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STATEMENT OF PURPOSE

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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Features

Editorial

Lynne Hunt, RDH, MS

In Defense of Qualitative Research

Twelve years ago, I started a graduate program in dental hygiene education. One of the core requirements was to develop and execute a thesis project. Another core requirement was to take a 3-series course on biostatistics. The word "quantitative" was offered up early on in these classes to describe our research projects. Research was about designing a question and then getting an answer in the form of a number or numbers (i.e. percentages).

My master's research project was entitled, "The effects of relaxation training on dental phobia during dental hygiene treatment." Pain perception and feelings of dental anxiety via Likert scales were monitored at various points during a dental prophylaxis, along with vital signs. The numbers were crunched to see if there was a statistically significant difference between the control group and the experimental group or those who received relaxation training. What I remember most about my project, however, are the stories the study participants presented to me, unsolicited, during the course of our time together. They told me how and why their fear developed, what they had done (or not done) to cope with it and how it affected other areas of their lives. Here, then, was a different kind of data and I was unprepared for, and I didn't know what to do with it beyond a brief mention in my thesis. My project, after all, was about those numbers.

Fast forward several years, and I enrolled in an evening doctoral program in Adult and Higher Education. At present, I am still in the program. Most of the professors are heavily qualitative and the atmosphere regarding research is completely different. I can remember how initially resistant I was to the concept of qualitative research being in the same league with quantitative research. How can you study what people feel? How can you base anything on a series of answers to open-ended questions and how do you measure that? Then I remembered my dental phobia stories. That was qualitative data and it was important to the overall picture of the phenomena of dental phobia. I wanted to know more.

So what exactly is qualitative research? Qualitative research, by its nature, is exploratory and is "concerned with words and their meanings in different contexts" and "summarizing themes."[1] Traditionally, qualitative inquiry often was a starting point for an eventual quantitative research study, but it has recently gained acceptance as a "legitimate" methodology on its own.[1-3] Some of the methods employed in this type of research include open-ended questions, interviews, focus groups, observations and analyzing documents (i.e. journals written by subjects in a study).[2] While there are many different qualitative approaches, I have chosen to briefly discuss 5 basic approaches: narrative research, phenomenology, grounded theory, ethnography and case study. Qualitative researchers choose their approach based upon the population to be studied and the research question they seek to answer.[2,3]

Narrative research seeks to hear and make meaning of the stories, either spoken or via written text, of an individual or individuals.[2] The environment, or the individual(s) context, is also analyzed so that the researcher can "restory" the stories into a type of "framework" where "themes" are analyzed.[2] Singh explored job satisfaction among a group of "dental therapists" trained at the same university by asking a single question about job satisfaction.[4] Their answers, or narratives, were then analyzed for common themes.[4] The narrative approach works best when the subject is an individual or a small group.[2]

Phenomenological research is the study of the meaning of "lived experiences" of a group of people around a specific concept (phenomenon).[2] Reeson et al studied the perceptions of both dental students and dental technician trainees as they worked together to provide complete and partial dentures.[5] Focus groups, personal diaries and feedback from the students provided insight into how to successfully create interdisciplinary collaboration in an educational setting.[5] Moustakas recommends asking 2 universal questions: "What have you experienced in terms of the phenomenon? What contexts or situations have typically influenced or affected your experiences of the phenomenon?"[6] In the end, researchers develop a description, called "textural description," of the shared experience of the study participants.[2]

Grounded theory takes the study of the shared experience of the group of individuals a step fur-

ther. The goal is to "move beyond description and to generate or discover a theory, an abstract analytical schema of a process."[2] The whole idea of a theory or potential theory from this approach is that it is "grounded" in the data obtained from the individual experiences and perceptions of the experiences according to Strauss and Corbin (as cited by Creswell).[2] The data drives the emerging theory. Rojo sought to explore how dental hygienists viewed their role in influencing the problem of access to oral health care from a grounded theory perspective.[7]

Ethnography moves beyond grounded research and explores whole cultural systems with their many intricacies.[2] The groups can also consist of teams or organizations.[1] The study population tends to be large and the researcher acts as an observer "immersed in the day-to-day lives" of those within the group."[2] Naturally, this approach draws heavily from the disciplines of anthropology and sociology.[2] Lalloo et al conducted a study on the cultural experiences of dental students in a "remote rural" area of Australia where the students lived within the community and kept journals on their experiences and observations.[8]

Case study research seeks to identify and investigate an issue explored through one or more cases within a bounded system" and has been historically utilized across many disciplines, including health care.[2] The case can be bounded by time, for example, or place. Data is collected via a variety of sources (i.e. interviews, documents, observations).[2,3] Koerber et al studied 19 dental hygiene programs across the U.S. on their tobacco cessation training within each curriculum and found them remarkably similar in their approach.[9] What is appealing about the case study methodology is the extensive data collection via a variety of methods. This aids the researcher in fully describing and analyzing the case and their relationship to the research problem.

As dental hygienists we seek to provide evidence-based practice. Qualitative research provides special insight into aspects of dentistry through the use of open-ended questions, interviews, focus groups, observations, and analyzing documents.[2] The 5 types of qualitative inquiry explored here (narrative, phenomenology, grounded theory, ethnography and case study) are some of the more common approaches.[2] Recently qualitative research has gained favor as a valid methodology by itself.[1-3] Many researchers, however, have chosen to conduct mixed methods research or to include both quantitative and qualitative methods in their studies. One method informs or enhances the other and they are seen as "complementary" not separate.[1] This, then, is a third option in the qualitative/quantitative debate. It is, perhaps, the best one.

Sincerely,

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Linking Research to Clinical Practice

Periodontal and General Health: Clinical Recommendations

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.

Consensus Reports: Periodontal and General Health

All dental and medical professionals should be aware of current recommendations and treatment guidelines related to the association between periodontal and systemic health; however, the literature contains varying and sometimes conflicting information about these associations and their implications in terms of primary prevention. In 2013, a series of consensus reports were published jointly by the European Federation of Periodontology (EFP) and the American Academy of Periodontology (AAP) to inform dental and health professionals of their rigorous scientific analysis of evidence linking periodontal disease, to other systemic diseases. These reports summarize the outcomes of the 9th European Workshop on Periodontology sponsored by both groups in Segovia, Spain in 2012 where more than 70 experts conducted intense reviews of the evidence. The reports appear in the Journal of Periodontology and the Journal of Clinical Periodontology.[1-4] The EFP also published a manifesto calling upon all dental and health professionals to take action to fight the devastating oral and general health consequences for the individual and society through prevention, early diagnosis, and effective treatment of periodontal disease.[5] The purpose of this article is to engage dental hygienists in this cause by summarizing the manifesto's clinical recommendations for treating patients at risk of, or presenting with, certain medical conditions.

Periodontitis is a chronic inflammatory disease with potentially negative consequences for general health. Patients with periodontal disease at risk for, or presenting with, certain systemic diseases are best served through interprofessional collaboration between dental and medical professionals to provide coordinated multidisciplinary patient care, regardless of where an individual enters the health care system.

Diabetes Mellitus

Precise recommendations were made for oral health education that should be provided for all patients with diabetes. They should be informed about the following:

- Periodontal disease risk is increased by poorly controlled diabetes, and glycemic control may be more difficult to manage when periodontal disease is present
- Risk for diabetic complications such as cardiovascular disease and kidney disease is greater in individuals with periodontal disease than for those with periodontal health
- Other oral conditions (e.g., dry mouth, burning mouth, oral fungal infections, slow wound healing) are possible, and they should seek advice from their dental practitioner if these conditions arise
- Patients with risk factors for diabetes who have periodontitis who have not been diagnosed with diabetes should be informed of their risk and referred to a physician for medical evaluation, or assessed using a chairside HbA1c test

Specific guidelines for oral assessments included:

- Initial assessment of patients with type 1, type 2 and gestational diabetes (GDM) should include a thorough oral examination including a comprehensive periodontal examination. Even children and adolescents diagnosed with diabetes should

be advised of the need for annual oral health and periodontal examinations.
- After diagnosis of diabetes, regular periodontal examinations are needed according to intervals determined by dental professionals as part of the ongoing management of their diabetes. Even when periodontitis is not present at the onset of the diabetes diagnosis, an annual periodontal examination is recommended.

Diabetes patients presenting with any signs and symptoms of periodontitis require prompt periodontal evaluation and treatment. Successful periodontal interventions improve glycemic control. Patients with diabetes who have missing teeth should be encouraged to seek dental care to restore adequate function for proper nutrition.

Cardiovascular Disease

Clear recommendations regarding atherosclerotic cardiovascular disease (ACVD) were made as follows:

- Clinicians need to be aware of the increasing evidence that periodontitis is a risk factor for ACVD, independent of other risk factors, and to advise patients that periodontal inflammation puts their general health at risk
- Patients at risk for ACVD due to other factors such as hypertension, obesity, smoking, etc., should be referred for medical examination if they have not seen their physician in the past year
- Lifestyle-associated risk factors such as smoking cessation programs, nutritional counseling, and recommendations for regular exercise should be addressed within the context of comprehensive oral/periodontal treatment plans. Collaboration between dental hygienists and other health professionals and programs may improve both oral and general health.
- Patients can be informed that systemic inflammatory markers are reduced with periodontal treatment but should not draw other conclusions about the outcomes of periodontal therapy and ACVD
- Treatment of periodontitis in patients with a history of cardiovascular events should follow American Heart Association (AHA) Guidelines

Adverse Pregnancy Outcomes

Pregnancy is a time of marked physiological change that can affect the oral health of the expectant mother. An increase in gingival blood supply and a greater tendency towards gingival swelling and periodontal disease exists. Oral bacteria and their by-products travel through the blood stream to the liver resulting in inflammatory and immune responses in the fetus. Oral health professionals need to be attentive to emerging of research evidence that shows the potential impact of poor periodontal health on the overall health of the pregnant woman and developing fetus.

