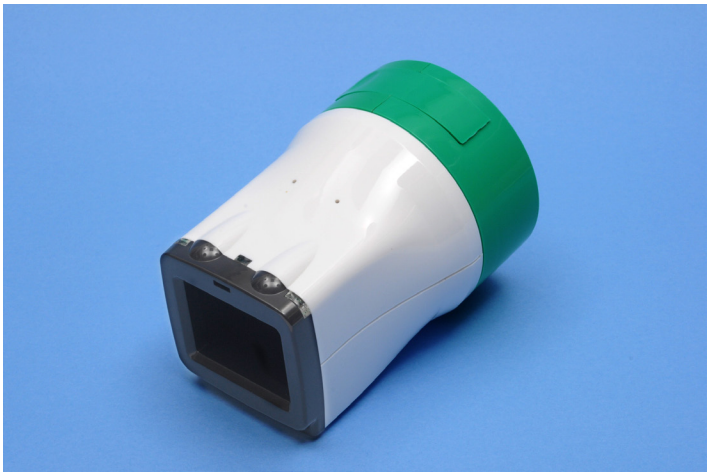
Survey Question	Survey Responses	n (Percent)
1. State any complications/malfunctions of the device/collimator combinations that you experienced when exposing the projections?	• Weight of enhanced device • Inaccurate light activation • Tube head instability with universal device • Universal device malfunction	8 (47) 6 (35) 4 (24) 1 (<1)
2. Which enhancement features (audible and visual signals, magnetic ring), if any, were helpful to the operator?	• Visual light • Magnetic ring • Audible beep	14 (82) 12 (71) 6 (35)
3. Which device did you perceive provided the best diagnostic images?	• Universal • Enhanced • Undecided	1 (6) 15 (88) 1 (6)
4. In general, which device did you find to be easier to use as the provider?	• Universal • Enhanced • Undecided	0 (0) 16 (94) 1 (6)
5. Please tell us your overall device preference and why.	• Universal • Enhanced	1 (6) 16 (94)

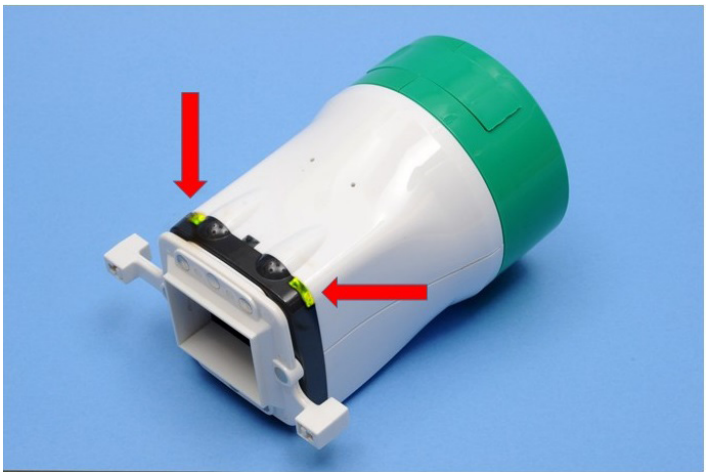
user feels that the device helps them to achieve diagnostic images with good image quality. The survey data indicated that the majority of subjects liked the enhancement features of the enhanced device and felt that the enhanced device would render a better diagnostic image. Subjects were able to work faster with the enhanced device and reported preference for this device. Zhang et al found that students reported a greater ease of use with the enhanced rectangular device encompassing a magnetic alignment ring as opposed to the freely adjustable universal rectangular collimator.[5] However, contrary to this study's findings, Zhang et al did not see a reduction in time necessary to complete an FMX.[5] This study showed improvement in time efficiency (approximately 4 mins) as well as a reduction of overall errors with the enhanced device regardless of the fact that in both study settings, subjects had no previous experience with the device. The subjects in this study did have prior experience using the XCP-ORA® which may have contributed to a short learning curve for putting the instruments together and using them for radiographic exposures. Thirty-five percent of the study subjects reported an inaccurate or false confirmation of the light and audible enhancement features of the enhanced device (Figure 9). Similarly, Zhang et al found that false signaling was common.[5] As a result, operators should be cautioned that false signals may influence negatively accurate alignment of the x-ray position indicating device (PID).

It appears that the enhanced device's enhancement features could have played a part in the reduction of collimator centering errors when compared to the universal device. This study found that the newly modified enhanced device produced fewer collimator centering errors than the freely adjustable universal rectangular device. These findings contradict the findings of Zhang et al who used the originally designed (unmodified) enhanced device.[5] Zhang reported that use of the original enhanced device produced almost four times the number of collimator centering errors as with the universal device.[5] The 35% larger beam area of the modified enhanced device compared to the originally tested prototype may be the reason for this finding. When image quality was assessed, there appeared to be slightly fewer errors with the use of the enhanced device but these errors did not render diagnostically unacceptable radiographs. Thus, the larger collimator area of the enhanced device may have reduced the number of collimator centering errors, but the data showed that the enhanced device did not produce more diagnostically acceptable images and it may have been at the expense of increased patient exposure.

It is important to note that the exposure area of the Rinn® universal device complies with the NCRP stipulation that rectangular collimated beams should not exceed the dimension of the image receptor by more than two percent of the source-to-image-receptor distance (SID) and has been measured as one percent of the SID.[8] The Tru-Align™ website suggests that the enhanced collimator "reduces the beam size to a pattern that is only two percent larger than the acquisition device."[9] But according to a previous study, the measured dimensions were reported to be 4% larger than the SID.[8] The manufacturer's claim of a 50% reduction in exposure area compared with a round collimator appears to be overstated compared to the study by Johnson et al.[8,9] Johnson et al determined that a 18% reduction in exposure area occurred when the enhanced device was compared to a 6 cm round collimator.[8] Similarly, the claim of a 60% reduction in patient dose is not substantiated with actual measurements.[8] Thus, the use of the designation "rectangular collimation" has an implicit

Figure 9: Displays the enhanced collimator without alignment ring engaged and therefore no confirmation lights (left) vs. flush magnetic attachment of the alignment right to the device resulting in visual light confirmation (right)





expectation of compliance with the standard established for it. As a consequence, the description of the enhanced device as rectangular collimator should be described as "non-standard".

When interpreting the results of this study, it is important to recognize the limitations of the study design. First, the images from the technical performance component of this study were exposed on DXTTR manikins. Tongue movement and patient cooperation, factors that often influence image acceptability, were not able to be factored in when determining the technical performance of the collimators. Thus, the number and types of errors seen with DXTTRs may be different from live patients. Second, only about half of the study population chose to participate in the study. This may have introduced a subject bias. Thus, a comparison of non-participants with study participants would have helped to determine if differences in groups existed. Although comparisons between groups were not done, attempts were made to standardize a minimum competency level for all subjects. For example, all subjects had passed their preclinical competency and participated in 2 semesters of radiographic clinical practice. Third, technical differences between the 2 collimators were based on the radiographic performance skills of the subjects. As mentioned, the subjects had minimal clinical experiences with patients. Performance results of the devices may have been different if they were used by experienced clinicians. Presumably, experienced clinicians are more likely to identify and problem solve incorrect placement of devices. The authors also made the observation that tubehead instability may influence the interlocking nature of the enhanced rectangular device with its magnetic ring. Enhanced device weight (n=8) and tubehead instability (n=4) reported by the subjects may have occurred due to weight of the devices. Weighing of the devices revealed that the universal method was heavier than the test method. Another interpretation might be that the subjects were referring to the weight of the magnetic aiming ring used with the enhanced device which is heavier and bulkier. In addition, the greater collimator length of the universal method may have contributed to the tubehead drift.

This study compared the performance of two rectangular collimated devices that are currently used in dental practice. While devices with enhancement features may be a step in the right direction, what is of utmost importance is the production of quality images while limiting dose to the patient.

Conclusion

To adhere optimally to the ALARA principle, the authors recommend that radiographers use rectangular collimation meeting NCRP specifications for beam limitation when exposing intraoral radiographs. Adherence to best practices of dental professionals by the adoption of rectangular collimation as a standard of care has been slow to evolve. However, growing concern about the link between low doses of ionizing radiation and the long-term and cumulative risks of cancer ensures this transition to be inevitable. The retail market provides choices to dental professionals when upgrading intraoral imaging equipment for rectangular collimation techniques, thus it is a goal of the authors to promote awareness that all rectangular collimators are not created equally. The rectangular format of a collimator is not by itself sufficient criteria to ensure that a reduction in radiation dose will result when compared to circular collimation. It is pertinent that device manufacturers adhere to guidelines set forth by the NCRP with respect to rectangular collimator dimensions. If the radiographer feels that the presence of enhancement features help them expose diagnostic images, then the enhanced collima-

tor evaluated in the current study is a better choice than a standard round collimator.

Ultimately, emphasis should be placed on quality training and consistent continuing education to reinforce the techniques and skills involved in imaging optimal intraoral projections. Implementing these recommendations will help ensure that ionizing radiation is used safely in dental practice and optimal image generation is achieved.

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An Assessment Model for Evaluating Outcomes in Federally Qualified Health Centers' Dental Departments: Results of a 5 Year Study

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Abstract

Purpose: The purpose of this report was to establish baseline data on 10 oral health performance indicators over 5 fiscal years (2007 to 2008 through 2011 to 2012) for an Iowa health center. The baseline data provides an assessment model and reports outcomes based on the use of the model. Performance indicators show evidence of provider performance, accountability to stakeholders and provide the benchmarks required for dental management to develop future goals to improve oral health outcomes for at-risk populations.

Methods: Using descriptive statistic, this report extrapolated data from the Iowa Health Center's computer management systems software, HealthPro, and Centricity electronic medical records, and analyzed using IBM® SPSS® 19. This report describes the change in utilization for number and type of visits for uninsured and Medicaid patients over 5 fiscal years (a fiscal year is measured from November 1 through October 31).

Results: The number of patients receiving at least 1 dental visit in a measurement year showed n=81,673 procedures with 21% (17,167) being unduplicated patients. Preventive averaged 46%, restorative 18%, urgent care 22% and other procedures 14%.

Conclusion: Federally qualified health centers (FQHCs) with a dental component serve populations with the greatest health disparities. This population includes ethnic and racial minorities, uninsured, underinsured, rural residents, Medicaid and Medicare. Establishing baseline data for FQHCs provides a foundational tool that will allow dental management to analyze successes as well as deficiencies in the goal to provide increased utilization to oral health care for at-risk populations.

Keywords: oral health performance measures, practice management for community oral health, FQHCs, baseline data

This study supports the NDHRA priority area, **Health Promotion/Disease Prevention:** Investigate how environmental factors (culture, socioeconomic status-SES, education) influence oral health behaviors.

Introduction

Federally Qualified Health Centers (FQHCs) are directed and governed by the Health Resources and Services Administration (HRSA).[1,2] Substantial grant moneys received by HRSA ensure FQHCs can maintain financial sustainability. Additionally, FQHCs receive these grants under Section 330 of the Public Health Service Act (PHS) and qualifies them to receive enhanced reimbursements from Medicaid and Medicare.[2] FQHCs are required to submit data to HRSA's Universal Data System on an annual basis.[3] This data tracks patient demographics, services provided, staffing, clinical indicators, utilization rates, costs and revenues of grantees at state and national levels on an annual basis. This data assists HRSA in evaluating a program's effectiveness and intervention of services to improve the health of vulnerable populations.[3] Besides the number of dental procedures provided, there are no nationally accepted oral health performance indicators required by HRSA for grantees to report to the uniform data system.[3]

This report provides descriptive statistic based on 10 indicators developed by Healthy People 2020, HRSA, Maternal Child Health, National Quality Forum, U.S. Department of Health and Human Services (DHHS) and Crescent Community Health Centers dental management over 5 fiscal years (2007 to 2008 through 2011 to 2012). Dental management selected indicators from these developers because they are leaders in the oral health profession.[2,4,5] Oral health is a high priority for these organizations as they have taken the lead to develop oral health measures that reflect the needs of at-risk populations.[2,6] This case study offers a model for community health centers with dental departments to follow.

FQHCs with a dental component are a primary safety-net solution for vulnerable populations and help decrease the barriers and inequities at-risk populations face in accessing and utilizing oral health care.[7-9] The mission of FQHCs is to provide primary care to vulnerable populations in underserved ar-

eas.[7] The Centers for Disease Control and Prevention (CDC) maintain there are significant oral health disparities related to socioeconomic status, racial and ethnic groups, geographic locations, age, and gender.[10] According to the CDC, oral health disparities continue to progress in the U.S.[10] Socioeconomic factors contributing to these disparities include race (non-Hispanic Blacks, Hispanics, American Indians and Alaskan natives), age and education. Children ages 2 to 4 and 6 to 8, who are Black, non-Hispanic and Mexican American have twice the amount of decay as white Non-Hispanics.[11] Those adults with less than a high school education aged 35 to 44 have 3-times the decay as college-educated adults.[11] Additionally, this same group has 3-times the amount of destructive periodontal disease.[11]

David Satcher, Surgeon General of the U.S., issued the Oral Health in America - A Report of the Surgeon General more than a decade ago, which revealed gaps in access to oral health care, suggesting that Americans do not benefit equally from improvements in health care.[12-14] The goals Healthy People 2020 established under the leadership of the Federal Interagency Workgroup include improving quality of life while living free of preventable diseases, attaining health equality for all population segments, promoting environments which are conducive to health, both social and physical, and encouraging healthy behaviors through all stages of life.[6] Dental departments located in FQHCs play a critical role in the support of those goals by reducing barriers in obtaining oral health services hence creating a better quality of life for those individuals they serve.[15,16]

FQHCs are documented leaders in treating chronic diseases and reducing health disparities while maintaining affordability of care.[8,17] They are local, nonprofit community needs-driven health care providers serving low income, medical and dental underserved communities. To date, FQHCs have served over 20 million people across the country with the primary goal to improve access to care for millions of people regardless of their insurance status or ability to pay.[8] Iowa is home to 14 FQHCs; of those, 12 have a dental component. FQHCs in the state of Iowa served over 180,000 individuals, providing in excess of 130,000 dental services in 2012.[8,17] Ninety-four percent of Iowa health center's patients have family incomes at or below 200% of the federal poverty line. The federal poverty level guidelines issued by the DHHS, recorded by year in the Federal Register, can be defined as the set minimum amount of gross income a family needs for food, clothing, transportation, shelter and other necessities and assists in determining financial eligibility for federal programs, including dental clinics of FQHCs.[18] The federal government defined the poverty level in 2007, for a family of 4, at $20,650 - this number increased to $22,350 for 2011.[18,19]

FQHCs provide a substantial safety net for both prevention and emergent dental care for at-risk populations. FQHCs provide a slide-fee price scale in which fees vary depending on a person's ability to pay. Ability to pay is based on annual income, family size and U.S. federal poverty guidelines.[2] Access to oral health care is often constrained based on financial barriers, where one resides, as well as a person's race and ethnicity. Oral health disparities widen by restricting access to care for at-risk populations. These restrictions impair quality of life, and inflict unnecessary pain and suffering on communities.[20-24] The presence of dental clinics in FQHCs improves access to care for low socioeconomic populations by minimizing these barriers.[25]

Utilization refers to the documented confirmation that patients are using services, as well as the frequency and types of visits.[26] Lack of utilization include:[26]

1. Oral health literacy
2. Provider distribution and availability
3. Financial limitations
4. Transportation, rural versus urban location
5. Ethnic and cultural preferences
6. Health related circumstances

Federally qualified dental clinics accept Medicaid patients, offer slide-fee discounts for the uninsured and provide language interpreters along with transportation.[25]

One of these health centers, which is located in Dubuque, Iowa (population of 57,637), serves a tri-state region including Illinois and Wisconsin border states.[27] According to internal statistics, this health center provided services to over 6,000 patients, 3,403 being medical and 3,497 dental. Of those, 2,438 (23%) were Medicaid, 3,018 (42%) were uninsured and 815 were homeless population.

The purpose of this exploratory study was to describe the change in utilization for number and type of visits for Medicaid, uninsured and privately insured patients of Crescent Community Health Center's dental department for the fiscal years of 2007 to 2008 through 2011 to 2012. This report provides descriptive statistics based on 10 oral health performance indicators, developed by National Quality Forum, Healthy People 2020, HRSA, Maternal and Child Health Bureau, Health Systems Capacity Indicator and Crescent's dental management (Table I).

Objective of Report

The objective of compiling retrospective data was to establish benchmarks for internal and external quality for dental practice management. Internal Quality is measured as:

Table I: Oral Health Indicators

Developer	Measure/Goal	Numerator	Denominator
#1: Healthy People 2020 OH-11, National Quality Forum	Increase the percent of patients who receive oral health services in a measurement year at FQHCs	Total number of unduplicated dental patients receiving at least one D-code procedure	Total number of all D-code procedures
#2: Health People 2020: OH-8, OH-14 Delta Dental National Quality Forum #1334	Increase the proportion adults and children who receive preventive services in a measurement year	Total number of preventive services by patients aged (0-21) and then by (22>)	Total number of preventive services by all age groups
#3: HRSA	Increase percent of sealants in a measurement year by ages (6-21)	Total number of (D1351) sealants by ages (6-21)	Total number of D-code procedures by children age category (6-21)
#4: Maternal Child Health, Health Systems Capacity Indicator #7b	Increase percent of dental procedures by children age (6-9) insured by Medicaid who received any dental service in a measurement year	Total number of dental procedures by children age (6-9) insured by Medicaid receiving any D-code procedure	Total number of dental procedure by children age (6-9) of all payer types receiving any D-code procedure
#5: Healthy People 2020 OH-1.1, National Quality Forum	Reduce the number of children aged (3-5) with restorative or extraction procedure while increasing preventive procedures in a measurement year	Total number of (3-5) year olds who received, preventive, or restoratives, or extractions, or other D-code procedures	Total number of (3-5) year olds who receive any D-code procedure
#6: Health Resources Services Administration	Increase percent of patients greater than or equal to 18 years of age in the target population who received D0150 in a measurement year	Total number of patients 18 and older who had a comprehensive exam (D0150)	Total number of patients of all ages who had a comprehensive exam (D0150) procedure
#7: Crescent Community Health Center management	Percent of dental procedures by provider	Total number of procedures by hygienist or dentist	Total number of procedures by all providers
#8: Health People 2020 OH:7	Increase the proportion of dental patients ages (2-17) that had a preventive procedure in a measurement year	Total number of preventive procedures by (2-17) years old	Total number of preventive procedures by all ages
#9: National Quality Forum #1388	Increase the percentage of Medicaid patients aged (2-21) years who had at least one dental procedure in a measurement year	Number of dental procedures for children aged (2-21) insured by Medicaid	Total number of dental procedures for all (2-21) year olds for all payer types
#10: Crescent dental management Healthy People 2020 OH:3.2	Increase Percentage of preventive visits while decreasing restorative and urgent care procedures for patients 65 > in a measurement year	Number of preventive, restorative, then urgent procedures by patients aged 65 >	Total number of procedures by patients aged 65 >

- Identify oral health performance indicators most applicable to Crescent Community Health Center's dental department
- Attaining baseline measures
- Develop ways to improve on clinical outcomes
- Assess benchmarks for provider performance and productivity
- Recognize areas for quality improvement
- External Quality
- Ensure transparency to HRSA, Medicaid and other grantors
- Educating Crescent Community Health Center community on dental utilization
- Establish data for grant writing
- Demonstrate to stakeholders that health care services are being utilized

Methods and Materials

This descriptive analysis used quantitative primary data obtained through this Iowa health center's administrative records to capture longitudinal trends in type and number of patients utilizing specific oral health services for fiscal years 2007 to 2008 through fiscal year 2011 to 2012. Change in utilization for specific types of visits for Medicaid, uninsured and privately insured patients of this Iowa health center's dental department were explored. Table I illustrates the oral health performance indicators, and the developers this report was based on.

Fiscal years for this Iowa health center were defined as November 1 through October 31 for each measurement year, (e.g. one fiscal year begin November 1, 2007 and ends October 31 2008 of the following year). Two electronic medical records HealthPro and Centricity were linked to oral health procedures, demographic characteristics, such as race, gender, payer type, provider, and age at the time of service. Data were transferred to Microsoft™ Excel® spreadsheet then to IBM® SPSS® 19, captured dental population characteristics, and oral health service data. The Massachusetts College of Pharmacy and Health Science University Institutional Review Board approved this study.

All records were de-identified to protect patient confidentiality and uphold HIPAA standards. The data included those patients who had at least 1 dental visit to the Iowa health center's dental department. Categorical variables such as age, provider type, race, gender, payer type and procedure type were collapsed for analysis in SPSS. Age ranges were constructed based on the 10 oral health performance indicators measured (Table I). Additional categories included payer type (Medicaid, uninsured, privately insured), provider type (dental hygienist or dentist), gender (male or female) and race (Caucasian, African American, Hispanic, more than one race, and Other). Procedural D-codes were divided into 4 main categories (preventive, restorative, urgent care and other). Three additional D-code categories were defined for comprehensive exams, extractions and sealants. The American Dental Association (ADA) developed a universal dental coding system for dental procedures and nomenclature (CDT) to ensure uniformity and consistency in the recording and billing for dental procedures.[28]

Results

To address the research objective (based on the 10 oral health indicators shown in Table I), data describes the change in utilization of preventive, restorative and urgent care procedures for Medicaid, uninsured and privately insured patients for specific age groups at the time of services from Crescent Community Health Center's dental department for the fiscal years of 2007 to 2008 through 2011 to 2012 (Tables II to XI). Data were plugged into the formulas and results reported as follows.

Oral health indicator #1 - National Quality Forum, Healthy People 2020 OH-11 goal: Increase the proportion of patients who receive at least one dental visit in a measurement year at a federally qualified health center.

Overall for fiscal year 2007 to 2008 to 2011 to 2012 there were n=81,673 procedures with 21% (n=17,167) being unduplicated patients. This shows an increase in unduplicated patients of 87% overall (n=1844). Figure 1 shows patient utilization percentages with preventive services averaging 46%, restorative 18%, urgent care 22% and other procedures 14%. From fiscal year 2007 to 2008 to fiscal year 2011 to 2012, there was an increase of 106% for preventive, 87% increase in restorative and a 25% increase in urgent care services.

Oral health indicator #2 - Healthy People 2020, Oral Health-14, National Quality Forum #1334 goal: Increase the proportion of adults (aged 22 and older) and children (aged 0 to 21) who receive preventive interventions in a measurement year.

The proportion of patients in both age groups who received preventive procedures remained stable over the 5-year measurement period. Data showed preventive procedures more than doubled from year 1 to year 5 for age group 0 to 21 from n=2,407 to n=4,850 and age group 22> from n=2,098 to n=4,415. The overall 5-year average for ages 0 to 21 was 53% and for ages 22> was 47% of all services were preventive in nature.

Oral health indicator #3 - Health Resources and Services Administration goal: Increase the percent of children between 6 and 21 years of age who received at least one sealant (D1351) in a measurement year.

While results show sealants increased from n=206 to n=376, the proportion of sealant placement compared to all other procedures utilized remained unchanged, averaging 7% over the 5 years. These results should encourage the providers of this health center to advocate and educate parents on the preventive benefits of sealants for this age group.

Oral health indicator #4, Health Systems Capacity Indicator #7b goal: Increase the percent of dental visits by children (ages 6 to 9) insured by Medicaid receiving any dental service in a measurement year.

Table II: Oral health indicator #1

Goal: To increase the proportion of patients who receive at least 1 dental visit in a measurement year at a FQHC	
Fiscal Year	Unduplicated patients/total number of all D-code procedures
2007	2,137/11,470 (19%)
2008	2,648/13,360 (25%)
2009	3,498/18,185 (25%)
2010	4,903/19,007 (20%)
2011	3,981/19,651 (20%)

Medicaid utilization for this age group remained stable averaging 85%, while the uninsured averaged 9% and privately insured averaged 6%. The goal to increase the percent of dental visits by children (ages 6 to 9) insured by Medicaid receiving any dental service in a measurement year was not met, showing 2% decrease in Medicaid from measurement year 1 to year 5 and a 2% increase in uninsured during this same measurement period.

Oral health indicator #5, developed by National Quality Forum, Healthy People 2020 OH-1.1 goal: Reduce proportion of children (ages 3 to 5) receiving restorative or extraction procedures, while increasing preventive procedures in a measurement year.

From fiscal year 2007 to 2008 to fiscal year 2011 to 2012, preventive procedures increased from n=545 to n=865, an upturn of 59%. Restorative procedures increased 56%, while extractions decreased by 40%. Of the n=81,673 procedures of the total population, 8% (n=6,269) were from the age group 3 to 5. Of those, 87% (n=5,479) were Medicaid, uninsured at 5.5% (n=344), and privately insured 7% (n=446).

Oral health indicator #6, developed by Health Recourses and Services Administration: Percent and type of patients 18 years of age and older who received a comprehensive (D0150) exam in a measurement year.

This benchmark showed that, for a 5-year measurement period, there was a 27% increase in comprehensive exams for the age group 18>. In total, there were n=54,348 procedures over the 5-year measurement period for ages 18>. Of those, 6% (n=3,383) were comprehensive exams. Payer type breaks down into 37% (n=1,248) being Medicaid, 57% (n=1,931) uninsured and 6% (n=204) privately insured. For gender, females accounted for 59% (n=2,011), and males 41% (n=1,372). For races, Caucasian accounted for 82% (n=2,752), African American 8% (n=283), Hispanic 6% (n=216), more than one race 1% (n=30), and combined races 3% (n=102).

Table III: Oral Health Indicator #2

Goal: Increase the proportion of adults and children who receive preventive interventions in a measurement year		
Fiscal Year	Children aged 0 to 21*	Adults 22 and older**
2007	2,407/4,505 (53%)	2,098/4,505 (47%)
2008	3,264/5,891 (55%)	2,627/5,891 (45%)
2009	4,571/9,225 (50%)	4,654/9,225 (45%)
2010	4,844/9,118 (53%)	4,274/9,118 (47%)
2011	4,850/9,265 (52%)	4,415/9,265 (48%)

*Total number of preventive services by patients ages 0 to 21/total number of preventive services by all age groups
**Number of preventive services by patients ages 22>/total number of preventive services by all age groups

Table IV: Oral Health Indicator #3

Goal: Increase the percent of children ages 6 to 21 who received at least 1 sealant (D1351) in a measurement year	
Fiscal Year	Total number of (D1351) sealants by ages (6-21)/ Total number of D-code procedures by children aged (6-21)
2007	206/2,767 (7%)
2008	317/3,806 (8%)
2009	360/4,996 (7%)
2010	413/5,662 (7%)
2011	376/5,445 (7%)

Table V: Oral Health Indicator #4

Goal: Increase the number of dental visits by children (ages 6 to 9) insured by Medicaid			
Fiscal Year	Medicaid	Uninsured	Privately Insurance
2007	86%	8%	6%
2008	83%	11%	6%
2009	84%	9%	7%
2010	89%	7%	4%
2011	84%	10%	6%

Table VI: Oral Health Indicator #5

Goal: Reduce proportion of children (ages 3 to 5) receiving restorative or extraction procedures, while increasing preventive procedures in a measurement year				
Total number of preventive, restorative, extraction or other D-code services by ages 3 to 5/Total number of D-code services by ages 3 to 5				
Fiscal Year	Preventive	Restorative	Extractions	Other
2007	545/914 (60%)	110/914 (12%)	32/914 (4%)	227/914 (25%)
2008	677/1,085 (62%)	129/1,085 (12%)	17/1,085 (2%)	262/1,085 (24%)
2009	915/1,442 (63%)	171/1,442 (12%)	28/1,442 (2%)	328/1,442 (23%)
2010	886/1,461 (61%)	203/1,461 (14%)	22/1,461 (2%)	350/1,461 (24%)
2011	865/1,367 (63%)	172/1,367 (13%)	19/1,367 (1%)	311/1,367 (23%)

Oral health indicator #7 endorsed Crescent Community Health Centers dental management: Percent and number of dental services provided by provider type in a measurement year.

For fiscal years 2007 to 2008 through 2011 to 2012, the dental hygiene department provided 39% of all D-code services and 61% by a dentist over the 5-year measurement period.

Oral health indicator #8, guided by Healthy People 2020 OH: 7: Number of dental patients ages 2 to 17 that had a preventive procedure in a measurement year.

Results of this benchmark showed preventive utilization for this age group increased by 97% (n=2,164 to n=4,271 procedures) from measurement year 1, fiscal year 2007 to 2008 to year 5 fiscal year 2011 to 2012.