- Periodontitis does not currently appear to be a true risk factor for adverse pregnancy outcomes in most populations; however, it may present a risk in some specific populations of patients. For example, those with a prior history of adverse pregnancy outcomes or with advancing periodontal disease during pregnancy may be at increased risk, although further studies are needed to identify those groups who may be at higher risk

- Special attention should be given to a woman's periodontal health prior to becoming pregnant if possible, as well as throughout pregnancy

Other Systemic Diseases

Additional studies are needed to strengthen the emerging evidence for associations between periodontal diseases and chronic obstructive pulmonary diseases (i.e., chronic bronchitis and emphysema), chronic kidney disease, rheumatoid arthritis, cognitive impairment, obesity, metabolic syndrome and some cancers. The only evidence to support a causal relationship associates respiratory microorganisms that colonize in oral biofilm which may subsequently cause hospital-acquired (nosocomial) pneumonia. Therefore, specific clinical recommendations were made only regarding nosocomial pneumonia, as follows:

- Staff and caregivers responsible for elderly and/or frail patients should be trained in the provision of basic oral hygiene twice daily for those patients incapable of self-care
- Staff in acute care environments should be trained in the use of antiseptic and manual methods for reducing the quantity of oral bacteria in ventilated patients

The Bottom Line

Collaboration between oral health professionals (dentists, periodontists, dental hygienists, dental nurses, and dental therapists), other health care professionals, researchers, health care policy makers, oral care product companies, the media, social organizations and patients is needed to effectively combat the devastating impact of periodontal disease as a major public health issue. The clinical recommendations made by the experts and published

in the EFP Manifesto Perio and Systemic Health are evidence based and should be implemented by all stakeholders.[5]

Summary

Dental hygienists are in a prime position to address the potential oral and general health effects of periodontal disease through oral health education, regular and comprehensive oral and periodontal assessments, effective periodontal treatment modalities, and interprofessional collaboration with other health professionals. Evidence indicates that periodontitis increases the risk of poor glycemic control in patients with diabetes mellitus, as well as the risk for diabetes complications. Patients should be informed of this risk and, if indicated, told that successful periodontal therapy improves glycemic control. Periodontitis also has been associated with ACVD, independently of other risk factors, and adverse pregnancy outcomes in some populations. Patients can be advised of this association and the advantage of periodontal therapy in reducing systemic inflammatory challenges. They should not be told that periodontal therapy prevents or improves ACVD or reduces adverse pregnancy outcomes because those conclusions have not been scientifically proven to date. Additional emerging evidence seems to link periodontal disease with pulmonary infections and pulmonary disease, certain types of cancer, and rheumatoid arthritis. Dental hygienists and others can access the full version of the EFP Manifesto Perio and General Health at perioworkshop.efp.org/efp-manifesto, and references for the full consensus papers follow.

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Preventive Services Program: A Model Engaging Volunteers to Expand Community-Based Oral Health Services for Children

Ann M. Hoffman, RDH, BSDH; Bonnie G. Branson, RDH PhD; Nancy T. Keselyak, RDH, MA; Melanie Simmer-Beck, RDH, PhD

Abstract

Purpose: This paper describes the Preventive Services Program (PSP), a community based oral health program model which engages volunteers to provide preventive services and education for underserved children in Missouri. In 2006, the Missouri Department of Health and Senior Services created a program for children designed to use a systems approach for population-based prevention of oral disease. Currently, 5 part-time dental hygienists serve as Oral Health Program Consultants to work with the citizens of a community to engage dentists, dental hygienists, parents and other interested stakeholders in the activities of the program. Dental volunteers evaluate oral health and disease in the community's children and facilitate referrals for dental care. Other volunteers apply fluoride varnish and provide educational services to the children.

Program Outcomes: In 2006, 273 volunteer dentists and dental hygienists and 415 community volunteers provided oral screenings, oral health education, 2 fluoride varnish applications and referral for unmet dental care for 8,529 children. In 2011, 775 volunteer dentists and dental hygienists and 1,837 other community volunteers provided by PSP services to nearly 65,000 children.

Conclusion: It has been demonstrated that when the local citizens take responsibility for their own needs that a sustainable and evidence-based program like PSP is possible. Guidelines which provide criteria for matching models with the specific community characteristics need to be generated. Furthermore, a national review of successful program models would be helpful to those endeavoring to implement community oral health program.

Keywords: population-based, oral health education, preventive services, fluoride varnish, community-based models, community volunteers

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

Introduction

Oral Health in America: A Report of the Surgeon General summarized the significance of oral health, identified the current evidence that dental caries is preventable and documented the profound disparities that affect the poor, the geographically isolated and those with special oral health care needs.[1] In response to this report, another report was developed - The National Call to Action to Promote Oral Health. The National Call to Action laid out three national goals:[2]

- Promote oral health
- Improve quality of life
- Eliminate oral health disparities

The Call to Action acknowledges that success requires collaboration between the public, health professionals and policy makers.[2] Furthermore, the Call identified 5 specific actions to meet their goals:[2]

- Change perceptions of oral health
- Overcome barriers by replicating effective programs and proven efforts
- Build the science and accelerate science transfer
- Increase oral health workforce diversity, capacity and flexibility
- Increase collaborations

As a response to the Call to Action, Missouri set out to document the oral health needs of its children. The "Show Me Your Smile" survey was conducted in Missouri from 2004 to 2005, to collect baseline information about the oral health of Missouri children.[3] Oral screenings were conducted on third graders throughout the state, by 11 dental hygienists, using the protocol and diagnostic criteria developed by the Association of State and Territorial Dental Directors.[4]

The "Show Me Your Smile" study describes the study population and data collected from randomized oral screenings of 3,525 third grade students

from 113 Missouri elementary schools during the school year of 2004 to 2005.[5] Key findings gathered from the data include:

- Fifty-five percent had a history of tooth decay
- Twenty-five percent had untreated dental decay
- Five percent had some form of urgent dental care need (often demonstrated as a painful lesion which interfered in school, play or daily life activities)
- Twenty-nine percent had dental sealants
- The amount of untreated dental decay was twice as high for African American children when compared to white children
- Children from Missouri schools where at least 75% of children qualitified for free or reduced lunch programs had a higher rate of decay and lower percentage of dental sealants

The report concludes that considerable progress must be made if Missouri is to meet the Healthy People 2010 oral health objectives.[6] To address the findings of the 2004 to 2005 survey, the Missouri Oral Health Preventive Services Program (PSP) was developed to facilitate community-based health interventions utilizing local partnerships.[7] This paper will describe the PSP, a community based oral health program model which engages volunteers to provide preventive services and education for underserved children in Missouri. In addition the authors will discuss lessons learned, future plans and recommendations.

Evidence to support the efficacy of fluoride varnish programs has been well-established in the literature, and many states and local groups have incorporated varnish programs as interventions to promote oral health among their citizens.[8-14] Fluoride varnish is cost effective, easy to apply and simple to implement in a public health setting. Additionally, application of fluoride varnish is adaptable to many types of populations including young children, adults with high caries risk and people with special health care needs. Weintraub suggests that fluoride varnish programs for people with special needs and adults with high caries risk will be superior to meeting the challenges presented with rinses and tray applications.[15-17] This adaptability allows fluoride varnish to be a benefit to a wide variety of people within a community.

Programs are more likely to be successful if local citizens participate. Involvement develops a sense of community responsibility and plays a large role in program sustainability. Partridge et al discussed the success of a local cancer screening program when the community members came together to build a feeling of mutual trust, shared experience and volunteer empowerment.[18] The concept of community collaboration was recognized and promoted in The National Call to Action.[2] This publication suggested that the lay public, policy makers and health professionals responding to the Call "… need to work as partners, sharing ideas and coordinating activities to capitalize on joint resources and expertise to achieve common goals."[2]

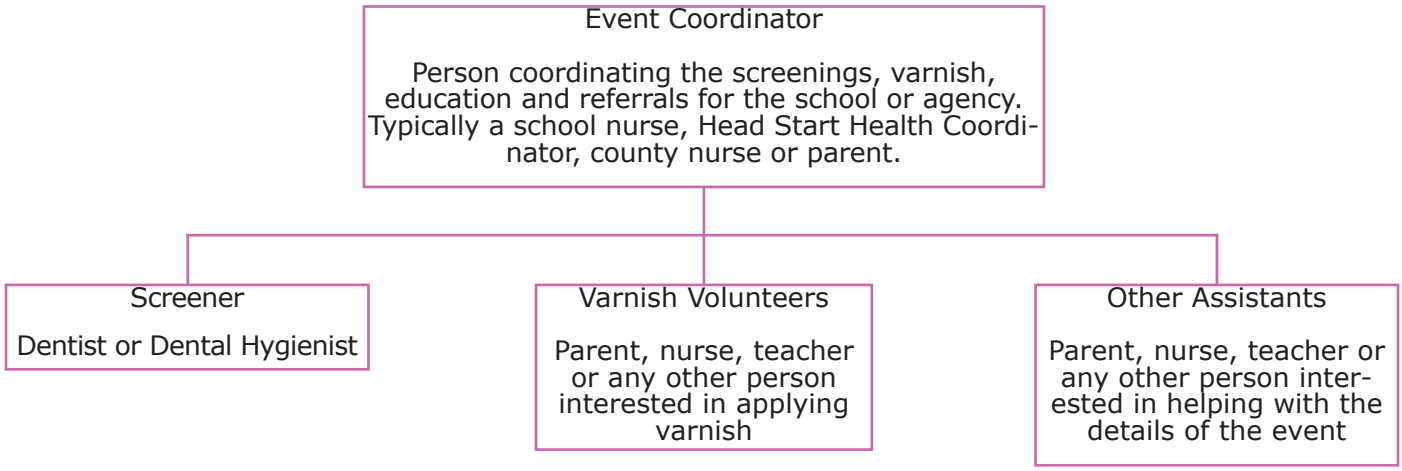
The Chronic Care Model suggests the importance of community partners, families and health care professionals working together to improve the health of individuals.[19] This model places the responsibility of health management equally on lay persons as well as health care professionals. The Cochrane Collaboration conducted a systematic review to examine the efficacy of health programs which involved lay people in the implementation. A total of 82 studies were examined and the majority of them spoke favorably of the collaboration of lay people with health care professionals.[20] A number of models exist that describe oral health programs for delivery of care to children in school based settings. Albert et al lists several of these, which include placing a dental health center directly in a school, collaborations between schools and community clinics and programs which provide screenings and preventive services only in the school setting. The authors speak of the need for these programs to be sustainable and replicable.[21]

Simpson has proposed a model that illustrates a framework for sustainable oral health interventions.[22] This multilevel model is built around 4 stages of implementation which, if embraced, will lead to long-term sustainability. The 4 stages include effective training and program dissemination, adequate planning and program adoption, effective implementation, and continual practice and improvement. Simpson offers the analogy of comparing a seed which is left unattended with the seed that is cultivated and nurtured. Much like the unattended seed, programs which do not embrace the multiple stages of program growth will become haphazard and short-lived. Those which follow a sustainability framework, or like the nurtured seed, will more likely have a long term impact.[22]

Preventive Service Program Description

PSP, although available to all children in the state of Missouri (infant to 18 years of age), is targeted toward the populations of underserved and low income children in rural areas of the state and is offered free of charge to all communities. This program is a partnership between the Missouri Department of Health and Senior Services (5 part-

Figure 1: Individual Volunteer Roles and Responsibilities for the Implementation of a PSP Event



time oral health consultants), the Maternal and Child Health Bureau (funding organization), public schools, head start facilities, local community volunteer dentists and dental hygienists, and volunteer lay members of the community who help facilitate program implementation. The collaborative actions among these community volunteers who share a common purpose are dedicated to improving the oral health of children in their communities.