Oral health indicator #9 endorsed and designed by National Quality Forum #1388: Percent of Medicaid patients ages 2 to 21 that had at least 1 dental procedure during a measurement year shows.

This benchmark showed Medicaid patients ages 2 to 21 that had at least 1 dental procedure during a measurement year showed (out of n=30,154 procedures), 78% were Medicaid compared to all other payer types, with 16% were uninsured and 6% were privately insured. Although the percent of Medicaid patients for this age group remained stable over this 5-year measurement period, results revealed 16% of patients in this age group were uninsured.

Oral health indicator #10 refers to Healthy People 2020 OH: 3.2: Number of patients ages 65 to 75 with untreated coronal caries in a measurement year. This Iowa's health center dental management modified this indicator, to increase preventive procedures while decreasing restorative and urgent care procedures for the age group (65>) from previous measurement years.

Table VII: Oral Health Indicator #6

Fiscal Year	Number of comprehensive exams for ages 18>/total comprehensive exams of all ages
2007	614/958 (64%)
2008	495/807 (61%)
2009	835/1,340 (62%)
2010	662/1,020 (65%)
2011	777/1,207 (64%)

Table IX: Oral Health Indicator #8

Benchmark: Number of preventive services for ages (2 to 17) in a measurement year	
Total number of preventive services for ages (2 to 17)/Total number of preventive services for all age groups	
Fiscal Year	Preventive procedures/total procedures
2007	2,164/3,321 (65%)
2008	2,920/4,522 (64%)
2009	3,926/5,786 (68%)
2010	4,279/6,590 (65%)
2011	4,271/6,146 (69%)

Figure 2 gives overall 5-year data for age category (65>), showing preventive procedures averaged 39% (n=1,524), restorative 20% (n=788), urgent care 25% (n=978), and other 15% (n=602). The goal to increase preventive procedures while decreasing restorative and urgent care procedures for this age group of (65>) from previous measurement years is being met. Our findings showed, there was an increase of n=216 or 140% for preventive procedures, restorative showed an increase of n=61 or 56%, while urgent care procedures decreased by

Table VIII: Oral Health Indicator #7

Percent and number of services by provider type in a measurement year		
Total number of D-code services performed by each provider/Total number of D-code services		
Fiscal Year	Dental Hygienist/Total Procedures	Dentist/Total procedures
2007	2,965/11,470 (26%)	8,505/11,470 (74%)
2008	4,819/13,360 (36%)	8,541/13,360 (64%)
2009	6,608/18,185 (36%)	11,577/18,185 (64%)
2010	8,467/19,007 (45%)	10,540/19,007 (55%)
2011	8,706/19,651 (44%)	10,945/19,651 (56%)

Table X: Oral Health Indicator #9

Percentage of Medicaid patients (aged 2 to 21) having at least one dental procedure during a measurement year			
Fiscal Year	Medicaid procedures/total Procedures	Uninsured procedures/total procedures	Private Insured procedures/total procedures
2007	3,030/3,827 (79%)	679/3,827 (18%)	118/3,827 (3%)
2008	4,049/5,177 (78%)	831/5,177 (16%)	297/5,177 (6%)
2009	5,178/6,724 (77%)	1,157/6,724 (17%)	389/6,724 (6%)
2010	6,033/7,417 (81%)	1,039/7,417 (14%)	345/7,417 (5%)
2011	5,355/7,009 (76%)	1,080/7,009 (15%)	574/7,009 (8%)

Table XI: Oral Health Indicator #10

Goal: Increase preventive procedures while decreasing restorative and urgent care procedures for the ages (65>) from previous measurement years			
Fiscal Year	Total preventive services for ages (65>)/Total services for age group (65>)	Total restorative services for age group (65>)/Total services for age group (65>)	Total urgent care services for age group (65>)/Total services for age group (65>)
2007	154/611 (25%)	109/611 (18%)	210/611 (36%)
2008	247/734 (33%)	153/734 (21%)	219/734 (30%)
2009	413/895 (46%)	163/895 (18%)	181/895 (20%)
2010	340/794 (43%)	193/794 (24%)	173/794 (22%)
2011	370/858 (43%)	170/858 (20%)	195/858 (23%)

n=15 or a 7% reduction. Of those visits, 81% were uninsured, 17% Medicaid and 2% privately insured.

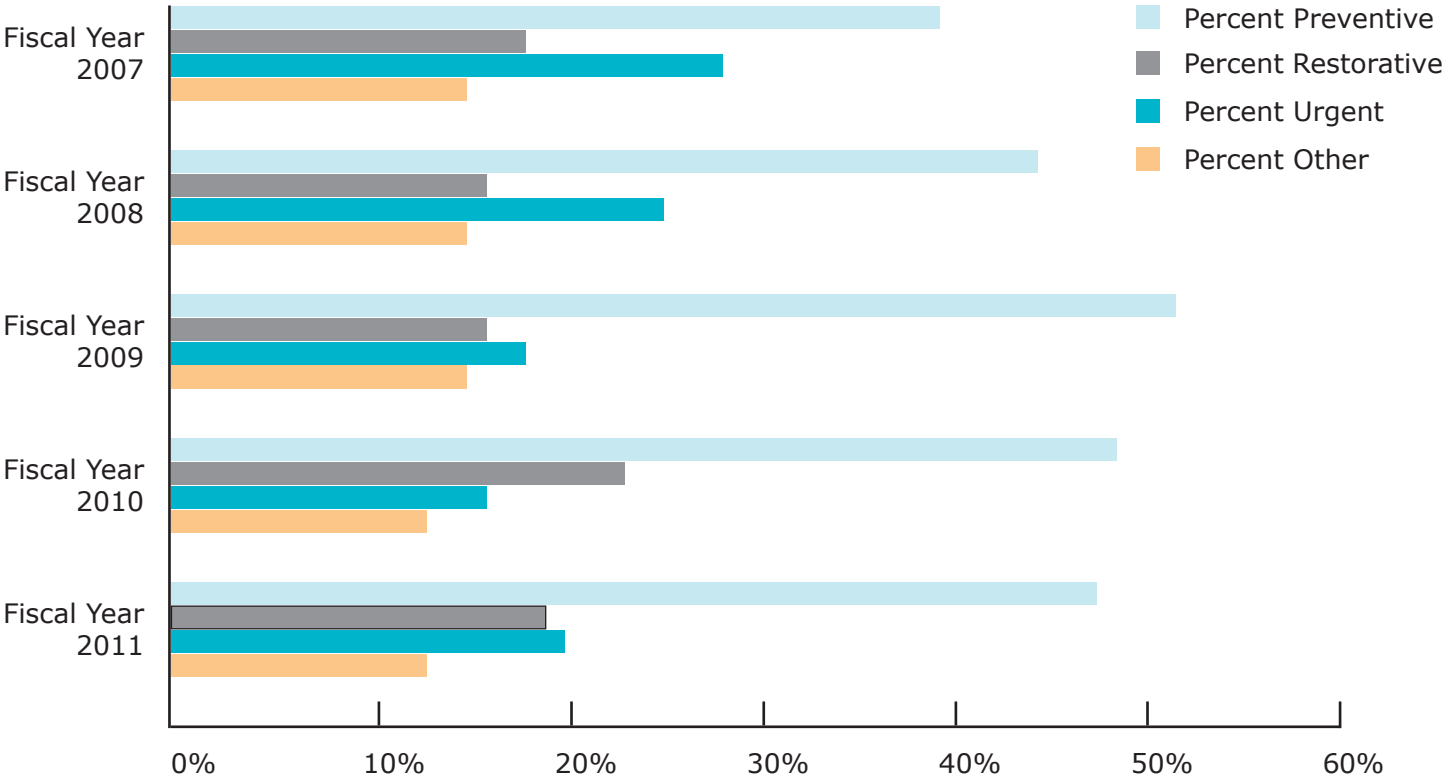
Overall, this community health center's dental department provided 50% of procedures (n=40,723) to Medicaid, 44% (n=36,033) were uninsured and 6% were privately insured patients over the 5-years measured. The racial breakdown showed an average of 75% Caucasian, 13% African American, 7% Hispanics, 2% more than one race and 3% for other. For gender, females received n=44,266 procedures, while males utilized n=37,407.

Discussion

Although there is little consensus among dental professionals on which performance measures should be adopted, the oral health indicators chosen for this report expressed the philosophy of the dental management of Crescent Community Health Center. The 10 oral health indicators, established by Healthy People 2020, HRSA, Maternal Health, National Quality Forum, DHHS, and Crescent Community Health Center's management were chosen based on the commitment these developers have to improving oral health outcomes for vulnerable populations. The objective of collecting data on the 10 measures were to show evidence of provider performance, accountability to stakeholders and provide the benchmarks for quality enhancement and ultimately improve oral health outcomes for at-risk populations.

The data showed there was an increase in number of unduplicated patients (86%), as well as an

Figure 1: Type of Dental Procedures Utilized for Fiscal Year 2007 to 2008 Through Fiscal Year 2011 to 2012



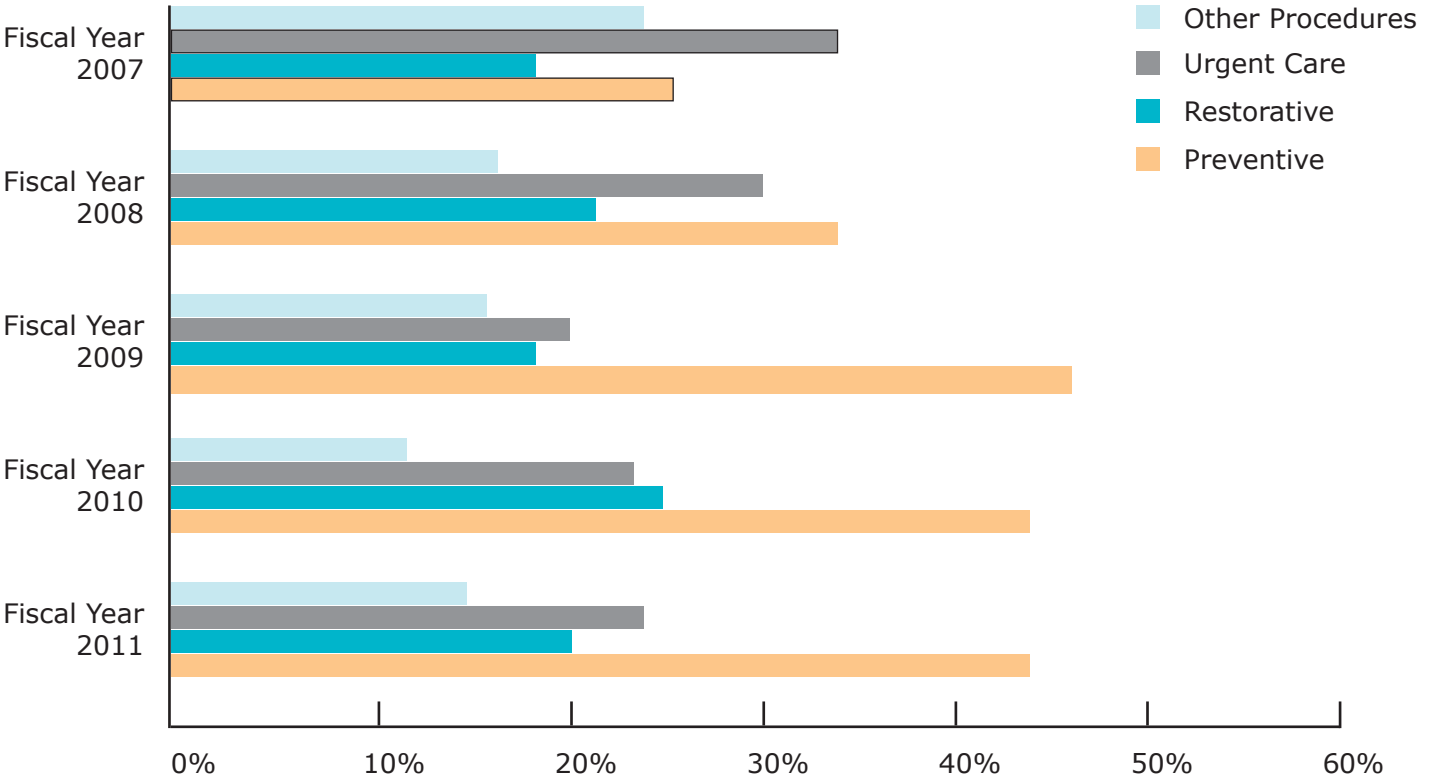
increase of 71% in the number of procedures from fiscal year 2007 to 2008 to fiscal year 2011 to 2012. The dental hygiene department provided significant impact regarding preventive services for oral health performance indicators #2, #3, #5, #6, #7, #8 and #10. Utilization for preventive procedures showed an overall increase of 106%, restorative increased by 87% and urgent care by 26%. Gender and age at the time of service remained stable in relation to procedure type. For payer type, Medicaid utilization declined slightly while the uninsured population grew. This result implies Crescent Community Health Center is reaching the uninsured populations of this community as affordability to oral health care increases access and reduces barriers to services.

Regarding oral health indicator #3, sealant utilization needs to increase. The Pew Center report, *Falling Short: Most States Lag on Dental Sealants*, provided a strong message that most states are ineffective when it comes to providing sealants to children.[29] Pew data showed out of 50 states, only North Dakota, Maine,and New Hampshire where given an "A" grade for sealant placement. Majority of states received a "C" or lower.[29] While dental hygienists and dentists understand the importance of sealant placement, our data showed a shortfall of sealant utilization for this community health center. These findings suggest the necessity for increased advocacy, diagnoses, treatment planning, and educating parents on the importance of the benefits of timely sealant placement.[30] In a recent New Hampshire study by Chi et al, the proportion of sealant placement compared to all other procedures averaged 12%.[31] The results of the current study showed only 7% of all procedures were sealants, roughly half found in Chi's study. With approximately 80% of all children under the age of 21 having Medicaid and 10% privately insured, this community health center appears to be falling short when it comes to sealant application.