The program involves 4 components. The first is an evaluation of the state of oral health/disease in the community's children through annual oral screenings. The second component ensures that all children receive toothbrushes, toothpaste, floss (age appropriate) and educational materials/presentations. The third component is the application of fluoride varnish 2 times per year. Positive parental consent is required for applications of the fluoride varnish. The fourth component establishes a referral network for immediate/urgent needs identified during the oral screenings. PSP is offered free of charge to all communities and utilizes local community dentists, dental hygienists and other volunteers for implementation.[7] The following sections will describe program training, planning, and implementation in detail.

Training (Dissemination)

The PSP utilizes local community dentists, dental hygienists and other volunteers to sustain and support the program.[7] Figure 1 describes the roles of the various volunteers participating in a PSP event. The participation of community-wide volunteers is essential to the implementation and success of the PSP.[7] Volunteers are recruited from the community and are assisted by 5 part-time dental hygienists known as Oral Health Consultants (OHC). Community dentists and dental hygienists are recruited by personal contacts or in some cases from a form letter provided by the OHC. Others are recruited from a local list of individuals who have completed the online PSP calibration session. Lay volunteers are typically parents, grandparents, teachers and health clerks.

Each OHC is responsible for a specific region of the state and has become locally known to most of the volunteers. This key element of utilizing local volunteers allows the community to be invested in the health of their own communities.[7]

Training and distribution of materials are key responsibilities undertaken by the OHCs, who work individually with local event organizers to coordinate paper work, order supplies and make suggestions for successful implementation of PSP.[7] All volunteers are trained online via a 30-minute voice-over PowerPoint course prior to participating in a PSP event. Two specific courses are offered - 1 for dental professionals conducting the screenings and 1 for volunteers who will be applying fluoride varnish. Dental professionals are instructed on how to complete the screening form and other community volunteers learn application techniques for the fluoride varnish.[23] During the oral screening course all participants are calibrated on how to complete the screening form with correct information. For example, decay must be obvious and visible with a flashlight and mouth mirror. No explorer or other instruments are used. Other community volunteers learn fluoride varnish application techniques by participating in a 30 minute course. The course provides the volunteer detailed instructions using photographs that demonstrate the application process. In addition, information about the benefits of fluoride varnish is included. The Missouri Dental Board does not regulate the actions of lay volunteers. The fluoride varnish training program for

the PSP has been reviewed by the Missouri Dental Board and the Missouri Dental Association.[24,25]

Adoption (Planning)

The decision to adopt PSP is usually made at an administrative level. For example, in a school district, the principal or school board often makes the final decision as to whether PSP will be implemented. The needs of the community are well-known to the local leaders and access to services is linked with those needs via the OHCs. The OHCs make access to this state resource affordable, convenient and compatible with the specific needs of the community. The recommendation to adopt is often brought forward by a school nurse, concerned parent or health department leader. These individuals make the choice to proceed based on program adaptability and flexibility.

Champions were developed at the inception of PSP. Meetings were held with state wide groups such as the Head Start Collaborative, the Missouri Coalition for Oral Health and the Missouri School Nurses' Association. Leaders within the state Department of Health and Senior Services and Missouri Dental Board were called upon to embrace the program and offer support. Local dental and dental hygiene societies were contacted to identify leaders to champion the program back to communities. Collectively, this networking created support for the decision to adopt PSP in the local community.[5]

Implementation

In an effort to "not recreate the wheel," Missouri offers PSP as a package of materials, forms, training and instructions that can be used by each local community. This allows the community to proceed with PSP without a great deal of up-front development. Forms are versatile and modifiable for use by a specific population. For example, the permission/consent form can be replicated on agency-specific letterhead which allows the community an easy adoption process without the need for time-consuming form development.[5,7]

Resources such as toothbrushes, toothpaste, floss (if age appropriate) and educational materials are provided by the state. Timing of the shipments to the local organizations is facilitated by the OHCs. The no-cost element of the program makes implementation possible for many groups. If costs were imposed, participation would most likely decrease.[5,7]

PSP requires 2 events throughout the year. Typically 1 event is held in the fall of a school year to provide the screenings and first fluoride varnish application, and 1 event is held in the spring to apply the second fluoride varnish.

Program Outcomes

The overarching goal of the PSP is improvement in oral health of a community. In public health, the community is the patient.[26] Individual students were not followed, but rather, the oral health of a group of school children in 1 year was compared to the oral health of a similar group of children 4 or 5 years later. PSP utilized a screening instrument modified from the Association of State and Territorial Dental Directors, the Basic Screening Survey.[4] This instrument measured sealants, untreated decay, treated decay, treatment urgency, oral hygiene, rampant decay and white spot lesions. Data from 4 different communities, geographically scattered around the state of Missouri, were used to illustrate the success of the program.

The communities selected had participated in the program for 4 to 5 years, and in the case of the Head Start group represented a unique age group. Table I displays the percent of children with untreated decay, treated decay and treatment urgency ratings for those selected communities.[5,27,28] The positive outcomes of PSP in a fifth grade population are displayed in Table I. The untreated decay in this representative population decreased from 52 to 13%, indicating a decrease in caries activity among fifth graders measured year 1, and fifth graders measured year 5. Similar results with a decrease in untreated decay are found in the other representative groups of third graders (44.9 to 39.7%), second graders (42.5 to 26%) and Head Start children (38 to 20%).

Two of the 4 groups demonstrated a greater percentage of treated decay at year 5 (year 4 for the Head Start children). Third graders and Head Start children demonstrated a much greater percentage of treated decay after several years in the program than the fifth and second graders. This could be due to a lower decay rate and the lesser need for restorative treatment. It may also indicate that the community has spent time establishing referral sources that are accepting and treating cases. The third column represents the percentage of urgent care needed within the population. Urgent care as defined in the PSP is an abscess, swelling or pain. It appears that, with the exception of second graders at year 1, most of the treatment urgency ratings hovered between 0.03 to 0.09%.

Table I: Percentage of Children with Untreated Decay, Treated Decay and Urgent Treatment Needs

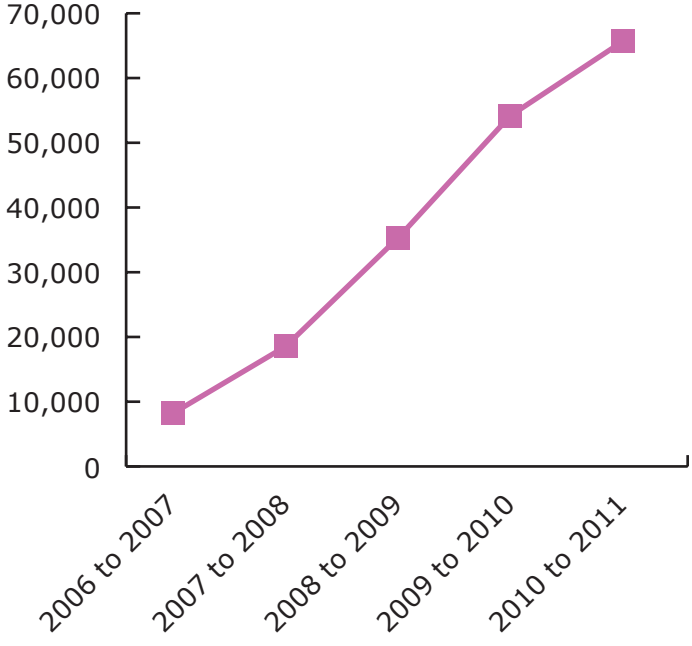
Population	Untreated Decay		Treated Decay		Treatment Urgency	
	Year 1	Year 5	Year 1	Year 5	Year 1	Year 5
School #1 Fifth Grade Year 1 (n=19) Year 5 (n=15)	52%	13%	47%	13%	0.05%	0.06%
	Year 1	Year 5	Year 1	Year 5	Year 1	Year 5
School # 2 Third Grade Year 1 (n=167) Year 5 (n=165)	44.9%	39.7%	28.7%	39%	0.04%	0.03%
	Year 1	Year 5	Year 1	Year 5	Year 1	Year 5
School # 3 Second Grade Year 1 (n=54) Year 5 (n=69)	42.5%	26%	38.8%	35%	14.8%	0.07%
	Year 1	Year 4	Year 1	Year 4	Year 1	Year 4
School #4 Head Start Year 1 (n=62) Year 4 (n=92)	38%	20%	0.08%	19%	0.06%	0.09%

The number of participants can be another measure of success for a program. When the PSP began in the fall of 2006, a total number of 8,259 children participated.[5,27] During the last 5 years the total number of children receiving PSP services has significantly grown (Table II). Data from the 2010 to 2011 fiscal year indicates that the number of children participating in PSP has increased to nearly 65,000.[5,27] Table III indicates the number of children that received the first and second applications of the fluoride varnish from 2008 through 2011.

Not only have the number of children participating increased, but also the number of community volunteers (Table IV). In 2006, approximately 273 volunteer dentists and dental hygienists and approximately 415 other volunteers throughout a variety of counties in the state offered their personal time to assist with PSP. During the 2010 to 2011 school year, approximately 775 dentists and dental hygienists and approximately 1,837 other volunteers offered to assist with this program.[4,5,27]

The "Show Me Your Smile" survey was repeated in 2009 to 2010 as a comparison to the 2004 to 2005 survey. Although this survey was not intended to specifically evaluate PSP and the time frame had been very short between inception of the program and the follow up "Show Me Your Smile" survey, a small improvement was noticed.[3,5,29] Table V compares data on the percentage of third graders with no obvious problems, a need for early dental care, and a need for urgent dental care from the "Show Me Your Smile" survey of 2005 and 2010.

Table II: Growth in the Number of Children Participating in the PSP from 2007 to 2011



Discussion

Long-lasting sustainability of oral health interventions depends on "service and organizational readiness, sufficient resource allocations and supportive team climate which include proper coordination of staff roles to maintain successful intervention implementation."[22,30,31] The increased number of Missouri children receiving PSP oral screenings from 2007 to 2011 combined with the increased number of dental professionals and other volunteers assisting with PSP clearly illustrate that these parameters have been in place. A number of enhancements since the inception of the program have been implemented which add to the success that is demonstrated. These include the development of online volunteer training, an increase in number of OHCs and the development of a program-specific website.

However, despite its success, the PSP is not without barriers and challenges. Demonstration of successful outcomes is imperative to maintaining the program. Now that the program has been active for 5 years, it is time to do a full program evaluation. This evaluation should include focus group interviews with parents, school nurses and administrators. Individuals with the state's Department of Health and Senior Services (DHSS) need to be queried for evaluative data. This would include DHSS administrators, the OHCs and staff who assist with the inventory and distribution of supplies. Furthermore, the cost effectiveness of the program should be evaluated to determine the numbers of children who have benefited and the costs per child.

Table III: Number of Missouri Children Receiving the First and Second Applications of Fluoride Varnish from 2008 to 2011

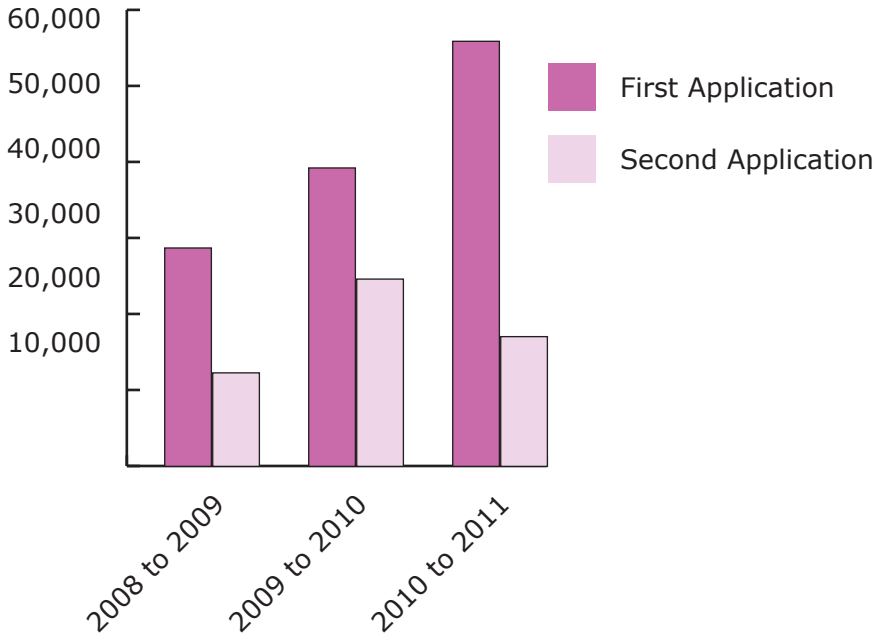
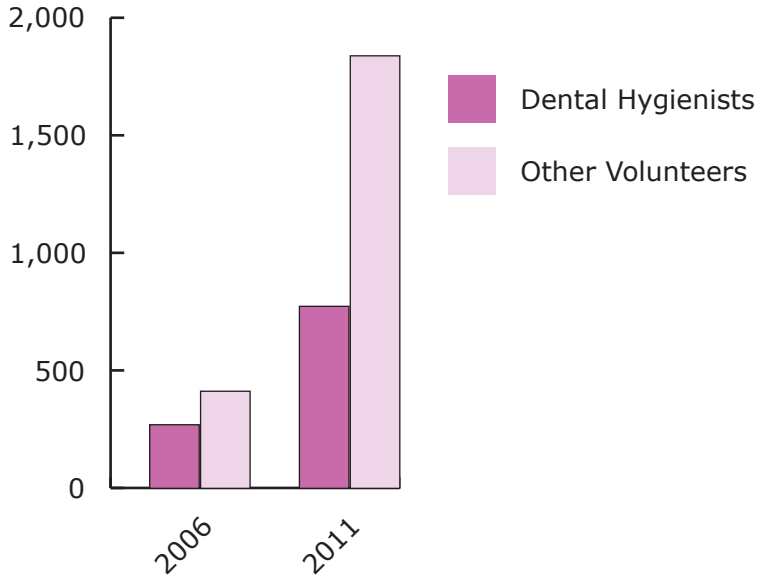


Table IV: Increase in the Number of Dental Professionals and Other Volunteers Assisting with PSP from 2006 through 2011

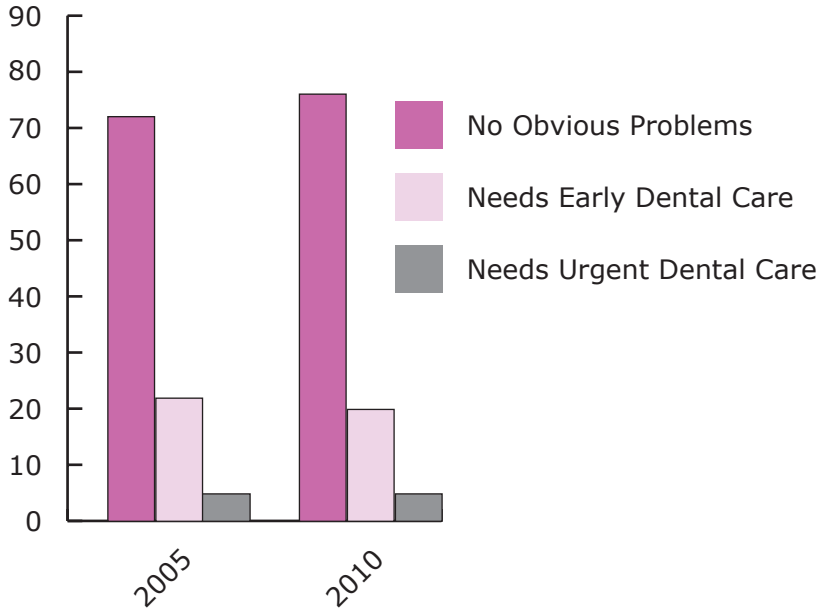


Both the adoption of PSP and training of volunteers are necessary steps in preparation for the program. Success will not be possible without the readiness of the services and the community. The following example illustrates this concept. In 2007, a local school district in a small Missouri town, population 8,500, chose to implement the program and began the planning and preparation. The program was championed by a concerned school nurse and approved by the school board. As the planning process continued, it became evident that some in the local community were not ready for the adoption of the program and the process was halted.[5,7] This example,[22] when applied to Simpson's Stages of Implementation Process, graphically illustrates how the process cannot be sustained if there is not a readiness to proceed and the program is fully adopted.

The barriers of time, space and resources need to be dealt with continually. Most of the programs occur during the fall and spring and this presents calendar challenges.[7] These 2 seasons are often busy with other school events, such as sports, festivals, stu-

dent testing and musical programs. Time to conduct a PSP event is not always a priority due to other school-related activities. Space utilization is another common barrier. A PSP event is usually held in a large area such as a cafeteria, library or school gymnasium. Individuals are sometimes resistant to the intrusion of PSP in these spaces. Another limitation that can influence the amount of children participating is the return of the permission/consent letter. The coordinator of the PSP event must be diligent and encourage participation by communicating with the parents to return the signed letter. Without positive consent, the child may not participate in the event. A program that has been thoroughly researched, is well-accepted and is meticulously planned can easily falter at this point if turf battles ensue. The importance of planning with all stakeholders is vital to avoid these problems. Of course, the barrier of funding can cause immediate problems if resources are decreased or eliminated. PSP is nearly at capacity and needs additional funding to expand.

Table V: Comparison of "Show Me Your Smile" Survey Data from 2005 and 2010. Percentage of Third Graders with No Obvious Problems, Early Dental Care needs and Urgent Dental Care needs



Early Dental Care: refers to tooth decay not associated with symptoms, spontaneous bleeding of gingival tissues, soft tissue lesions or faulty fitting appliances.
Urgent Dental Care: refers to pain, swelling, infection, or soft tissue ulceration of more than two weeks.

The decision to repeat the process in succeeding years is an important one that must be determined. It is essential that this decision is consciously made by the community at the end of each program so that planning for the future remains an on-going process.[5,7,22] The program should be evaluated from a materials and costs point of view. Furthermore, the smoothness of delivery is critical to consider. Barriers experienced during training, adoption and/or implementation can choke off sustainability.

The role of the OHC is extremely important. The OHC communicates with the local agency to determine the willingness to proceed for the coming year. If barriers were encountered, it is here that solutions can be created. Excellent service from an OHC and the timely delivery of materials and supplies can be major determinants in whether a program is sustained. It is important to continually develop the skills and knowledge base of the OHCs so that their service will be valuable to the communities.

Data collected from PSP is very beneficial. The data provides a snapshot of the oral health of children in Missouri. These data are valuable to future planning decisions. It is important to keep in mind that the data are only as accurate as the ability of the professionals collecting the data. Although all professionals complete an online training program, discrepancies will still exist in determination of disease status. Therefore, those making program decisions should bear in mind that calibration issues will exist with data collection. The same will be true for the application of fluoride varnish. Volunteers, although trained, will develop a personal system that will vary from that used by others.

Careful planning needs to go into developing a referral protocol for children with dental decay, especially those with urgent needs. This can be a barrier to success when dental care is located sparsely across a large geographic area. Also financing the follow-up care can be difficult when uninsured children are involved. Creative strategies will need to be sought to overcome these barriers.

New models will continue to emerge as the efficacy of varnish programs is demonstrated. It is important to bear in mind that the model for this program may evolve over time. Several other states have programs utilizing fluoride varnish.[32-35] These programs are aligned in such a way as to meet the oral health objectives of the respective state. Some programs utilize pediatricians and nurse practitioners to place the varnish at well-baby checks. Other programs utilize the certification visits through Woman, Infant and Children (WIC) to serve as the venue for delivery of

the varnish. Fluoride varnish is an evidenced based treatment for the prevention of dental decay and its utilization in a variety of programs is to be expected.

Conclusion

The PSP, a community-based oral health program, has been successful in reaching a large number of children and improving their oral health through the use of volunteer training, community adoption, individualized planning, program implementation including the development of a referral network and continuous evaluation. It has been demonstrated that when the local citizens take responsibility for their own needs that a sustainable and evidence-based program like PSP is possible. Guidelines which provide criteria for matching models with the specific community characteristics need to be generated. Furthermore, a national review of successful program models would be helpful to those endeavoring to implement community oral health programs.