The goal to reduce the proportion of children (ages 3 to 5) receiving restorative or extraction procedures, while increasing preventive procedures, showed measurable change. Preventive procedures increased by 59% (n=545 to n=865) and restorative procedures increased 56% (n=110 to n=172). Extractions showed the least amount of change at 17% (n=117 to n=137) over the 5 years measured. These findings indicate, by reducing barriers, access to preventive utilization for Medicaid children may replace more invasive procedures.[32] Again, the Crescent Community Health Center dental hygienists' role as a preventive specialist influences the change from extractions to restorative through preventive intervention. Hygienists provide and track oral health education, nutritional guidance, and fluoride placement, leading to improved oral health outcomes for this age group (3 to 5).

Additional research is needed to assess the number of patients who received a comprehensive exam compared to the number of patients completing their treatment in a measurement year (oral health indica-

Figure 2: Age Category 65 and Older by Procedure for Fiscal Year 2007 to 2008 Through Fiscal Year 2011 to 2012



tor #6, patients age 18>). The prevalence of unmet dental needs is an ongoing problem for low-income populations, placing them at risk of advanced oral health conditions.[33] This dental department needs to use this data to develop a goal to complete treatment plans base on the number of comprehensive exams performed. Developing a plan to track incomplete treatment plans can facilitate better health outcomes for Crescent Community Health Center dental patients.

Most importantly, results of this study revealed the contribution dental hygienists make to this health center, providing close to 40% of all services. Overall, preventive utilization has increased from 39% to 47%, and urgent care utilization showed a slight decline from 15% to 13%. Dental hygienists at this FQHC play a critical role in the success of patient oral health outcomes. The dental hygienist's role in oral health promotion in this clinic encompass a multitude of services: oral cancer screenings, nutritional guidance, blood pressure screenings, smoking cessation, the delivery of periodontal care, and counseling on the connection between oral health and general health for at-risk populations. Evidence shows that dental hygienists play an integral part in the success in meeting the oral health goals set forth in this report.

Identifying uninsured children should be a priority of Crescent Community Health Center. Even though the percent Medicaid patients (ages 2 to 21) receiving at least 1 dental service in a measurement year remained stable, there were 16% of children in this age group who were uninsured. This data should encourage this community health center's dental administration to educate and facilitate enrollment of this uninsured child population to an appropriate state children insurance program, as this should translate into increased utilization of all procedure types for this age group.[34]

The combinations of barriers such as poverty, living in a rural community, paucity of providers, provider acceptance, add to oral health inequities.[15,35] This Iowa health center provides a safety-net for both prevention and urgent dental care needs for patients experiencing utilization barriers. Given the number of urgent care visits (n=16,936 over a 5-year period), this data provides a critical tool to support the premise this Iowa community health center's provision of care may affect local hospital emergency departments.[36] The goal for Crescent Community Health Centers is to provide continued access to oral care by reducing barriers that prevent equity in oral health for people of low socioeconomic status, thus reducing the need for emergency department visits.[36]

Limitations

The limitations of this report lay in the lack of standardization of oral health measures among federally qualified health centers with a dental component.

Without integration of oral health measures among health centers, there is no mode to compare discrete measures with other dental departments. Outcome measures evaluated here are not meant to be generalizable to private practice settings but to be used to improve Iowa community health centers dental programs. The strength of this data is that is provides other centers with the model to compare and design measures significant and meaningful to their dental population.

Conclusion

Providing baseline data is instrumental in analyzing deficiencies as well as successes. These oral health indicator measures created a jumping off point for this Iowa health center and provided a model for other dental departments of federally qualified health centers to adopt. Outcome measures provide the tools to create and secure grants for dental programs; they show trends and benchmarks for establishing future goals that improve oral health outcomes for the patients we serve. Baseline measures are a tool, which can promote efficiency in planning for future years. They provide critical data for policy change. Measures promote collaboration between community health centers and lastly provide evidence to our community, stakeholders, professional colleagues, and local business leaders the benefits of having a community health center with a dental component in their community.

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Evaluating Utility Gloves as a Potential Reservoir for Pathogenic Bacteria

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Abstract

Purpose: This pilot study sought to determine the rate and degree to which gram-negative Klebsiella pneumoniae, Escherichia coli and Pseudomonas aeruginosa and gram-positive Staphylococcus aureus occurred on the inside of utility gloves used at University of Maine at Augusta, Dental Health Programs' dental hygiene clinic.

Methods: Five steam autoclave utility gloves were randomly selected to serve as control and a convenience sample of 10 used utility gloves were selected from the sterilization area. A sample was collected from a predetermined surface area from the inside of each steam autoclave utility glove and used utility glove. Each sample was used to inoculate a Petri plate containing 2 types of culture media. Samples were incubated at 37º C for 30 to 36 hours in aerobic conditions. Colony forming units (CFU) were counted.

Results: Confidence intervals (CI) estimated the rate of contamination with gram-negative K. pneumoniae, E. coli and P. aeruginosa on the inside of steam autoclave utility gloves to be n=33 95% CL [0.000, 0.049], used utility gloves to be n=70, 95% CL [0.000, 0.0303]. Data estimated the rate of contamination with gram-positive S. aureus on the inside of steam autoclave utility gloves to be n=35, 95% CL [0.233, 0.530], used utility gloves to be n=70, 95% CL [0.2730, 0.4975]. Culture media expressed a wide range of CFU from 0 to over 200.

Conclusion: The risk of utility glove contamination with gram-negative bacteria is likely low. The expressed growth of S. aureus from steam autoclave utility gloves controls raises questions about the effectiveness and safety of generally accepted sterilization standards for the governmentally mandated use of utility gloves.

Keywords: pathogenic bacteria, infection control, utility gloves, dental hygiene

This study supports the NDHRA priority area, **Occupational Health and Safety:** Investigate methods to decrease errors, risks and or hazards in health care and their harmful impact on patients.

Introduction

Multi-drug resistant (MDR) bacteria such as methicillin-resistant Staphylococci aureus (MRSA) have evolved from hospital-acquired infections to community-acquired infections. Increasingly, MDR bacterial infections have the potential to cross the boundaries of hospital intensive-care units to those most susceptible.[1-3] The global emergence and accelerated evolution of MDR bacteria has resulted in a call by researchers for more effective infection control measures in an attempt to halt their dissemination.[2,4]

It has long been recognized that the single most effective means of preventing the spread of disease is proper hand hygiene measures which includes the use of protective gloves.[5-7] Beginning in 1986, governmental organization such as Centers for Disease Control and Prevention (CDC), and Occupational Safety & Health Administration (OSHA) have recommended and mandated respectively the use of utility gloves as part of dental health-care providers (DHCP) personal protective equipment (PPE) to prevent percutaneous and chemical injury during sterilization and disinfection procedures.[8,9] Unlike disposable examination gloves, utility gloves are not considered a medical device and manufacturing standards are not regulated by the U.S. Food and Drug Administration.[5,8,9] Utility gloves are meant to protect DHCP's from percutaneous/chemical injury rather than a means to prevent cross-contamination and/or cross-infection.[5,8,9] There is no universally established protocol for the donning, use, disinfection and sterilization; protocols are largely designed and implemented by dental hospitals, academic dental clinics and private dental practices with minimal guidance by those governmental and professional agencies that recommend and mandate their use.

A review of the literature detailed the evolution of handwashing and protective gloves as a means of infection control in health care. It also analyzed the elements of disease transmission, the role of resident and transient hand flora in cross-contamination/cross-infection, and the top 5 MDR bacteria as a possible underestimated reservoir for pathogenic bacteria. When utility gloves are used to carry out disinfection and sterilization procedures, they are donned with bare hands. The written policy, which follows governmental guidelines, instructs "Utility gloves

must be washed with antimicrobial soap, rinsed and sprayed with a disinfectant after each use" should repeated use be anticipated in the same day.[10] Used utility gloves are steam autoclaved at the end of each day at 250 pounds per square inch for 20 minutes.

The "clean hand" technique implemented for donning and removing utility gloves requires multiple steps and can be repeated numerous times during a clinical day, increasing the risk of infection control error. As utility gloves are pulled on, the length of utility glove cuffs extend beyond the length of exam glove cuffs to the contaminated sleeve of lab coats increasing the risk of transferring bacteria to the inside of utility gloves. The very act of washing utility gloves with soap and water may inadvertently allow for contamination. Water could travel the length of the glove, transporting bacteria from the outside to the inside via loose utility glove cuffs. The contaminated utility glove would then serve as a reservoir for bacteria, causing the recontamination of DHCP's hands with each subsequent use. The inside of utility gloves may provide an underestimated growth medium, given the literature's verification that proliferation of bacteria increases rapidly in warm wet environments,[11,12] combined with numerous other factors, such as the accumulation of hand sweat, inadvertent water contamination during the disinfection protocol, and the survival times of pathogenic bacteria on inanimate surfaces.[13]

It was theorized this "perfect storm" of like conditions could diminish the safety for which their donning was intended to prevent. It is well established that dry or damaged hands can serve as a portal of entry as well as increase the risk of transient bacterial carriage and subsequent cross-contamination by way of DHCP's hands.[5,14]

No study was found to refute or support the presence or absence of pathogen bacteria on the inside of utility gloves. Four bacteria that accounts for 34% of all reported hospital-acquired infections were selected for the study.[15] Since the environmental survival of pathogenic bacteria parallels the environmental survival of MDR bacteria of the same species, the presence of pathogenic found inside utility gloves served as an indication that environmental conditions equally favored the growth of MDR bacteria introduced into the same environment.[12] A pilot study was conducted to lend empirical data and to help determine the need for the re-evaluation of the utility glove protocol by answering the following questions:

1. After a day of use, what frequency are gram-positive S. aureus, K. pneumoniae, E. coli and P. aeruginosa present on the inside of used utility gloves?
2. To what degree are utility gloves contaminated?
3. Does the degree of contamination match the expected outcome?

Methods and Materials

Institutional review board approval was granted. The researcher incurred all costs and no financial stakes from the design, conduction or analysis of this pilot study were gained.

Each Wednesday for 6 weeks, 5 steam autoclaved utility gloves from the clean utility glove storage container were randomly selected to serve as control. A convenience sample of 10 used utility gloves placed in the sterilization area for sterilization following an 8 hour clinic day were selected for sampling. The randomness of the used utility gloves samples was defined by the random number of times the gloves are worn, the random size ranging from small, medium, large and extra-large, the variation in hand washing techniques and the variation of unique bacteria found on individual hands.

Utilizing aseptic technique, the inside of each utility glove was turned inside on a fabricated hand form to expose the index finger, palm area and thumb. Utilizing standard biological swabbing technique, a sterile swab moistened with sterile saline was used to collect a sample from each of the utility gloves. The sampling area originated from the index finger, continued from the index finger into palm area and then extended to the tip of the thumb. The swab was used to inoculate the center area of 2 Fisher Brand Sterile 100 mm x 15 mm Polystyrene Petri dishes containing Mannitol Salt agar (Carolina Biological Supply Company, Burlington, NC) and MacConkey agar (Baltimore Biological, Baltimore, MD). A new sterile swab moistened with sterile saline was used to uniformly distribute the inoculum on the Mannitol Salt agar (MSA) employing a standard streak method. A second sterile swab moistened with sterile saline was used to distribute the inoculum on the MacConkey agar employing the same streak method. Additionally, a Petri plate of Mannitol Salt and MacConkey culture media were uncovered at the beginning of the sampling session and covered at the end of the session to serve as an airborne control.

The samples were incubated at 37º C for 30 to 36 hours in aerobic conditions. Each plate was evaluated for CFUs. MSA is selective for salt-loving bacteria such as Staphylococci and differential in that pathogenic species of Staphylococci typically produce yellow colonies with yellow zones. Initially, S. aureus was identified by colony morphology, gram stain and the microscopic examination. Subsequent identification of S. aureus was identified by distinct visual appearance of colony morphology on Mannitol Salt agar. Gram-negative K. pneumoniae, E. coli and P. aeruginosa were identified by the distinct visual appearance on the selective and differential MacConkey culture media. CFU were counted up to 200 per Petri plate. The CFU counts were assigned a range of values to further qualify the degree of contamination expressed per Petri plate as shown in Table I.

Analysis and Statistics

Confidence intervals (CI) were constructed to estimate the rate of contamination. CI's were viewed as the probability that any randomly selected utility glove would express CFU contamination with a 95% confidence level (CL). Data collected from the pilot week of this pilot study were included in the statistical analysis because the results were consistent with the study data.

Results

Rate of contamination: gram-negative K. pneumoniae, E. coli and P. aeruginosa: Petri plates of MacConkey agar expressed no growth for both steam autoclave utility gloves and used utility gloves. Table II summarizes the estimated rate of contamination expressed in confidence intervals for steam autoclave utility glove controls and used utility glove samples.

Degree of used utility gloves contamination: K. pneumoniae, E. coli and P. aeruginosa: No Petri-plate of MacConkey agar expressed gram-negative CFU. Therefore, the degree of contamination could not be calculated.

Rate of contamination: gram-positive S. aureus: Petri plates of Mannitol Salt agar expressed growth for both steam autoclave utility gloves and used utility gloves. Table III summarizes the estimated rate of contamination expressed in confidence intervals for steam autoclave utility glove controls and used utility glove samples.

Degree of used utility gloves contamination: gram-positive S. aureus: The degree of used utility gloves contamination was extremely varied over the seven week sampling period. Therefore the contamination rates were calculated separately for each of the sampling periods. The TNTC entries required an upper limit value to be included. A value of 1400 CFU was assigned to TNTC. Table IV presents the estimated mean intensity CFU with a 95% CL for each sampling periods.

To further explore the relative intensity of used utility gloves samples, the chronology of weeks were arranged to identify perhaps three levels of contamination intensity as illustrated on Table V. By comparing the lower CI and the upper CI limits with the mean, it is clear there is a wide range of contamination from week to week. Arranged in this way, the intensity of contamination is at the lowest level in weeks 3 and 6, followed by weeks zero (pilot week), 1, and 4, with weeks 2 and 5 at the highest level of contamination intensity.