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Review of the Literature

Adjunctive Use of the Diode Laser in Non-Surgical Periodontal Therapy: Exploring the Controversy

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Abstract

Purpose: Despite the controversy regarding clinical efficacy, dental hygienists use the diode laser as an adjunct to non-surgical periodontal therapy. The technique to maximize successful laser therapy outcome is controversial as well. The purpose of this review is to explore the scientific foundation of the controversy surrounding the use of the diode laser as an adjunct to non-surgical periodontal therapy. Further, this paper addresses the weaknesses in study design, the heterogeneity of methodology in the published clinical studies, especially the laser parameters, and how these issues impact the collective clinical and microbial data, and thus conclusions regarding clinical efficacy. Evaluation of the literature identifies possible mechanisms that could contribute to the varied, often conflicting results among laser studies that are the foundation of the controversy surrounding clinical efficacy. These mechanisms include current paradigms of periodontal biofilm behavior, tissue response to laser therapy being dependent on tissue type and health, and that the successful therapeutic treatment window is specific to the target tissue, biofilm composition, laser wavelength, and laser energy delivered. Lastly, this paper discusses laser parameters used in the various clinical studies, and how their diversity contributes to the controversy. Although this review does not establish clinical efficacy, it does reveal the scientific foundation of the controversy and the need for standardized, well designed randomized controlled clinical trials to develop specific guidelines for using the laser as an adjunct to non-surgical periodontal therapy. Using evidence-based laser guidelines would allow dental hygienists to provide more effective non-surgical periodontal care.

Keywords: diode laser, scaling and root planing, periodontal diseases, periodontitis, bacteria, dental hygienists, soft tissue laser, non-surgical periodontal therapy

This study supports the NDHRA priority area, **Clinical Dental Hygiene Care:** Assess the use of evidence-based treatment recommendation in dental hygiene practice.

Introduction

Lasers have been available for use in dentistry since 1989, but their use has not been universally accepted. Their efficacy for certain dental procedures, such as non-surgical periodontal therapy, is still controversial. In order to explore this controversy, the PubMed database was searched for literature regarding laser use in periodontal therapy. Utilizing key search terms, including diode lasers, scaling and root planing, bacteria, and periodontal disease, over 100 articles were identified and screened for inclusion in this review.

Some dental hygienists where not prohibited by their state dental practice act, are using lasers as an adjunct to non-surgical periodontal therapy.[1-5] Although the carbon dioxide (C02), erbium-doped yttrium aluminium garnet (Er:YAG) and neodymium-doped yttrium aluminium garnet (Nd:YAG) can all be used for soft tissue procedures, the 810 nm to 980 nm diode lasers appear to be the most common lasers used in private practice.[1] However, the efficacy of all lasers for use as an adjunct to non-surgical periodontal therapy is controversial. Relatively few clinical trials have been published studying the use of the diode as an adjunct to non-surgical periodontal therapy. Most of these trials were performed by dentists affiliated with university medical and dental clinics. All trials had a small sample size. In 8 of the 10 published clinical studies, the authors stated that the diode group showed a trend of some clinical benefit, compared to the control groups.[6-13] One study showed no significant difference in the clinical outcomes between the intervention and control groups.[14] In one trial, the control group showed an improvement over the intervention group in the end-point clinical measures.[15] The varied study outcomes and heterogeneity of methodology identified in other laser literature reviews, together with the impossibility for a meta-analyses due to lack of sufficient, well designed standardized trials, create the foundation for the controversy.[16-19] The American Academy of Periodontology (AAP) in April 2011 issued a statement of no efficacy for the use of lasers as an adjunct to non-surgical therapy for the treatment of periodontal disease, citing a lack of consistent evidence among the reviewed studies.[20]

The purpose of this review is to explore the scientific foundation of the controversy surrounding the clinical

efficacy of the diode laser as an adjunct to non-surgical periodontal therapy. Further, this paper addresses the weaknesses in study design and the heterogeneity of methodology in the published clinical studies, especially the laser parameters, and how these issues impact the collective data regarding clinical outcomes, such as reductions in pocket depth (PD), bleeding on probing (BOP), subgingival bacterial loads, bacteremia and gain in clinical attachment level (CAL). Lastly, this paper discusses laser parameters used in the various clinical studies, and how their diversity contributes to the controversy.

Background of the Controversy

Chronic Periodontitis (CP): Current evidence indicates that 47.2% of the U.S. adult population has some degree of periodontitis.[21] The severity of periodontal disease is dependent not only on the presence and composition of biofilm, but on the host response to the biofilm microorganisms.[22] Periodontal disease may be related to diabetes, respiratory disease and cardiovascular disease.[23-26] Although scaling and root planing (SRP) is considered the "gold standard" for non-surgical periodontal therapy, it is not adequate for every patient. Patients who respond sub-optimally or are at high risk due to systemic complications, such as patients with diabetes or compromised health, may benefit from adjunctive therapy.[27] Diode lasers may have the potential to provide this additional benefit.

The primary etiology of CP is the bacterial composition of the microbial biofilm. Porphyromonas gingivalis (Pg), Tannerella forsythia (Tf) and Treponema denticola (Td) are members of the "Red" complex of periodontal pathogens, and are frequently associated with CP.[28] While Pg and Tf are the strongest bacterial markers for periodontal disease,[29] the additional presence of Td creates the "Consortium" gf periodontal pathogens associated with disease progression.[30] Most recently, Pg, despite being present in small numbers, has been shown to dramatically alter the compositaon of oral microbiota. Pg directs the genetic response of other microbes and the host, hence earns the designation as a keystone pathogen.[31,32] Biofilm is able to invade the cementum and epithelial lining of diseased pockets.[33,34] Disruption of the biofilm is the most effective means of treating periodontal disease.[27] Specifically, removal of Pg from the mouth reverses aberrant inflammation.[32,35] A 810 nm diode can destroy Pg in vitro.[36] Kamma et al found that use of a 980 nm diode laser plus SRP has been shown to reduce the levels of Pg and Td, as well as the total bacteria load, for 6 months post-baseline in patients with aggressive periodontitis.[6] However, the study did not address the extent of the bacterial load and the aggressiveness of the bacteria beyond 6 months post-baseline.

Soft Tissue Lasers

Laser light is a man-made single photon wavelength, which emits non-ionizing (non-cancer-associated) radiation.[37] The wavelength is determined by the typm of elements in the laser. The diode laser is actually a semiconductoz, and is usually some combination of Gallium, Arsenide, Aluminum, Indium and Phosphorous. The wavelength range continues to expand, but currently, the most common diode wavelengths used in dentistry are 610 nm (red) to 980 nm (infrared), and can be operated in continuous-wave (CW) and gated-pulsed (PW) modes.

When laser light reaches a tissue, it can reflect, be absorbed, scatter or be transmitted to the surrounding tissues. The absorbed energy can result in tissue warming, coagulation or vaporization, depending on the wavelength, power and optical properties of the tissue.[17] The diode laser light is highly absorbed in hemoglobin and other pigments.[16,17] This property makes it an excellent device for removing the inflamed, highly vascular tissue within a periodontally involved pocket.[18]

The diode laser can be bactericidal.[6,7,13,36,38] Diode lasers target "pigmented" bacteria.[18,37,39] While it is unknown if "pigmented" pathogens are actually pigmented within the periodontal pocket,[40] it is known that diode lasers can oblate Pg in vitro.[36] The 810 nm to 980 nm diode laser light creates thermal changes resulting in the destruction of the bacteria in soft tissue. Most non-sporulating bacteria, including anaerobes, are readily deactivated at temperatures of 50 degrees Celsius.[37] The 810 nm to 980 nm diodes can create thermal changes elevating tissue temperature beyond this threshold.[39] Lower intensity diode lasers, such as the 610 nm to 750 nm (red) diodes, are currently gaining interest due their affordability, minimal treatment risk and potential to kill bacteria.[41] Inclusion of a photosensitive dye, known as photo-activated disinfection, photodynamic therapy (PDT) or antimicrobial photodynamic therapy, may enhance the bactericidal effect.[42,43] However, like other studies on lasers, PDT studies show modest clinical improvement of CP and lack the meta-analyses on existing clinical trials that can make a definitive statement regarding their efficacy.[44] Diodes of many wavelengths used at a lower non-surgical power (i.e. with a non-initiated tip, at less than 1 watt, and/or with a gated pulse) are currently gaining popularity due to the flurry of research on their photobiomodulation ability and promotion of healing.[42,45-49]

Diode lasers are smaller in size and less expensive than most dental lasers.[16,17] The 810 nm diode laser is easy to operate, and has been marketed to dental hygienists. Their hemostatic properties can reduce post-

treatment bleeding.[37] Other advantages of lasers include cell regeneration, collagen growth and mucosal tissue regeneration, along with an anti-inflammatory effect.[47,48,50] In a recent study, the diode laser significantly reduced the level of tumor necrosis factor-alpha (TNF-α) a pro-inflammatory cytokine, in gingival papillae of patients with chronic advanced periodontal disease.[47] This study also demonstrated that more frequent use of the laser related to greater reduction in the levels of TNF-α.[47] It is unclear whether these benefits from both low level and high intensity diode laser exposure can also be obtained when diode lasers are used for adjunctive periodontal therapy.

Reasons for Controversy

Heterogeneity of Clinical Studies: Few clinical trials on the high intensity diode lasers have been published to date.[18] The heterogeneity of methodology among these studies makes comparisons and conclusions challenging, hence contributes to the controversy surrounding a statement of efficacy.[16-19] Studies have varied in laser power density settings (350 mW/cm2 to 2,830 W/cm2), exposure time (3 seconds to 90 seconds), frequency of laser treatments (1 to 6 times) and clinical assessment parameters (plaque index to clinical crown length). The First International Workshop of Evidence Based Dentistry on Lasers in Dentistry addresses this heterogeneity by identifying use parameters,[39] which had been omitted from previous studies, to be specified in all future laser studies including:

- Exact laser specification, including manufacturer, wavelength, power output, control of output
- Spot size of irradiated area, joules/spot, and joules per session expressed as J/cm2
- Mode of application, number of sessions, treatment schedules

Lack of these use parameters in previous research may have contributed to the inconsistency in outcomes among studies.

The heterogeneity of methodology and weaknesses is some of the studies' designs are evident in Table I. In 7 of the 10 referenced studies the same type of non-surgical treatment (scaling, SRP or ultrasonic scaling) was conducted in both the control group and intervention group. In addition to this treatment, Moritz et al included a hydrogen peroxide (H_20_2) rinse to only the control group.[7] Lin et al included a 1% chlorhexidine rinse to only the intervention group.[14] Zingale et al failed to include SRP in the control group.[10] Quadri et al added a placebo laser with a very low-power red diode to the control group, which may have rendered an unintentional intervention. The heterogeneity of variables in the control groups makes comparison of the studies challenging. Lack of examiner masking (blinding) to the treatment groups, and lack of a clear statement regarding examiner calibration is also evident in Table I. Studies lacking examiner masking and calibration are suspect for bias.

Although the published trials utilized a wide variety of clinical assessments, Table II illustrates the clinical end-point measures that were common to these studies. In 8 of the 10 clinical trials, the diode group showed a trend of at least 1 clinical outcome benefit over the control or alternate treatment groups.[6-13]

As illustrated in Table II, six clinical studies used microbial assessments as outcomes. Of those, 3 showed that laser treatment reduced the number/amount of pathogens in the periodontal pockets, or bacteremia associated with ultrasonic scaling.[6,7,13] The Moritz7 and Borrajo[9] studies are among the few non-split mouth trials found in the literature. Most of the diode laser studies have used the split-mouth, quadruple split-mouth, or multi-site design.[6,8,10-15] With current knowledge regarding periodontal pathogens and biofilm behavior, microbial or clinical assessment data collected from these study designs may not be valid. Pathogens in the biofilm may be released from the biofilm at 1 site, enabling them to colonize in other sites of the mouth.[28] One study utilizing multi-sites per mouth showed improvement among all groups, including the control.[10] The behavior of pathogens within the biofilm may contribute to the varied study outcomes, hence prove to be a significant confounder to the collective data obtained from these common multi-site study designs.

Mammalian Cell Behavior

Further complicating the interpretation of the results from laser studies is the overall health of the cell that is undergoing laser exposure. Human fibroblasts cultured in serum-starved medium, consistently exhibited enhanced procollagen production when exposed to low level laser.[51] This was not observed with laser exposure to fibroblasts cultured in serum-containing medium. Houreld et al studied the effect of laser exposure on diabetic-induced fibroblasts in an in- vitro wound model.[46] They found that diabetic-induced fibroblasts exhibited more complete wound closure and less apoptosis when exposed to laser therapy in a dose and wavelength dependent manner, as compared to non-irradiated cells. Obradovic and colleagues examined histological specimens of diabetic patients who received conservative periodontal therapy for chronic periodontal disease with and without low level laser therapy.[49] The histological specimens of diabetic patients treated with both conservative periodontal therapy and laser exhibited less inflammation and greater healing, as compared to those specimens

Table I: Summary of Clinical Studies

Study	Intervention (Test)	Control	Study Length	Split/ whole mouth	# Patients	# Teeth/ sites	Examiner blinded	Calibrated
Moritz et al., 1997	Scaling + 805nm DL 2.5 PW 1s/mm PD 3 times (X)	Scaling + H2O2	6 m	Whole mouth	46	Not stated	Not stated	Not stated
Borrajo et al., 2004	SRP + 980nm DL 2PW 10s/ tooth surface 2X	SRP	6 weeks	Whole mouth	30	Not stated	Yes	Not stated
Quadri et al., 2005	SRP + 635nm DL 10mW 90s/papilla + 830nm DL 70mW 25s / tooth 6X	SRP + Placebo Laser with very low power red diode	6 weeks	Split-mouth	17	Unclear	Yes	Not stated
Kreisler et al., 2005	SRP, H2O2 + 809nm DL @ 1 CW 10+s/tooth 1X	SRP, H2O2 + saline rinse	3 m	Split-mouth	22	492 T	Yes	Not stated
Kamma et al., 2006, 2009 Aggressive Perio	SRP + 980nm DL 2CW 30s/ pocket 1X	SRP only 980nm DL only No Tx	6 m	Quadrant split-mouth	30	750+ T	Yes	Yes
Assaf 2007	810nm DL 1PW 15s/tooth 1X + US scaling	US scaling (ultrasonic scaling)	4 weeks	Split-mouth	22	Not stated	Yes	Yes
Caruso et al., 2008	980nm DL + SRP	SRP	6 m	Split-mouth	13	38T	Unclear	Unknown
De Micheli et al., 2011	SRP + 808nmDL 1.5CW 20s/ tooth, saline rinse 2X	SRP + non-activated 808nm DL, saline rinse	6 weeks	Split-mouth	27	Not stated	Yes	Yes
Lin et al., 2011	810nm +1% chlorhexidine 2W exposure time not stated 1X	Subgingival curettage	4 weeks	Quadrant split-mouth	18	206T	No	No
Zingale et al., 2012	SRP PR/SRP/FC LC/SRP 810DL 0.8CW 30-45s/ site 1X LC/SRP/ LS 810nm DL 0.8CW 2X	No treatment	6m	Multi sites/ mouth	25	170 sites	Yes	Yes

DL=diode laser, PW=pulse watts, CW=continuous watts, PR=papillae reflection, FC=flap closure, LC=laser curettage, LS=laser sealing, Tx=treatment

Table II: Summary of End-Point Clinical Measures

Study	Test v. Control Reduction PD (mm)	Test vs. Control Gain in CAL mm	Test v. Control BOP% Reduction	Test v. Control Reduction in Bacteria
Moritz et al., 1997	1.30 v. 0.40	n.a.	97 v. 67	71% v. 25%
Borrajo et al., 2004	n.a	0.95 v. 0.85	72 v. 53	n.a.
Qadri et al., 2005	0.9 v. 0.2	n.a	n.a.	No Sig Diff
Kreisler et al., 2005	1.8 v.1.6	1.6 v. 1.3	38 v. 34	n.a.
Kamma et al., 2006, 2009	SRP+DL 2.80 SRP only 2.34 DL only 2.00 No Tx 0.13	SRP+DL 2.14 SRP only 1.87 DL only1.97 No Tx 0.27	SRP+DL 58 SRP only 56 DL only 61 No Tx 56	Sig. Diff SRP+DL
Assif et al., 2007	0.37 v. 0.28	0.39 v. 0.18	n.a	Sig Diff Bacteremia DL
Caruso et al., 2008	1.4 v. 1.08	2.0 v. 1.69	16 v. 10	No Sig Diff
DeMicheli et al., 2011	2.1 v. 2.4	1.2 v. 1.9	n.a.	No Sig Diff
Lin et al., 2011	1.54 v. 1.49	0.65 v. 0.70	53 v. 48	n.a.
Zingale et al., 2012	SRP 1.57 PR/SRP/FC 1.57 LC/SRP 1.72 LC/SRP/LS 1.62 No Tx 0.84	*SRP 0.48 *PR/SRP/FC 1.05 *LC/SRP 0.42 *LC/SRP/LS 0.15 *No Tx 0.15 *gain clinical crown length	RP 66 PR/SRP/FC 69 LC/SRP 63 LC/SRP/LS 67 No Tx 60	n.a.

from patients treated with conservative periodontal therapy alone. These cases illustrate the positive effects of laser therapy on healing at the cellular level, as observed in compromised cells. However, it is unclear whether these same positive effects from low level laser therapy can be obtained when lasers are used for adjunctive periodontal therapy.

Laser Technique: The technique of using the laser may influence the outcome of the study, further contributing to the controversy over the efficacy of laser use. In one split-mouth trial, the control group, rather than the laser group, showed a significant improvement in the PD and CAL.[15] In this study, the laser was used twice on the experimental group at 1.5 continuous watts (CW) for 20 seconds per tooth. This exceeds the 0.4 to 0.6 CW guidelines currently recommended in periodontal therapy to avoid collateral damage.[38] This study may also have exceeded a recommended maximum continuous exposure time of 10 seconds per pocket.[52] Observing recommended settings for power, time and tip angulation is necessary to avoid collateral damage to healthy tissue, pulp and roots.[52,53] In this study,[15] the gingival fibroblasts may have been damaged by excessive heat resulting from application of too much laser energy. Another possible reason that the control group showed greater improvement than the laser group is that in the control group, the authors state that the laser was used "without activation," but were not clear whether or not they utilized the red laser guide light present on the "Zap Laser." If utilized in the control group, the visible red low level laser guide light may have inadvertently served as an intervention yielding anti-inflammatory properties that affect PD and CAL.[49] This same study failed to state whether or not the laser fiber was changed between the experimental and control sites. If the same laser fiber was used throughout the mouth in all sites, the capillary action of the laser fiber may have facilitated transmission of pathogens between the control and experimental sites, similar to transmission of pathogens from site to site via the periodontal probe.[54,55] Failure to provide laser energy within the therapeutic treatment window in this study may explain the greater improvement of the control group over the laser group. The diode laser has been shown to stimulate fibroblasts at a low level of laser energy, yet inhibit fibroblasts at a higher level, as explained by the Arndt-Schultz curve.[56] Stimulating fibroblasts to synthesize collagen and bone is dependent on applying and regulating laser energy within the therapeutic treatment window.[45] Delivering laser energy within the therapeutic treatment window remains the challenging and sometimes elusive treatment goal. All of these variables related to laser technique can influence the outcome of clinical studies.

Practical Perspective of Laser Use

Although support for the diode laser as an adjunctive method of treating periodontal disease is controversial, some dental hygienists continue utilizing lasers.[1,3,4] Earlier barriers, including uncertainties surrounding new technology, purchase cost, expense and

Table III: Summary of States Permitting Dental Hygienists to Use Laser for Curettage

State	Yes/No	Supervision	Comment
Alaska			Curettage allowed. Use of lasers not addressed
Arizona, Colorado, Maine, Missouri Montana Nebraska, North Dakota	Yes	General	–
California , Hawaii Idaho , Michigan, Nevada	Yes	Direct	–
New Hampshire, Tennessee	Yes	–	Board ruled hygienists can use lasers if properly trained
DC, Illinois, Kansas, Maryland, New Mexico, New York, Oklahoma, Oregon, Pennsylvania, South Dakota, Utah, Washington	-	-	Not Addressed
Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Indiana, Iowa, Kentucky, Lousiana, Massachusetts, Minnesota, Mississippi, New Jersey, North Carolina, Ohio, Rhode Island, South Carolina, Texas, Vermont, Virginia, West Virginia, Wisconson, Wyoming	No	–	–

This is intended for general informational use only. Dental Hygienists must contact their state dental board for further information permitting laser use. Provided courtesy of ADHA. Updated January 2012.

limited sources of training, are diminishing. The United States Food and Drug Administration has approved multiple lasers for clinical use.[57] A surgical diode laser can now be purchased for less than $3,500 (Zila, Inc., personal communication, February 2013). Basic laser training for both dentists and dental hygienist is readily available through laser companies, the Academy of Laser Dentistry and large continuing education venues. Dental insurance carriers, such as Delta Dental, have partnered with the California Academy of General Dentistry in sponsoring laser continuing education classes. The Academy of Laser Dentistry (ALD) recommends that laser practitioners should complete, at minimum, a Category II Standard Proficiency level certification course as described in ALD's Curriculum Guidelines and Standards for Dental Laser Education.