Table I: Designation of CFU to Degree of Contamination per Petri Plate

CFU per Petri Plate	Degree of Contamination
<20	light
20 to 100	moderate
100 to 200	heavy
>200 too numerous to count (TNTC)	gross

Table II: Estimated Rate of Contamination with Gram-Negative K. pneumoniae, E. coli and P. aeruginosa

Steam Autoclave Utility Gloves	n=33 CL 95% (0.000, 0.049)
Used Utility Gloves	n=70 CL 95% (0.000, 0.030)

Table III: Estimated Rate of Contamination with Gram-Positive S. aureus

Steam Autoclave Utility Gloves	n=33 CL 95% (0.233, 0.530)
Used Utility Gloves	n=70 CL 95% (0.273, 0.498)

Table IV: Estimated Mean S. aureus CUF for Each Week of Data Entries

Week	Mean	Lower CI limit	Upper CI limit
0 (pilot week)	4.10	2.84	5.30
1	2.90	1.91	3.97
2	997.28	978.18	1016.80
3	0.20	0.00	0.48
4	5.90	4.43	7.46
5	153.47	145.95	161.22
6	0.10	0.00	0.30

Discussion

Frequency of used utility gloves contaminated and expected outcomes: It was hypothesized that gram-negative culture media would not express growth of K. pneumoniae, E. coli or P. aeruginosa. No petri plate expressed growth and therefore, the raw date matched the expected outcome of zero. CI based on 70 samples and a 95% CL estimated the rate of contamination was no higher than 3%.

It was hypothesized that gram-positive culture media would express growth of S. aureus but would not exceed the upper limits of the average carriage rate of 30% found in general population in the U.S.[17] The raw data yielded a higher than expected outcome of

38.5%. CI, based on 70 samples, and a 95% CL, estimate the rate of contamination to be between 27% and 50%. However, the unexpected growth of S. aureus from steam autoclave utility gloves controls confounded the used utility glove sample results.

The raw data of steam autoclave utility gloves showed a contamination rate of 37.1%. CI, based on 35 samples, and a 95% CL, estimate the rate of contamination to be between 23% and 53%.

Degree of contaminated with S. aureus: The raw data of steam autoclave utility glove controls and statistical analysis of used utility glove samples produced a wide variation of contamination levels ranging from under 20 CFUs to over 200 CFUs per Petri plate. Beyond the degree of contamination, CI's suggest a wide variation in the intensity of contamination.

When the used utility glove sample mean intensity confidence intervals are paired with the corresponding week of raw steam autoclave utility glove CFU control data, the contamination intensity and the range of contamination are closely matched (Table VI). The similarities of steam autoclave utility gloves to used utility gloves samples suggest the possibility of a correlation. It is reasonable to hypothesize steam autoclave utility gloves contamination was a contributing factor to the S. aureus growth expressed from the used utility gloves samples. Additionally, the 3 levels of contamination shown in Table V suggest there is some mechanism or process or event that occurs some weeks and not others that might explain the high level of variation between weeks.

Steam autoclave utility glove contamination with S. aureus: Weekly biological spore tests were conducted in the morning and utility gloved sampling was conducted in the afternoon of the same day. The spore test results indicated all autoclaves were functional. It seems unlikely that functional steam autoclaves would kill highly resistant spores and not kill the less resistant staphylococci bacteria. The possible mechanism, process or event that preceded steam autoclave utility gloves contamination from functional autoclaves present concerns about the standard steam autoclave sterilization procedures and the subsequent handling/ storage of sterilized utility gloves. A number of possible contributing factors must be considered:

- Over-loading autoclave: Overloading may not allow for sufficient penetration for the utility gloves located closer to the middle of the autoclave.
- Length of time utility gloves were stored: Utility gloves were stored in a covered storage container over the summer. It is possible that the utility gloves became contaminated due to an extended period of storage.

Table V: Three levels of Used Utility Gloves Sample Contamination Intensity Grouped by Week

Week	Mean CFU	Lower CI limit	Upper CI limit
3	0.20	0.00	0.48
6	0.10	0.00	0.30
0 (pilot week)	4.10	2.84	5.30
1	2.90	1.91	3.97
4	5.90	4.43	7.46
2	997.28	978.18	1016.80
5	153.47	145.95	161.22

Table VI: Comparison: Used Utility Gloves Lower and Upper CI of Contamination Intensity to Steam Autoclave Utility Gloves Raw Data

Week	Used Utility Gloves contamination intensity lower CI	Used Utility Gloves contamination intensity upper CI	Steam Autoclave Utility Gloves range of CFU per plate/raw data
3	0.00	0.48	0
6	0.00	0.30	<20
0 (pilot week)	2.84	5.30	<20 to >200
1	1.91	3.97	<20
4	4.43	7.46	<20
2	978.18	1016.80	100 to >200
5	145.95	161.22	100 to 200

Table VII: CI Estimated Rate of Petri Plate Contamination

MacConkey culture media	95% CI (0.011, 0.054)
Mannitol salt culture media	95% CI (0.022, 0.073)

- Condition utility gloves were stored: Utility gloves that were stored wet could have facilitated bacterial growth if S. aureus was already present. It has also been shown that S. aureus and MRSA have been recovered after periods of desiccation.[12]
- Airborne contamination: Airborne controls of Mannitol salt agar yielded a mean of 2.14 CFU per Petri plate for the 7 week trails.
- Damaged Utility Gloves: Damaged utility gloves such as tears or could provide and entry point for environmental S. aureus contamination.

Alternatively, contamination could explain the expression of S aureus on culture mediate from samples taken from steam autoclave utility gloves. Given

the technique sensitive method of preparing, handling and inoculation culture media, technique error cannot be ruled out.

Study limitations: steam autoclave utility gloves as "negative" controls: The study intended to evaluate the presence or absence of specific pathogenic bacteria inside utility gloves as a result of the protocol for donning and removing them during a day of clinical use. The contamination of steam autoclave utility gloves controls with S. aureus confounded used utility gloves sample results.

The study design did not include controls to estimate the rate of sterile swab and sterile saline contamination. Culture media was prepared by the researcher and inspected for contamination prior to use. The number of contaminated culture media was recorded each week. The estimated rate of contamination of solid culture media preparation was evaluated with CI (Table VII).

Testing such as blood agar, alpha-hemolysis, coagulase activity and catalase should have been conducted to further differentiate of S. Aureus CFU on the Mannitol Salt agar. There is no standardized method for sampling environmental surfaces largely due to the vast variety of surface areas chosen to sample by researchers. UMA, Dental Health Programs provides 4 sizes of utility gloves; small, medium, large and extra-large. The size variation helped to define the randomization of the utility gloves sampled but also served to weaken the strength of the study outcomes because the size of surface area sampled inside the utility gloves varied corresponding to the size of the utility glove.

The sample size was small for CI to be constructed. The confidence intervals would be narrower given a more precise estimate of the contamination rates. The arbitrary assignment of 1,400 CFU to any value beyond the CFU count of 200 for the purpose of measuring the intensity/degree to which utility gloves were contaminated does not accurately represent the true level of contamination and therefore, limits interpretation of the data represented on Tables I, V and VI.

The emergence and dissemination of MDR bacteria begs a concerted effort by all health-care providers to review and, if necessary, revise current infection control policies and procedures. The small sample size of this pilot study limits the conclusions that can be drawn. However, confidence intervals indicate the risk of utility glove contamination with gram-negative bacteria to be low. The findings of this study support current literature suggesting a low risk of transmission and/or infection with gram-negative bacteria in dentistry.[16]

Study design limitations and study design flaws notwithstanding, the unexpected contamination of steam autoclaved utility gloves illuminate a potential gap in infection control. The ramifications of DHCP's donning utility gloves contaminated with S. aureus are unclear. However, steam autoclave utility gloves's contaminated with S. aureus may put DHCP's at risk for infection and increase the risk of becoming hand carriers of pathogenic bacteria.[7,17]

Utility gloves, considered a non-medical device, are not regulated by the FDA. Therefore, the quality of utility gloves varies by manufacturer specifications. This researcher found no studies in the literature evaluating the efficacy of utility gloves for their intended purpose of protecting DHCP's from chemical and puncture injury nor were any studies found evaluating steam autoclave effects and/or efficacy on utility glove material. The data collected from this pilot study can serve as an impetus for a more scientific and controlled study.

Conclusion

The risk of utility glove contamination with gram-negative bacteria is low. The expressed growth of S. aureus from steam autoclave utility gloves controls raises questions about the effectiveness and safety of generally accepted sterilization standards for governmentally mandated use of utility gloves. Subsequent research should be conducted to more thoroughly differentiate, count and statistically analyze microbial flora found on the inside of utility gloves. Research should also be conducted to determine if there are differences in material quality between manufacturers and to evaluate the effectiveness of steam autoclave sterilization. In the era of evidence-based practice, the lack of studies representing the mandated use of utility gloves, combined with non-standardized protocols, increases the potential risk of discrepancies in infection control outcomes.

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A Survey of Clinical Faculty Calibration in Dental Hygiene Programs

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Abstract

Purpose: This study investigated the calibration efforts of entry-level dental hygiene programs in the U.S. Four aspects were explored, including attitudes, characteristics, quality and satisfaction, to evaluate current calibration practices.

Methods: A descriptive comparative survey design was used. Directors of accredited dental hygiene programs (n=345) were asked to forward an electronic survey invitation to clinical faculty. Eighty-five directors forwarded the survey to 847 faculty; 45.3% (n=384) participated. The 37-item survey contained multiple-choice and Likert scale questions and was available for 3 weeks. Descriptive statistics were used to analyze demographic data and research questions. The Kruskal-Wallis, Spearman Correlation Coefficient and Mann-Whitney U tests were employed to analyze hypotheses (p=0.05).

Results: The demographic profile for participants revealed that most worked for institutions awarding associate entry-level degrees, had 1 to 10 years' experience, taught clinically and didactically, and held a master's degree. Clinical instructors valued calibration, believed it reduced variation and wanted more calibration. Some were not offered quality calibration. There was a difference between the entry-level degree awarded and the program's evaluation of clinical skill faculty reliability, as analyzed using the Kruskal-Wallis test (p=0.008). Additionally, full-time versus part-time educators reported more observed student frustration with faculty variance, as evaluated using the Mann-Whitney U test (p=0.001, bfp=0.004).

Conclusion: Faculty members value calibration's potential benefits and want enhanced calibration efforts. Calibration efforts need to be improved to include standards for measuring intra- and inter-rater reliability and plans for resolving inconsistencies. More research is needed to determine effective calibration methods and their impact on student learning.

Keywords: dental hygiene, faculty, clinical skills, reliability, validity, calibration, education

This study supports the NDHRA priority area, **Professional Education and Development:** Investigate the extent to which new research findings are incorporated into the dental hygiene curriculum.

Introduction

In dental hygiene education, clinical instructors with varying experience, backgrounds and education unite with the common goal of creating competent graduates prepared to care for the public. This unique expertise provides a wealth of knowledge not found in textbooks. However, this diversity might also interfere with providing quality dental hygiene education.[1]

While the educational goal might be unified, the teaching methods and clinical techniques of instructors might be conflicted. Faculty variation distracts the students from focusing on patient care and redirects them to satisfying the evaluating instructor.[2] Dental hygiene students develop competence through didactic instruction, evaluation of clinical care and performance modeled by instructors. There are often multiple ways to perform efficacious skills. Novice students learning to think critically and problem-solve might experience difficulty sorting through instructor inconsistencies.

Students begin their careers with education as their sole foundation. Reducing variation to better meet the Standards for Clinical Dental Hygiene Practice and accreditation standards will help programs accomplish student competencies in patient care, ultimately benefiting the public.[3] As programs improve instruction and assessment methods, graduates will be better prepared for ever-changing patient demands. Investigating current efforts should aid in planning and implementing effective future calibration offerings.

Previous medical education research investigated student perceptions of faculty variation, variation causes, calibration attempts and faculty development. Several studies demonstrated considerable variation in assessment and clinical judgment among health care education faculty.[4-10] Dental education faculty exhibited variation in periodontitis diagnosis and treatment planning,[7] cavity preparation assessment,[9] calculus detection,[4] radiographic

interpretation,[8] periodontal probing[11] and student performance assessment.[10]

Qualitative research has described faculty and student frustration with instructor inconsistency.[2,12-14] One study reported only 53% of dental students were satisfied with the consistency of clinical instruction and assessment.[12] Common concerns reported were different standards and frequent disagreements among instructors.[12] Students reported altering clinical performance to satisfy instructors.[12] Twenty percent of perceived program weaknesses revolved around faculty inconsistency.[12]

In investigating possible variation causes, some researchers indicated faculty status as a culprit,[10] while others suspected varying educational and/or professional backgrounds,[1,11,14] personal preference differences, and aging faculty populations could be responsible.[1] For example, grades for student performance were assigned differently by full-time faculty, residents and part-time clinical faculty.[10] This variation was possibly due to differing calibration requirements of faculty groups; part-time faculty were calibrated yearly, whereas full-time faculty were only calibrated upon hiring.[10] Variation was also linked to years of clinical experience. One study involving periodontal probing accuracy showed the highest agreement among faculty with more experience.[11]

Calibration methodology studies revealed varied, but promising, results.[4,6,8] While calibrating faculty in explorer calculus detection, researchers concluded calibration became increasingly difficult as calculus detection became more complex.[4] Studies have demonstrated short- and long-term potential for calibration efforts to reduce radiographic interpretation variation[8] and cavity assessment preparations.[6] Similarly, the collective literature on faculty development is optimistic, revealing high levels of faculty appreciation and desire for more professional development opportunities.[15-18] Faculty members have reported altering their teaching and/or assessment methods following calibration exercises, and they perceive un-calibrated colleagues as resistant to changing teaching methodology.[16] An operational definition of calibrate is "to standardize as a measuring instrument by determining the deviation from a standard so as to ascertain the proper correction factors ... to measure precisely; especially to measure against a standard."[19]

Available literature on clinical faculty variation and calibration might seem ample; however, dental hygiene is clearly underrepresented.[4] The majority of studies have been conducted in medical and dental educational programs. The level of variation and consequences cannot be assumed to be similar among different types of health care programs. Additionally, little research is devoted to faculty development for teaching in clinical (versus didactic) settings.[16]

Based on literature reviewed, research questions and hypotheses were developed to answer questions regarding calibration efforts for entry-level dental hygiene clinical faculty members. The questions were:

1. What were the faculty attitudes regarding calibration?
2. What were the characteristics and quality of the current calibration efforts?
3. Were faculty satisfaction with their program's calibration efforts?

Methods and Materials

The voluntary electronic survey involved minimal risk and was approved as exempt from review by the Human Subjects Committee (#3706) at Idaho State University. Instructors who taught in accredited dental hygiene clinical programs during the 2011 to 2012 academic year were invited to participate, regardless of employment status, years of experience or responsibilities. A census of the entire population was used to include as many clinical instructors as possible and obtain a large sample. Supervising dentists were excluded.