It has been reported that approximately 25% of dentists are using lasers, and that number is growing rapidly.[58] A 2012 article in RDH reports that the number of dentists and hygienists utilizing laser technology in private practice has doubled since 2008.[1] However, the actual number of dental hygienists utilizing lasers has not been documented. It is not currently possible to report accurately how many dental hygienists use the laser since few, if any states require a separate license for laser use. Some states have authorized dental hygienists to use the laser within their scope of practice. Other states have either prohibited laser use by hygienists, or not taken a position in either direction. Table III provides a summary of each states' position regarding laser use by dental hygienists, as reported by the American Dental Hygienists' Association.

The diode laser may have potential as an adjunctive therapy, but support for that view based on the scientific evidence is equivocal and remains controversial. Outcomes of studies are varied and often conflicting in terms of efficacy. This review identifies possible mechanisms that could have contributed to this issue: tissue response to laser therapy was demonstrated to be dependent on tissue type and health, and the successful therapeutic treatment window was shown to be specific to the target tissue, biofilm composition, laser wavelength and energy delivered. Studies have varied as to the number of times the laser was used during the course of periodontal therapy, the laser wavelength, the laser power delivered, the lasing exposure time, the study design (full mouth, split-mouth, quadrant or multi-sites), and the clinical and microbial assessments. Furthermore, few of the studies provide sufficient detail to be reproducible. The lack of standardization, varied study tissue type and health, poor study design and improper lasing technique, may be responsible for the varied end-point clinical measures that create the controversy surrounding the efficacy of laser use. Literature reviews on lasers conclude that more standardized, randomized controlled clinical trials are needed to determine if there is benefit in using lasers as an adjunct to non-surgical periodontal therapy, and if that benefit out-weighs any associated risk.[16-19,59,60] The American Academy of Periodontology (AAP) commissioned review in 2006, the First

International Workshop of Evidence-Based Dentistry on Lasers in Dentistry, as well as the AAP statement issued April 2011, have all concluded that there is a need to develop an evidence-based approach to the use of lasers for the treatment of CP.[17,20,39]

Conclusion

Although this review does not establish efficacy, this review does reveal the scientific foundation of the controversy and the need for standardized, well-designed randomized controlled clinical trials to develop specific guidelines for using the laser as an adjunct to non-surgical periodontal therapy. Using evidence-based laser guidelines would allow dental hygienists to provide more effective non-surgical periodontal care.

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Analysis of Patient Factors Impacting Duration of Periodontal Maintenance Appointments: An Exploratory Study

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Abstract

Purpose: The periodontal maintenance (PM) appointment requires varying amounts of time and is absolutely essential for long-term successful periodontal therapy. This study assessed time requirements for PM and relative contribution of patient-level factors such as oral health status, complex medical history, maintenance compliance and demographics.

Methods: One hundred patients receiving PM in a graduate periodontal program at a dental school participated in this cross sectional, observational study and components of their PM were timed in minutes/seconds. Descriptive data were obtained for average total-time required for PM and relative time for each treatment component. Hierarchical multiple linear regression determined what patient-level factors demonstrated the greatest impact on total-time to complete PM.

Results: The average PM appointment interval, with radiographs, was 1 hour, 16 minutes, 23 seconds (SD 19:25 minutes). When cubicle preparation and disinfection was included, the total-time was 1 hour, 24 minutes, 31 seconds (±19:32 minutes). Multiple regression showed that BOP, dentist examinations, number of carious lesions and/or restorative defects, number of teeth/implants, taking radiographs, female gender and deposit aggregate (supragingival and subgingival calculus and stain) were significant predictors of total PM duration and explained 57% variance ($p<0.05$, $R2=0.569$).

Conclusion: Based on the average comprehensive PM appointment time of 1:16 minutes, the typical appointment of 60 minutes is insufficient to achieve the goals of a comprehensive PM in this academic clinic setting. These findings suggest the need to utilize more customized models for scheduling PM in order to achieve time allocations that are individualized to address specific patients' needs.

Keywords: periodontal disease/therapy, patient care planning, appointment and schedules, dental prophylaxis, oral hygiene, continuity of patient care

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

Periodontal maintenance (PM) is imperative for long-term success of periodontal treatment.[1-10] While treatment of periodontal disease may encompass a variety of procedures (surgical and non-surgical) designed to restore health to the periodontium, nonsurgical therapy including removal of subgingival plaque and calculus by scaling and root planing remains the standard of care.[11-24] Current accepted practice for non-surgical PM is a 45 to 60 minute appointment with follow-up appointments at 3 month intervals.[8,16,22,25,26] While effectiveness of the 3 month PM appointment interval has been well documented, very little evidence exists to support the customary 45 to 60 minute time-frame parameter, with the exception of a report by Schallhorn et al.[25] Their landmark citation set the standard for PM therapy, reporting a typical PM appointment taking 52.61 minutes, including average time spent on the various PM components (Table I). According to the American Academy of Periodontology (AAP), the current standard for PM treatment-considerations recommends time be individualized and dictated by such factors as number of teeth or implants, patient cooperation, oral hygiene efficacy, compliance, systemic health, previous PM frequency, instrumentation access, history of disease or complications, and distribution and depth of the sulci.[26] Despite this, no data exists in contemporary literature providing guidance on the relative contribution of these factors to total-time needed for effective PM.

Although Schallhorn et al have provided guidance on PM therapy,[25] in the 3 decades since its publication there have been significant changes in patient care, e.g. in-depth medical history, contemporary standards of care on compre-

Table I: Components of typical PM appointment and time requirements (taken from Schallhorn and Snider[25]) and Comparison of PM components between Schallhorn and Snider vs. AAP Position Paper[26]

	Schallhorn and Snider, 1981 25	2003 AAP Position Paper 26
8.50 min	**Patient greeting** **Health and dental history** Brief review of patient's chart and radiographs; update patient's history through conversation. If change in patient's health that will affect treatment, dentist is consulted.	**Review and update of medical/dental history** **Radiographic examination** Current, diagnostically readable radiographs based on the needs of the patient, for evaluation and interpretation of the status of the oral structures, teeth, periodontium, and dental implants. Clinician judgment, prevalence and/or degree of disease progression, will determine need, frequency, and number of radiographs. Note radiographic abnormalities
1.12 min	**Dental screening** Includes: visual extraoral exam of face, lips, neck, and a brief, intraoral exam of oral mucosa, tongue, floor of the mouth, pharynx, tonsillar area, and palate; examination of oral tissues for evidence of cancer, or other aberration. If any pathologic condition is present, it is recorded in the chart and dentist consulted.	**Clinical examination (to be compared with previous baseline measurements)** Extraoral exam, recording of results Intraoral exam, recording of results: Oral soft tissue evaluation Oral cancer evaluation
3.25 min 0.22 min	**Periodontal assessment** Color, architecture Exudation Pocket/sulcus Recession Fremitus	**Periodontal examination to include dental implants and peri-implant tissues and recording of results:** Probing depths Bleeding on probing Evaluation of furcations Exudate Other signs of disease progression Microbial testing if indicated Gingival recession Attachment levels if indicated Tooth mobility, fremitus Occlusal factors, Examination Evaluation of implant stability Occlusal adjustment, if indicated Other signs and symptoms of disease activity (e.g., pain, etc.)

hensive periodontal examinations, utilization of electronic records and universal precautions for infection control, to name a few. Obviously, the advent of universal infection control procedures has increased the time required for providing care as many of the standards became effective after 1981.[27] Furthermore, advancements in medical/dental technology and improved life styles have allowed Americans to live longer while retaining much of their natural dentition.[28,29] However, while innovations improved health and life expectancy, many elderly are disabled, suffering from chronic medical and oral conditions requiring time-consuming medical/dental management.[30,31] Consequently, the progressive evolution of patient care, federal safety regulations and the complexity and interaction of variables that can impact treatment, suggests the customary time-frame parameter outdated and insufficient when considering the goals of a contemporary PM visit.[26,27,32]

The purpose of this study was to systematically evaluate the relative time requirements for each PM component and overall total-time for a PM appointment. Additionally, the study was designed to determine the degree patient-level characteristics, such as oral health status, complex medical history, maintenance compliance and demographics contribute to variation in time required for the contemporary PM visit, as these data may provide guidance for determining time estimates useful in treatment planning.