The self-designed 37-question survey was developed by reviewing the literature related to calibration. This review steered the question development. Participants' demographics were collected by including 7 closed and open-ended questions. Attitude about calibration at the institution was assessed using 8 Likert type questions on a scale ranging from 1 being "strongly agree" to 5 for "strongly disagree." Characteristics of calibration were evaluated incorporating 5 closed and open-ended questions. Quality of the calibration was examined using 7 items and satisfaction of calibration efforts with 10 items that were constructed using the 5-point Likert type scale.

The 37-item questionnaire was assessed for content validity by performing a Content Validity Index (CVI).[20] Experts were asked to rank each survey item for relevancy to research questions. Questions ranked as "not relevant" or "somewhat relevant" were revised or excluded. A minimum CVI score of 0.75, indicating at least 75% of experts viewed the item as "relevant" or "quite relevant," was required for inclusion. Reliability was analyzed using a test-retest format. An agreement of 75% or greater among 8 participants indicated acceptable reliability. Items below 75% were revised for increased clarity. The pilot study determined 92.6% reliability between the test and retest responses.

The final survey was constructed using SurveyMonkey® to reduce cost while enhancing efficiency and convenience. Participant consent was obtained in the survey introduction. Survey access was denied to non-consenting participants. To ensure anonymity and confidentiality, SurveyMonkey® did not store personal identifiers. Participants could discontinue the survey at any time prior to submitting their responses. Data were downloaded for statistical analysis and reported in aggregate form.

Dental hygiene program directors' emails were obtained from the American Dental Hygienists' Association and from the programs' websites.[21] An email was sent to directors of all 345 programs in the U.S., asking them to forward a survey invitational letter and Uniform Resource Locater (URL) to all clinical instructors. Directors were asked to indicate participation by responding to the email and providing the number of clinical faculty receiving the survey invitation. An incentive drawing for one prepaid $100 Visa® card encouraged director participation. One week later, a second email was sent to non-responding directors, and a reminder email was sent to those who indicated participation, asking them to forward a reminder letter to clinical faculty. This follow-up procedure was repeated 1 week later; the survey was available for 3 weeks.

Research questions were analyzed using descriptive statistics. Mean, minimum and maximum values were calculated for Likert-style questions. Frequencies and percentages were calculated for multiple-choice items. Hypotheses involved ordinal data and were tested with non-parametric inferential statistics. The Kruskal-Wallis test was used to detect differences within variable groups, the Spearman Correlation Coefficient was used to identify relationships between ordinal variables and the Mann-Whitney U test determined differences on ordinal scales between 2 variables ($p=0.05$). The Bonferroni correction was utilized to control Type I statistical errors encountered when multiple analyses were performed.

Results

Eighty-five program directors (24.6% of those contacted) forwarded the survey invitation to their clinical faculty (n=847). While 393 faculty members consented to and opened the survey, 384 (45.3% of those invited) completed it. One hundred and three (26.8%) respondents were not able to answer questions regarding the characteristics of, quality of and satisfaction with calibration efforts, because they were not offered calibration during the 2011 to 2012 academic year; thus, only 281 responses were possible for the analysis of these questions. Additionally, some participants chose not to answer specific questions, resulting in differing numbers of responses (254 to 384) for the remaining survey items.

The demographic information for the sample was evenly distributed from each geographic area (Table I). The majority of respondents were faculty members who taught both clinically and didactically (55.7%, n=214) in programs awarding entry-level associate degrees (47.9%, n=178). One-third (38.2%, n=147) worked only in the clinical setting. Half of the respondents held a master's degree (50.8%, n=193) and worked full-time (53.0%, n=196).

Table II conveys the results of survey items that investigated attitude toward calibration based on the Likert scale of 1=strongly agree, 2=agree, 3=undecided, 4=disagree and 5=strongly disagree. Participants indicated a strong mean agreement (1.1) and no disagreement with viewing faculty calibration as an important aspect of educating students. Responses also revealed an overall willingness to attend non-mandatory calibration exercises. Clinical instructors perceived students were more satisfied with their clinical experiences when instructors were calibrated, and frustrated when instructors were not calibrated. There was agreement (2.1) with students changing their performance depending on their evaluator, and agreement with instructor status and varying professional judgment presenting difficulties in calibrating faculty.

The characteristics of calibration questions revealed that full-time and part-time educators were required to participate (69.0%, n=189) (Table III). Nearly one-fourth of the participants reported attendance was not required for clinical faculty. Participants could also select the answer choice of "other" and provide written responses, which included reports of calibration being required, yet not attended, or calibration only implicating specific faculty members, such as those involved with particular skills or clinics.

When asked about calibration frequency, the majority of participants (74.6%, n=200) were offered calibration every year, semester or quarter. A small portion (7.1%, n=19) was offered calibration only once every 2 to 4 years. Two-thirds (66.5%, n=169) reported their institutions offered calibration on a routine basis, although many indicated calibration was offered whenever deemed necessary (41.7%, n=106), such as when a problem arose or a new technique was introduced. "Accreditation" and "new faculty" were not significant reasons for calibrating clinical faculty. Participants who selected "other" and provided written responses (1.6%, n=4) included calibration being offered infrequently, when needed, or when external continuing education classes were available as a means of calibration. Other written responses mentioned that getting the entire faculty together for participation was challenging.

Calibration compensation was included in contracted salary/pay for about one-third (35.0%, n=95) of

Table I: Demographic Variables of Respondents (n=384)

Demographic Characteristics	Participants	Percent	n
Geographic region in which program is located (n=371)	Northeast	20.8	77
	Midwest	27.8	103
	South	30.7	114
	West	20.8	77
Entry-level degree for dental hygiene awarded by the institution (n=372)	Certification/Associate of Applied Science	25.8	96
	Associate of Science, Arts, or Allied Health	47.9	178
	Bachelor of Science	26.3	98
Years employed as clinic instructor (n=369)	1 to 5	31.4	116
	6 to 10	23.3	86
	11 to 15	16.8	62
	16 to 20	10.6	39
	21 or more	17.9	66
Employment status (n=370)	Part-time	47.0	174
	Full-time	53.0	196
Faculty responsibilities (n=384)	Clinical instructor only	26.0	100
	Clinic administration only	0.5	2
	Both clinical instructor and clinic administration	11.7	45
	Both clinical instructor and didactic instructor	55.7	214
	Program administrator	2.6	10
	Other combination of instruction and/or administration	3.4	13
Faculty member's highest degree (n=380)	Associate of Applied Science	2.1	8
	Associate of Science, Arts, or Allied Health	6.1	23
	Bachelor of Science or Arts	36.1	137
	Master of Science or Arts	50.8	193
	Doctoral	5.0	19

the respondents, while another 38.5% (n=106) received no compensation. One-fifth (19.6%, n=54) of the participants were compensated on an hourly basis. Written responses (6.5%, n=18) revealed some institutions paid part-time, but not full-time educators, as it was considered a part of contracted duties, and other programs compensated one calibration session per semester. Receiving continuing education credit for calibration participation was another form of compensation, and some also received reimbursement for travel expenses. Scheduling calibration during regular working hours prevented some institutions from paying additional wages.

All clinical skills questioned in the survey were included in calibration exercises. Power instrumentation was calibrated the least (54.6%, n=142). Periodontal assessment/classification was the most commonly calibrated skill (85.4%, n=222). Written responses indicated that local anesthesia, computer training, grading and professional documentation also were calibrated.

The respondents were divided about the quality of their institutions' calibration (Table IV). Most participants indicated that calibration was held in a clinical setting (2.4) but were undecided if calibration consisted of discussion rather than skill calibration (2.5).

Table II: Summary of Attitudes Toward Calibration (n=384)

Statement	M	Min.	Max.
Clinical faculty calibration is an important aspect of educating dental hygiene students. (n=384)	1.1	1	3
Even if not required by my institution, I am willing to attend calibration exercises. (n=382)	1.4	1	4
Students are more satisfied with their clinical education when faculty members are calibrated. (n=379)	1.5	1	5
Students have indicated frustration with or concern about the lack of clinical faculty calibration. (n=383)	1.8	1	5
I am frustrated or struggle with my role as an educator when I am NOT calibrated. (n=378)	1.9	1	5
Students change their performance based on who evaluates them in the clinical setting. (n=381)	2.1	1	5
Differing instructor status (e.g. part-time versus full-time, assistant professor versus full professor, etc.) presents a challenge in calibrating faculty. (n=379)	2.4	1	5
It is difficult to calibrate clinical faculty due to differing professional judgment. (n=382)	2.4	1	5

Key: 1=Strongly agree; 2=Agree; 3=Undecided; 4=Disagree; 5=Strongly disagree

Respondents had varied attitudes when asked if calibration assessed clinical performance (3.3), a predetermined level of performance was required (2.5) or if calibration assessed reliability (3.1) and consistency (3.3). Faculty disagreed (3.8) that calibration efforts included a pre-test to determine pre-calibration performance.

Table V summarizes the survey questions pertaining to calibration satisfaction. Participants felt that calibration reduced variation and that they preferred more calibration (2.1). The mean values were between "agree" and "indecision" that calibration adequately addressed variation between members (2.6), calibration quality satisfaction (2.6) and individual faculty inconsistency being adequately addressed (2.7). The results were inconclusive (range 2.8 to 3.0) if faculty had been calibrated in each specified clinical skill.

The Kruskal-Wallis test (p=0.008) revealed a difference between the entry-level degree awarded and the program's evaluation of clinical skill faculty reliability. Further analysis of this finding with the Mann-Whitney U test revealed a difference between bachelor and associate entry-level programs (p=0.003, bfp=0.009). In addition, comparing certificate to bachelor entry-level programs was also suggestive of a difference (p=0.021, bfp=0.063). It was also found that full-time versus part-time faculty members reported more observed student frustration with faculty variance, as evaluated using the Mann-Whitney U test (p=0.001, bfp=0.004).

Discussion

Research shows instructors with less experience have greater levels of variation.[11] One-half of respondents worked part-time and had 10 or fewer years of experience as clinical faculty. If this sample is representative of the dental hygiene faculty population, one-half of clinical instructors have not yet reached the level of expert. It is accepted among various fields of study that reaching expertise requires 10 years of experience.[22] Experts view, process and react to situations differently than novices and have enhanced judgment and decision-making skills.[23]

For the majority of participants, all faculty members were required to attend calibration; however, participants described difficulties in getting part-time employees to attend, due to commitments to other jobs. One-half of respondents had master's degrees and were more likely to have completed advanced educational methodology coursework. More than one-third of the participants worked only in clinic (either instructors and/or administration) and might not have the same opportunities as instructors working in both the clinic and classroom for hearing student frustrations, discovering gaps between classroom theory and clinical practice, or benefiting from networking with other didactic colleagues.

The overall attitude of clinical faculty toward calibration was positive. Participants viewed calibration as very important and were willing to voluntarily participate. These findings are congruent with previous

Table III: Summary of Characteristics of Calibration Exercises (n=281)

Question	Response	Percent	n
Select the statement that best describes clinical faculty participation in planned calibration exercise. (n=274)	All clinical faculty were required to attend.	69.0	189
	Only full-time faculty were required to attend.	5.8	16
	Only part-time faculty were required to attend.	0.7	2
	Calibration was provided but not required.	23.4	64
	Other	1.1	3
My institution offered clinical skills calibration exercises (e.g. exploring, radiographic interpretation, treatment planning, etc.): (n=268)	once per month or more.	14.2	38
	once per semester or quarter.	41.4	111
	once per academic year.	33.2	89
	once every 2 to 4 years.	7.1	19
	Other	4.1	11
My institution offered calibration (check all that apply): (n=254)	on a regular, scheduled basis.	66.5	169
	when new clinical faculty were hired.	5.2	13
	when calibration is deemed necessary (evidence of a problem, new instrument or technique, etc).	41.7	106
	when accreditation was approaching.	3.5	9
	Other	1.6	4
Compensation for faculty calibration exercises: (n=275)	was built into my contracted salary/pay.	35.0	95
	was paid on an hourly basis for time spent in calibration.	19.6	54
	was a pre-determined amount per calibration session.	0.7	2
	was not offered.	38.5	106
	Other	6.5	18
Calibration workshops at my institution have covered topics including (check all that apply): (n=269)	powered instrumentation.	54.6	142
	hand-activated instrumentation.	73.1	190
	radiographic techniques and/or Interpretation.	64.6	168
	periodontal assessment/ classification.	85.4	222
	treatment planning.	66.2	172
	Other	4.2	11

research.[16,17,24] Clinical faculty also felt calibration improves student satisfaction with their educational experiences, while variance frustrates students. There was agreement that students change their performance to match the evaluating instructor, as reported in previous studies.[2] It is possible for such alterations to go unnoticed by faculty; surveying students might help determine the effects of variance on their education. Participants were divided in their attitude toward the effects of professional judgment

Table IV: Summary of Quality of Calibration (n=281)

Statement	M	Min.	Max.
Calibration was conducted in a clinical setting. (n=269)	2.4	1	5
Calibration efforts must result in a required determined level of performance being achieved for the clinical faculty member to be considered calibrated. (n=267)	2.5	1	5
Calibration efforts consisted of discussion rather than calibration of actual clinical performance. (n=270)	2.6	1	5
During calibration, my performance was compared to the performance of other clinical faculty. (n=267)	3.1	1	5
During calibration, the skill was evaluated more than once in order to assess my consistency. (n=268)	3.3	1	5
Calibration included an evaluation of my clinical performance. (n=267)	3.3	1	5
Calibration efforts often utilized a pre-test to determine my pre-calibration performance. (n=267)	3.8	1	5

Key: 1=Strongly agree; 2=Agree; 3=Undecided; 4=Disagree; 5=Strongly disagree

Table V: Summary of Satisfaction with Calibration Efforts (n=281)

Statement	M	Min.	Max.
Clinical faculty calibration efforts reduced faculty variation. (n=267)	2.1	1	5
I would like to have been offered more clinical faculty calibration opportunities. (n=267)	2.1	1	5
Clinical faculty calibration efforts adequately addressed variation between faculty members. (n=266)	2.6	1	5
I was satisfied with the quality of clinical faculty calibration efforts. (n=267)	2.6	1	5
Clinical calibration efforts adequately addressed inconsistent clinical performance of individual faculty members. (n=266)	2.7	1	5
The clinical faculty was calibrated in calculus detection using an explorer. (n=263)	2.8	1	5
The clinical faculty was calibrated in radiographic interpretation. (n=264)	2.9	1	5
The clinical faculty was calibrated in powered instrumentation techniques. (n=263)	3.0	1	5
The clinical faculty was calibrated in hand activated instrumentation techniques. (n=262)	3.0	1	5
The clinical faculty was calibrated in radiographic exposure techniques. (n=262)	3.1	1	5

Key: 1=Strongly agree; 2=Agree; 3=Undecided; 4=Disagree; 5=Strongly disagree

and instructor status on calibration. While some felt these factors make calibration more difficult, others did not. Further research to reveal sources of difficulty would be beneficial.

Attendance for calibration efforts was mandatory for the majority of full- and part-time employees, yet some faculty did not attend, or attendance was only required for the educators involved in teaching/evaluating the skill being calibrated. True calibration evaluates the reliability of faculty; this can only be achieved if every clinical faculty member participates

fostering a sense of teamwork as they work toward common goals.

More than one-third of the respondents reported calibration occurred when a specific problem or need arose. Calibration should be preventive and is necessary well before need is evident. Establishing a schedule for frequency and what is to be calibrated would ensure each clinical skill is addressed and maintained on a regular basis. Many programs acquire new part-time clinical faculty as often as every year or semester. Newer faculty might be heavily influenced by their clinical experiences and find calibration efforts personally threatening.[14] Experienced dental educators view expert technical skills as an essential element for clinical faculty,[1] yet might be resistant to change or unable to see the need for it.[16] Program directors indicated that calibration is one of their biggest challenges; allotting ample opportunities for clinical calibration sessions, in positive, non-threatening manners, would help increase the likelihood of achieving faculty reliability.

The desire to improve reliability, consistency, and effective teaching might often be enough incentive for participation. However, many part-time instructors also work in private practice and full-time faculty work many hours to fulfill their responsibilities. Compensating faculty for time in calibration exercises would increase its appeal and help encourage attendance. More than one-third of respondents did not receive compensation, perhaps because of budget restraints. The relationship between compensation, mandatory participation and attendance should be investigated to determine if remunerating faculty or other factors might enhance participation.

For many, calibration opportunities were not used to improve reliability and consistency of clinical skills. This concept identifies the need for programs to decipher between true calibration (including an evaluation and comparison of performance), teacher in-services, educational methodology workshops and faculty meetings. Some respondents were quite positive about their experiences, while others were not. Faculty members need perceived benefits from calibration including measurable goals for faculty calibration.

Most respondents thought that calibration occurred in clinical settings, yet most also agreed that calibration consisted of discussion rather than actual calibration of skills performance. Gathering all clinical faculty members might pose an ideal time to discuss clinical issues; however, such activity does not necessarily reduce performance variability. Most calibration sessions did not include any measurement of inter-rater (consistency between faculty members) or intra-rater (consistency of each individual faculty member) reliability. Utilizing a standard to which everyone will be compared is optimal for calibrating and streamlines the process of evaluating inter-rater and intra-rater reliability.[4,6] Dental hygiene programs and licensure exams use standards to measure student performance and clinical instructors should be held to the same expectations, if not greater. If everyone is compared to the same standard, all participants who agree with the standard also agree with each other, and measuring each participant multiple times would determine intra-rater reliability. After gathering reliability data, programs need a plan for resolving inconsistencies and re-evaluating outcomes to ensure reliability was established. Discovering a problem is only beneficial if an effective resolution plan has been constructed.

Previous literature suggested a connection between faculty status/years of experience and attitudes toward faculty development.[15,16,24] However, this study did not. Full-time employees did voice a stronger agreement with faculty variance causing student frustration that is in agreement with previous research.[2,12,13] This effect could be because full-time faculty members have more opportunities to witness frustration. Also, faculty who worked for institutions awarding an entry level bachelor's degree (as opposed to an associate's degree or certificate) had significantly lower agreement with instructors being assessed multiple times to evaluate intra-rater reliability. This finding could be attributed to these universities employing faculty or administrators with advanced degrees and strong research backgrounds, heightening the need for reliability and their programs' possible shortcomings.

Respondents were undecided about their satisfaction with calibration. If the efforts do not actually calibrate participants, the sessions are not a wise use of resources. Therefore, recommendations for administrators for improvement include establishing guidelines about attendance and remuneration and including this information in the faculty written department policies. Also, the department might involve the entire faculty in creating a calibration philosophy and publish it for existing and new faculty. A plan should be created for calibrating new faculty. If existing faculty are calibrated, a mentor could be assigned to work alongside a new instructor until calibration is achieved, as evidenced by evaluating students simultaneously to establish inter-rater reliability. Calibration efforts can be enhanced by implementing student evaluation mechanisms, by using patients during the exercises and by incorporating a standard for measuring performance. The calibration experience would also be recreated for any absence, therefore, attendance could improve knowing that additional time is involved in make-up sessions for the calibration presenter as well as for faculty. The individuals responsible for planning and implementing calibration must have ample scheduled time

to ensure calibration is quality-oriented, meets outcome measures and merits the participants' time and the program's resources.

Additionally, calibration efforts need to be safe and non-threatening for participants, which include maintaining confidentiality of results. Faculty members should not feel threatened about job security or that the calibration exercise might be due to a lack of performance. The emphasis needs to be placed on improving teaching skills to enhance student learning.

This study design posed several limitations. The sampling method depended on the program directors' cooperation for eligible clinical instructor invitation. Self-selection bias presents a limitation in which subjects decide for themselves if they want to participate.[25] Directors and faculty members might have decided whether or not to participate as a result of their personal attitudes, experiences or satisfaction with their institution's calibration. In addition, when writing multiple-choice questions, it is difficult to include every possible answer choice, thus soliciting forced answers.[26] If there was doubt that every reasonable response was included, an "Other (please specify)" answer choice was added. Email invitations might have been disregarded by potential participants.[27] Therefore, sending multiple invitations helped increase the number of faculty members who read the message.

Conclusion

Demographic data found equal distribution of respondents from the 4 regions of the U.S. Calibration characteristics, attitudes, quality and satisfaction as measured by this survey research would seem to be generalizable to most dental hygiene programs. Dental hygiene programs are encouraged to strategically plan frequent calibration events that address each clinical skill taught and assessed. Such calibration sessions need to utilize a standard measuring clinical faculty's performance and a plan for reducing unreliability.

This study's findings support past research indicating mixed yet promising results that calibration reduces variation, and that more research specific to dental hygiene is necessary, such as identifying calibration methods that effectively reduce clinical faculty inconsistencies.[4,6,8] The effect of calibration on the students' learning has not yet been investigated. Determining effective calibration techniques that enhance student learning should be a focus of future research.

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Dental Fear and Delayed Dental Care in Appalachia-West Virginia

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Abstract

Purpose: The people of Appalachia-West Virginia are culturally unique and are known to have oral health disparities. The purpose of this study was to evaluate dental fear in relation to delayed dental care as a factor influencing oral health behaviors within this culture.

Methods: A cross sectional study design was used. Participants were urgent care patients in a university dental clinic. The sample included 140 adults over age 18 years. The Dental Fear Survey was used to determine dental fear level. Self-report of delayed dental care was provided by the participants. The Dental Fear Survey was dichotomized at score 33, with higher scores indicating dental fear.

Results: The prevalence of dental fear was 47.1% (n=66). There was a significant association of dental fear and dental delay. The unadjusted odds ratio was 2.87 (95% CI: 1.17, 7.04; p=0.021). The adjusted odds ratio was 3.83 (95%CI: 1.14, 12.82; p=0.030), controlling for tobacco use, perceived oral health status, pain, and last dental visit. A difference in dental delay between men and women was not present in this sample. The only significant variable in delayed dental care was dental fear.

Conclusion: In Appalachia-West Virginia , there remains a high level of dental fear, despite advances in dental care, techniques, and procedures.

Keywords: Unmet need; delayed dental care; dental fear; dental anxiety

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

Introduction

Delayed dental care is a significant public health concern which could be addressed in public health outreach programs. Delayed dental care is frequently more complex, costly and urgent.[1] Delayed dental care often results in dental visits to the emergency department of hospitals, and such visits stress the health care system.[2] Many hospitals do not have the equipment or staff for dental care;[3,4] and 90% of dentally related emergency department visits do not result in definitive dental treatment.[2] In the U.S., there were 1.1 million dentally related emergency department visits in 2000, and 2.1 million in 2010.[4] Overall, approximately 4.3% of emergency visits in the U.S. are dentally related.[2] The average cost of dentally related emergency department care from 2008 to 2010 was $760 (adjusted to 2010 dollars).[2] More importantly than the financial burden is the progression of dental disease to complex and life-threatening levels. From 2008 to 2010, there were 101 dentally related deaths in the emergency department in the U.S. (56 caries-related, 43 related to a pulp/periapical lesion, 18 related to periodontal diseases and 24 related to cellulitis/abscess).[2]

One determinant for delayed dental care is cost. Reed et al indicated that cost of care was a factor for 9% of participants.[5] Singhal et al studied unmet dental need during pregnancy and found women, whose annual incomes were less than $40,000, were more likely to have unmet dental needs.[6]

Riley et al indicated the sensory and temporal characteristics of pain were factors in delayed dental care.[7] It was later suggested dental attitudes more accurately explained oral health behaviors, including delayed dental care.[8] Riley et al used the categories of:[8]

1. Individuals with favorable attitudes to dental care
2. Frustrated believers in dental care
3. Individuals with negative attitudes and cost concerns
4. Individuals pessimistic about personal and professional oral care

Dental anxiety and dental fear may also have a role in explaining dental health behaviors such as delayed dental care. Dental anxiety is defined as the emotional state of unpleasant cognitions and feelings, and the physiological and behavioral responses relative to a dental experience which precedes

the dental encounter.[1,9,10] Dental fear is defined as the emotional state involving the actual encounter often associated with fear of dental pain, fear of damage/catastrophe, fear of specific stimuli, generalized anxiety, lack of power/control, feeling embarrassed or shame, and/or distrust of dental personnel.[1,9,10] Dental phobias are defined as clinically diagnosed mental disorders with excessive anxieties and fears.[1,9,10] The prevalence of dental fear is difficult to establish as various scales and criteria exist to measure dental fear, and researchers and clinicians often use similar language interchangeably. For example, some researchers report "dental fear" prevalence with a definition of moderate to severe levels of fear, while other researchers do not include moderate levels in their definition of "dental fear." Crego et al,[11] in a review of literature of dental fear prevalence, found prevalences reported at 16%,[12] 24%[13] and 5 to 7%.[14] As a consequence of the reported data from the various studies, there is a lack of precise prevalence estimates for dental fear.[11]

Dental fear, dental anxiety, and dental pain affect oral health care.[15] A vicious cycle dynamic is suggested as a mechanism where fear affects delayed dental care or irregular dental visits, which affects the severity of dental conditions, and reinforces treatment-related fear and anxiety as the treatment needs become more complex.[11] Individuals who delay dental care often forego preventive care which is less intensive, expensive and severe.[11]

Appalachia-West Virginia is a culturally unique region of the U.S. It has a population of 1.85 million, of which 94% is non-Hispanic white.[16] The median income is $40,043 (the national median is $53,046), and 17.9% of the population is below the federal poverty level (the national median is 15.4%).[16] West Virginia is 42% rural. Its location has been described as being in the South, in the Mid-Atlantic region and being in the Appalachia region—features adding to its unique characteristics. The rugged mountains have isolated much of the population which has resulted in strong areas of shared culture and cultural pride. Appalachia-West Virginia's population is described as being centered on religion, family, food, outdoor activities and being independent. In a previous study of 27 adults over age 18 years in Appalachia-West Virginia, the mean score on the Dental Fear Survey (which has values from 20 to 100) was 65.7 (standard deviation=23).[17]

The people in Appalachia-West Virginia have greater dental disparities as compared with the rest of the nation. Appalachia-West Virginia has the highest national prevalence of older adults who are edentulous (36% in Appalachia-West Virginia compared to 17% nationally).[18] Fewer people in Appalachia-West Virginia have visited the dentist within the past year than the people in the nation (61% in Appalachia-West Virginia compared to 70% nationally).[18]

The purpose of this study was to evaluate dental fear as a factor for delayed dental care in the Appalachia-West Virginia culture. The rationale for this study is that it is important to determine the risk factors for delayed dental care in a population with significant oral health disparities. The theoretical framework for the research is the Andersen Model of Health Services Use. In the Andersen Model, service use outcomes (also called realized access to care, or actual utilization) are influenced by predisposing characteristics, enabling resources and need.[19] The enabling resources include finances/insurance for care, the presence of a site for care in the community, support from family/friends to seek care, etc.[19] Need is both a perception from the perspective of the individual and an evaluation of a clinician that a service should be performed. The model was developed to have a scientific means by which to evaluate access to health service utilization.[20] It is an effective model for use in this study in that health services involve more than state indicators, they involve interrelationships of many factors, and the Andersen model helps in explaining the relationships.[21]

Methods and Materials

This study was approved by the Appalachia-West Virginia University Institutional Review Board and was in compliance with the Declaration of Helsinki. The study design was cross-sectional. Participants were recruited from community-dwelling patients seeking care at a West Virginia University dental school urgent care clinic during their wait in the reception area. The inclusion criteria for the participants were that they were age 18 years and above, and that they provided verbal consent. The researchers posed the questions to the participants. Exclusion criteria included an age of less than 18 years, refusal to provide consent and an inability to understand the posed questions. Consent was obtained from all participants. Participants did not receive an incentive to participate in the survey. The sample included 140 individuals, ages 18 years and above.

The study outcome was delayed dental care. The participants were asked "How long have you had today's symptoms?" The potential responses were dichotomized to 1 to 3 days vs. more than 3 days. The cut-point for this study was based upon the 2009 consensus definition of oral neglect for institutionalized elderly in which the criteria for neglect for caries, abscesses, moderate pain and periodontal disease (among other listed oral conditions) from detection to diagnosis was 3 days.[22] The cut-point was also determined as the criteria as abscesses, and cellulitis from

odontogenic infections may develop very quickly from the onset of symptoms and become serious risks to health and life.[23,24]

The 20-question, publicly available Dental Fear Survey was used to evaluate the primary variable of interest, dental fear. The scale was validated across 4 demographically and geographically diverse groups.[25] In factor analysis, factor score variables had correlations on comparable factors of 0.93, 0.96 and 0.97.[25] The survey has a high internal consistency and a high test-retest reliability (r=0.74).[25-27] It has been translated in many languages and is a research survey used worldwide.[17,29-32]

The questions in the Dental fear survey have Likert-style response sets of: 1=Not afraid at all, 2=A little afraid, 3=Somewhat afraid, 4=Pretty much afraid and 5=Very afraid.[32,33] The survey was dichotomized at a score of 33 based upon the operationalized value for moderate fear in previous research.[28,34-36] For this study, scores 33 and above indicated dental fear. In the collected data, there were 9 missing values from the potential 1,800 values (0.5%), and these were replaced with the imputed neutral response value of 3.

Other Variables

Bivariate analyses included variables considered in previous studies and important in the Andersen Model of Health Services Use.[19] The predisposing variables in the study were: sex (male vs. female), race/ethnicity (minority vs. white - dichotomized due to the high non-Hispanic White population in Appalachia), age (25 to 44 years; 45 to 59 years, 60 and above vs. 18 to 24 years), and highest education of a member of the family in the household (high school or less than high school vs. more than high school). The enabling resources evaluated in the study were: household income category (less than $15,000, $15,000 to $49,000 vs. $50,000 and greater), difficulty in arranging a ride to a dental appointment (yes vs. no), difficulty in managing a dental bill or dental copay balance of ($51 to $100, more than $100 vs. $50 or less), and difficulty with taking time from work (yes, I do not have employment vs. no).

The last dental visit (1 to less than 3 years, 3 years and above vs. 0 to 1 years) was the "health service usage" in the model. Perceived need was evaluated with pain level (6 to 10 vs. 0 to 5) and self-reported oral health status (very good, neutral, somewhat poor, very poor vs. excellent). Personal health practices were evaluated with smoking status (currently smoking (yes vs. no)).

Statistical Analysis

IBM SPSS Statistics 21 (Armonk, NY) was used to analyze the data. The statistical significance level was determined as 0.05 prior to the study. Descriptive statistics were analyzed. The variables of interest were compared with delayed dental care using Chi square exact analyses. The data were analyzed with logistic regression on dental delay.

Results

The descriptive statistics of the study sample are presented in Table I. There were 140 participants, 57.1% of whom were men, 46.4% of whom were 25 to 44 years and 96.4% of whom were non-Hispanic white. The racial characteristic of the survey sample is representative of Appalachia-West Virginia. A majority of the participants (83.6%) had a high school education or above. There were 42.9% of participants who reported an income of $25,000 to $50,000. More than half of the participants (53.6%) reported current smoking. There were 46.4% of participants who reported a somewhat poor or very poor oral health status, and 17.1% who reported a pain level of 10 on a 0 to 10 scale. In terms of dental fear, there were 47.1% with moderate to high dental fear scores on the Dental Fear Survey. In terms of the outcome variable, delayed dental care, the prevalence of delayed dental care over 3 days was 78.6% (110 participants).

In bivariate analysis with delayed dental care (Table II), there were several significant relationships between delayed dental care and the other variables presented in the study. In the primary analysis of interest, the relationship of delayed dental care and dental fear, the association was significant (p=0.014). Significant relationships emerged between delayed dental care and the pain scale (p=0.021), delayed dental care and last dental visit (p=0.009), delayed dental care and current tobacco use (p=0.033), delayed dental care and self-reported oral health status (p=0.014), and delayed dental care and income (p=0.026). The p-values corresponded to an exact Chi square, one-sided test for these variables.

Table III provides the logistic regression on delayed dental care and dental fear. In the unadjusted analysis, the odds ratio is 2.87 (95% CI: 1.17, 7.04; p=0.021). In the parsimonious adjusted analysis, which included the significant variables from the bivariate analysis (dental fear, current tobacco use, income, perceived health status, pain and last dental visit), the association of delayed dental care and dental fear was 3.83 (1.14, 12.82; p=0.030). None of the other variables were significantly related with delayed dental care in the adjusted logistic regression. In an analysis which additionally included sex, race/ethnicity, age and education, the association of delayed dental care and dental anxiety/fear had an odds ratio of 4.83 (95% CI: 1.30, 17.86; p=0.019). Dental fear was the only significant variable in the models.

Table I: Sample Description

All	n (140)	Percent (100)
Sex		
Male	80	57.1
Female	59	42.1
Age		
18 to 24	23	16.4
25 to 44	65	46.4
45 to 59	38	27.1
60 and above	14	10.0
Race/Ethnicity		
Non-Hispanic Whites	135	96.4
Non-Hispanic Blacks	suppressed	suppressed
Non-Hispanic, Other	suppressed	suppressed
Duration of oral symptoms before seeking care		
1 day	7	5.0
2 to 3 days	22	15.7
More than 3 days, but less than 1 month	70	50.0
Over 1 month	40	28.6
Pain level on a 0 to 10 scale		
0	16	11.4
1	8	5.7
2	5	3.6
3	10	7.1
4	2	1.4
5	17	12.1
6	11	7.9
7	17	12.1
8	24	17.1
9	6	4.3
10	24	17.1
Last dental visit		
0 to 1 year	64	45.7
1 to less than 3 years	43	30.7
3 years and above	32	22.9

Table I: Sample Description (continued)

All	n (140)	Percent (100)
Difficulty in arranging a ride to a dental appointment		
Yes	13	9.3
No	125	89.3
Difficulty in managing bill or copay balance of:		
$50 or less	33	23.6
$51 to $100	36	25.7
More than $100	68	48.6
Difficulty with taking time from work		
Yes	41	29.3
No	63	45.0
I do not have employment	34	24.3
Education		
Less than high school	22	15.7
High school graduation and above	117	83.6
Current tobacco use		
Yes	75	53.6
No	62	44.3
Self-reported oral health status		
Excellent	suppressed	suppressed
Very good	23	16.4
Neutral	48	34.3
Somewhat poor	45	32.1
Very poor	20	14.3
Income		
More than $50,000	14	10.0
$25,000 to $50,000	60	42.9
Less than $25,000	50	35.7
Dental Fear Survey Scores		
Less than 33	74	52.9
33 and above	66	47.1

Mean DFS score: 41.6; SD=23.7
Mean Avoidance/Anticipatory Fear score: 15.2; SD=9.8
Mean Fear of Specific Dental Stimuli score: 14.0; SD=8.4
Mean Physiological Arousal score: 10.1; SD=6.4

Discussion

This study of Appalachia-West Virginia attendees to a university urgent care clinic examined the patterns of delayed dental care associated with dental fear. The participants had a high (47.1%) prevalence of dental fear which was associated with increased odds of delayed dental care. This study describes dental fear associated with delayed dental care in a region of known health disparities compared with the rest of the U.S.

Table II: Sample Description by Dental Delay (n=140)

	Less than 3 days	Over 3 day delay	p-value
Sex			
Male	14 (17.5%)	66 82.5%)	0.294
Female	15 (25.4%)	44 (74.6%)	
Age			
18-24	5 (21.7%)	18 (78.3%)	0.475
25-44	13 (20.0%)	52 (80.0%)	
45-59	6 (15.8%)	32 (84.2%)	
60 and above	5 (35.7%)	9 (64.3%)	
Race/Ethnicity			
Non-Hispanic Whites	28 (20.7%)	107 (79.3%)	-
Non-Hispanic Blacks	0	suppressed	
Non-Hispanic, Other	suppressed	0	
Pain level on a 0-10 scale			
0	6 (37.5%)	10 (62.5%)	0.021
1	2 (25%)	6 (75.0%)	
2	1 (20.0%)	4 (80.0%)	
3	0	10 (100%)	
4	0	2 (100%)	
5	6 (35.3%)	11 (64.7%)	
6	4 (36.4%)	7 (63.6%)	
7	4 (23.5%)	13 (76.5%)	
8	5 (20.8%)	19 (79.2%)	
9	1 (16.7%)	5 (83.3%)	
10	0	24 (100%)	
Last dental visit			
0-1 year	19 (29.7%)	45 (70.3%)	0.009
1 to less than 3 years	7 (16.3%)	36 (83.7%)	
3 years and above	3 (9.4%)	29 (90.6%)	
Difficulty in arranging a ride to a dental appointment			0.542
Yes	3 (23.1%)	10 (76.9%)	
No	26 (20.8%)	99 (79.2%)	

Table II: Sample Description by Dental Delay (n=140) (continued)

	Less than 3 days	Over 3 day delay	p-value
Difficulty in managing bill or copay balance of:			
$50 or less	3 (9.1%)	30 (90.9)	0.114
$51-$100	9 (25.0%)	27 (75.0%)	
More than $100	15 (22.1%)	53 (77.9%)	
Difficulty with taking time from work			
Yes	6 (14.6%)	35 (85.4%)	0.080
No	13 (20.6%)	50 (79.4%)	
I do not have employment	10 (21.0%)	24 (70.6%)	
Education			
Less than high school	4 (18.2%)	18 (81.8%)	0.459
High school graduation and above	25 (21.4%)	92 (78.6%)	
Current tobacco use			
Yes	11 (14.7%)	64 (85.3%)	0.033
No	18 (29.0%)	44 (71.0%)	
Self-reported oral health status			
Excellent	2 (50.0%)	2 (50.0%)	0.014
Very good	8 (34/8%)	15 (65.2%)	
Neutral	9 (18.8%)	39 (81.3%)	
Somewhat poor	8 (17.8%)	37 (82.2%)	
Very poor	2 (10.0%)	18 (90.0%)	
Income			
More than $50,000	6 (42.9%)	8 (57.1%)	0.026
$25,000-$50,000	12 (20.0%)	48 (80.0%)	
Less than $25,000	7 (14.0%)	43 (86.0%)	
Dental Fear Survey Scores			
Less than 33	21 (28.4%)	53 (71.6%)	0.014
33 and above	8 (12.1%)	58 (87.9%)	

Exact 2-sided Pearson Chi square used for the variables: sex, age, and race/ethnicity.
Exact 1-sided Pearson Chi square used for the other variables.

This study indicates that dental fear is an additional consideration in the dental attitudes associated with oral health disparities in adults.[8] Previous studies have addressed dental avoidance; however, few studies have investigated dental care when a person is symptomatic. Riley et al stated no previous publication had examined sociodemographic predictors of delayed dental care in relation to when a person was symptomatic, prior to their study.[7] They indicated that minority status individuals and women were at

Table III: Odds Ratios and 95% Confidence Intervals from Logistic Regression on Delayed Dental Visits (n=131)

	Odds ratio [CI]	p-value	-2 Log Likelihood	model p-value
Unadjusted				
High vs. Low fear	2.87 [1.17, 7.04]	0.021	137.033	0.016
Adjusted model 1				
High vs. Low fear	3.83 [1.14, 12.82]	0.030	99.964	0.016
Adjusted model 2				
High vs. Low fear	4.83 [1.30, 17.86]	0.019	94.070	0.058

Model 1 is parsimonious model adjusted for the significant variables from the bivariate analyses (dental fear, tobacco use, income, perceived oral health status, pain, and last dental visit).
Model 2 additionally includes sex, race, age, and education.

greater risk of delayed dental care longer than 48 hours after onset of pain than non-Hispanic whites and men, respectively.[7] This current study of Appalachia-West Virginia participants did not support the results related to gender; the only variable which was significant in this study's adjusted models was dental anxiety/fear. This result was also reported in a study that examined dental fear and found greater dental fear was related to non-symptomatic delayed dental care or avoidance of dental visits for any reason.[37]

The attitudes and behaviors of Appalachia residents have been described as reflecting a unique culture.[38] One of the common cultural behaviors of Appalachia described in the medical literature is "present time orientation" in which patients seek to address needed health care services on the day that the problem manifests, particularly through the request for antibiotics and the belief in the cure of antibiotics even for non-bacterial diagnoses.[37] This time orientation was not evident in the dental setting of the present study, nor was it present in a study of Appalachia-Virginia in which residents delayed health care due to cultural beliefs described as "self-reliance," and "fatalism" (controlled for health insurance).[39] And although health perceptions were associated with general health behaviors in the Appalachia-Virginia study,that association was not significant for oral health perceptions in the adjusted logistic regression on dental delay in this study.[39] In a focus-group study in Southern Appalachia-West Virginia , findings indicated that not all cultural characteristics historically ascribed to Appalachians are evident in Appalachia-West Virginia, including the belief in fatalism.[40] Limited health-seeking behavior was attributed to lack of knowledge rather than fate/religious faith.[40] Culture has been previously associated with health behavior, and needs to be considered as a factor in delayed dental care as well, but lack of knowledge and dental fear are important as well.[40]

This study has limitations. It was conducted using a cross-sectional design, which is a very useful epidemiologic design, but, by nature, cannot be used to establish a causal relationship or temporal inferences. Participants were asked to recall the length of time from symptom onset. These data may be subject to non-differential misclassifications due to recall bias. Generally, recall bias tends to weaken an association. The participants may have been embarrassed or ashamed to admit a long delay. Therefore, a social desirability bias may exist in the data which would tend to increase the number of responses of short delay reports. Such a bias would tend to weaken an association of delayed dental care and dental fear. The data were collected over several months in one dental school clinic's urgent care area, therefore, the participants may not have represented all dental patients. Also, the culture of Appalachia-West Virginia may have a unique quality making the results not generalizable to other cultural or geographic regions. However, the study design allowed for the present evaluation of dental fear in a dental setting, rather than a retrospective recall of fear. The logistic regressions and the resultant odds ratios answered the research question as to if there were an association of dental delay and fear in the Appalachia-West Virginia population. The study would be strengthened if it were conducted in practice-based research networks across Appalachia-West Virginia under similar circumstances.

Conclusion

Evidence from this cross-sectional study in a population located in Appalachia-West Virginia with higher than normal dental disparities indicates a role of dental fear in delayed dental care. Data from this study add to the available literature evidence further supporting a need to address dental fear with the public in regard to the impact of delayed dental care on dental treatment.

These data may be utilized by dental hygienists, particularly public health dental hygienists who are responsible for outreach programs and routinely ed-

ucate the public about oral health conditions. Discussing delayed dental care is relevant and may help to provide better care if the public can be encouraged to seek preventive, routine and early intervention. The education programs should include a discussion on dental fear, and educators should stress that the technological advances in dental care have made dental procedures more comfortable; and the technological advances in prevention/control help to reduce the need for urgent care.

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