Table I: Components of typical PM appointment and time requirements (taken from Schallhorn and Snider[25]) and Comparison of PM components between Schallhorn and Snider vs. AAP Position Paper[26] (continued)

3.04 min 5.00 min	**Plaque index (with aid of assistant)** ***Plaque index (without assistant)** Patient performs hygiene care prior to appt., teeth are disclosed, use of O'Leary index, compare previous visits.	**Assessment of personal oral hygiene** General levels of plaque and calculus
4.20 min	**Oral hygiene review** Therapist must discern underlying problem of poor hygiene as one of motivation, dexterity, or understanding.	**Behavioral modification** Oral hygiene reinstruction Adherence to suggested PM intervals Counseling on control of risk factors (e.g., smoking, nutrition, stress)
6.83 min 10.05 min	**Scaling/root planning** Ultrasonic with aid of assistant **Hand instrumentation and instrument sharpening**	Removal of subgingival and supragingival plaque and calculus. Selective scaling or root planning, if indicated Occlusal adjustment, if indicated
10.90 min	**Polishing/flossing** Polish and floss teeth before S/RP to minimize embedding polishing agent to interfere with healing.	**Polishing teeth**
1.00 min	**Assess caries, defective restorations** After scaling/root planning and polishing. Caries, fractured restoration, or problems with prostheses, assessment of the dentition.	**Dental examination and recording of results** Coronal and root caries assessment Restorative and prosthetic factors, defective restorations, open contacts or malpositioned teeth Exam of prosthesis/abutment components
1.50 min	**Chemical therapy** For compromised maintenance or recurrent disease, irrigation with saline solution or Chloramine T, antiformin TX, and antimicrobial agents.	Use of systemic antibiotics, local antimicrobial agents, or irrigation procedures, as necessary
1.00 min	**Fluoride rinse** For caries control and desensitization of roots.	Root desensitization, if indicated
1.00 min	**Patient dismissal, re-appointment**	Assessment of disease status or changes by reviewing the clinical and radiographic examination findings, compared to baseline **Communication** Informing the patient of current status and need for additional treatment if indicated Consultation with other health care practitioners who may be providing additional therapy or participating in the PM program, or whose services may be indicated. **Planning** For most patients with a history of periodontitis, visits at 3-month intervals may be required initially. Based on evaluation of clinical findings and assessment of disease status, PM frequency may remain the same, be modified, or the patient may return to mechanical, chemical, surgical, and/or non-surgical treatment. Surgical therapy (or discontinuation of periodontal maintenance and treatment of recurrent disease), if indicated.
Total	**52.61 min**	

Methods and Materials

Sample

Upon approval from the Institutional Review Board (IRB), the primary investigator was responsible for recruiting, explaining procedures, collection of all data and performing all PM procedures on all subjects. The investigator had 40 years of combined practice experience in periodontal private, government and academic settings. Volunteer subjects signed informed consent and Health Insurance Portability and Accountability Act (HIPAA) forms. All subjects were assigned a study number to ensure anonymity and utilization of all data collection.

A cross sectional, observational study design was utilized. A convenience sample of 100 consecutive patients presenting for PM treatment were recruited starting in August 2009 and completed in November 2009. Inclusion criteria required subjects understand spoken English, have ≥6 teeth, be between age 30 to 89 years, exhibit moderate to severe periodontitis conforming to case types III or IV (American Dental Association (ADA) Periodontal Classification)[33] and meet the American Society of Anesthesiologists (ASA) physical status of ASA I, II, or III.[34] Exclusion criteria included patients presenting with acute periodontal abscess, and/or ASA IV or VI health status.[34] It should be noted the ADA classification of periodontal disease status was used in lieu of the 1999 classification of periodontal diseases/conditions due to available electronic programmed software.[33,35]

Procedures

Patient data, consisting of the various PM components, were entered electronically using electronic clinical management software (Paradox® Runtime, Corel Corporation, Ottawa, Ontario) and included oral and medical examinations, medications, restorative charting, treatment notes, treatment planning and digital radiographs using electronic radiographic imaging (MiPACS® Dental; Medicor Imaging, Charlotte, North Carolina). Periodontal assessment data included: probing depths (PD), gingival recession, bleeding on probing (BOP), plaque index (6 sites per tooth), tooth mobility, furcation involvement and any other existing muco-gingival problems or conditions.[36] Annual or periodic dental examinations and periodontal consultations were provided as needed by a small cohort of supervising periodontists who provided care consistent with that in practice, depending on individual need.

Format Utilized

Component time and overall appointment duration was recorded using a digital software stopwatch/count-down timer (XNote Stopwatch® dnSoft Research Group, Cheboksary, Russia) measuring time intervals in seconds, minutes and hours. The software was loaded on the same computer as the electronic dental record for ease of data collection. The primary feature of the stopwatch included the ability to "snap" and record times in minutes/seconds with a single mouse click for each treatment component to include the following: greeting patient, radiographic evaluation/assessments and/or taking necessary radiographs, medical/dental history, dental/oral examinations, periodontal examinations, oral hygiene assessments and communication, instrumentation/treatment phase, dentist examinations, and treatment planning and patient dismissal. These features allowed for time efficiency, while minimizing errors collecting data, and prevented the process of data collection from adding substantially to overall appointment duration. Timing results were collected in a standardized manner and duplicated with each participant utilizing a pre-determined component sequence (Table II). After participants were released, the recorded data were copied and saved, and the stopwatch was re-set for next subject.

Pilot Study

Pilot testing was used to determine a standardized total-time allocation for pre- and post-infection control procedures. The authors were primarily interested in capturing the variance in PM time as described by AAP Parameter of Care;[32] however, infection control procedures are important to consider in overall appointment planning. Since infection control occurs in the inter-appointment interval where many other actions take place, we elected to isolate the pre- and post-infection control time and obtained an average estimate uncontaminated by other non-PM care factors. The standardized infection control time was derived by timing a total of 10 sessions, (5 operative set-ups and 5 break-downs) for the PM treatment according to the Center for Disease Control (CDC) and Occupational Safety and Health Administration (OSHA) guideline standards.[27] It should be noted the subsequent regression modeling did not include the time for infection control.

Statistical Design and Analysis

An observational, cross-sectional study design was utilized. Subjects were observed at a single time point and received PM therapies as indicated. Data were analyzed descriptively to obtain relative time needed for each component and overall average time required for PM procedures. For these analyses, the PM treatment time excluded time allocated for the inter-appointment cubicle preparation and disinfection procedures. Hierarchical multiple linear regres-

Table II Periodontal maintenance component sequence used in current study

Greeting
Greet and seat patient, sign-in to electronic patient chart.
Medical History
Health assessments: medications, blood pressure screening, take blood glucose or INR as indicated. Consultation with other health care practitioners who may be providing additional therapy, or whose services may be indicated prior to treating patient.
Radiology
Radiographic assessments, and/or taking necessary digital radiographs.
Dental/Oral Examination
Extra-oral, Intraoral examinations: oral soft tissue evaluation, oral cancer screening. Dental Examinations: caries assessment, defective restorations, overhangs, open contacts, etc.
Periodontal Examination
Full mouth probing/pocket depths, bleeding upon probing, furcation involvement, gingival recession, exudate, tooth mobility, plaque index, implant evaluation, muco-gingival conditions.
Oral Hygiene Assessments/Communication
Assessing disease status, personal oral hygiene, informing patient of current status and need for additional treatment if indicated, to include but not limited to: Behavioral Modification, Motivational Interviewing, Oral hygiene review/instruction, adherence to PM intervals, counseling on control of risk factors (stress, smoking, nutrition, health status, etc.).
Instrumentation/Treatment Phase
Removal of subgingival/supragingival plaque and calculus, to include selective scaling and root-planing if indicated (using ultrasonic and hand-instrumentation, instrument sharpening, polishing and flossing teeth). Administration of topical and/or local anesthetics, nitrous oxide, chemical therapy; local antimicrobial agents, irrigation agents, localized drug delivery, exposed root desensitization, and/or fluoride, as indicated.
Dentist Examination/Periodontal Consultation, Treatment Planning
Dentist/Periodontist examinations/consultation as indicated. PM intervals based on evaluation of clinical and radiographic findings and assessment of disease status; PM frequency may remain same, be modified, or patient may return for mechanical, chemical, surgical, and/or non-surgical treatment.
Patient Dismissal
Gathering patient's belongings, dispensing homecare items, scheduling patient for next appointment. Finish electronic record notes and sign out of electronic chart.
Variables
Any unforeseen, occurring during PM appointment time noted.

sion analysis with a backward elimination approach was used to determine which patient-level factors and various components of the appointment have the greatest impact on treatment time to complete PM procedures. Backward elimination was used to produce the simplest explanatory model for explaining variance in treatment time as a function of key patient-based and appointment-based predictor variables, while controlling for collinearity amongst predictors.

Results

One hundred subjects were enrolled out of 102 screened, with 100 consenting and 99 subjects available for analysis, as 1 subject was exited from the study due to determined need to re-activate alternative care. The number of subjects enrolled in the study each day ranged from 1 to 4. Given the clinician's typical schedule treating 6 PM patients per day, fatigue was not likely given the ratio of the number of patients seen vs. the number enrolled per day. Demographic characteristics (Table III) reveal an average age of 64.4 years, and a 3% greater distribution of women than men. Periodontal case type status revealed 42% of subjects classified as case type III and 57% case type IV.[33] More than half (53%) of subjects were ASA III.[34] While the majority of subjects (75%) reported taking 1 to 5 medications, almost half (47%) had previously smoked, with 12% current smokers.

Results from clinical summary data (Table IV) shows the average number of teeth including im-

Table III: Sample characteristics

	All Participants (n=99)	Periodontal Class III33 (n=42)	Periodontal Class IV33 (n=57)
Age			
Mean (SD)	64.4 (11.1)	63.6 (11.2)	65.0 (11.1)
Gender			
Males	48 (48%)	18 (38%)	30 (62%)
Females	51 (51%)	24 (47%)	27 (53%)
ASA Classification34*			
I	23 (23%)	10 (43%)	13 (57%)
II	23 (23%)	8 (35%)	15 (65%)
III	53 (53%)	24 (45%)	29 (55%)
Number of Medications†			
0	1 (1%)	0 (0%)	1 (100%)
1 to 5	75 (75%)	32 (43%)	43 (57%)
6 to 10	12 (12%)	6 (50%)	6 (50%)
11 to 20	10 (10%)	4 (40%)	6 (60%)
>20	1 (1%)	0 (0%)	1 (100%)
Tobacco Use			
Never	40 (40%)	20 (50%)	20 (50%)
Previous	47 (47%)	19 (40%)	28 (60%)
Current	12 (12%)	3 (25%)	9 (75%)
Last Recall (months)			
Mean (SD)	4.6 (2.4)	4.7 (2.1)	4.5 (2.6)
Median (SIQ)	3.2 (0.8)	4.1 (1.1)	3.7 (0.7)
Proportion On Time +1 month	75.5%	71.4%	78.6%
Proportion Overdue 1 to 4 months	19.4%	26.2%	14.3%
Proportion Overdue >5 months	5.1%	2.4%	7.1%

* ASA Classifications:[34] I healthy, II mild-moderate systemic disease, or III controlled severe systemic disease
† Number of medications taken daily

plants among subjects was 23.5 (±4.4), and an equal distribution in periodontal case types III and IV.[33] Mean BOP was equal among the case types, averaging 16.3% (±19.0%) for case type III and 16.5% (±15.0%) for case type IV.[33] Subjects were relatively compliant with their PM recall frequency with a median PM recall of 3.2 (SI 0.8) months. An average proportion (63%) were overdue for their PM appointment, with the range of months for those overdue being 2 to 4 months. Almost half (42%) exhibited poor oral hygiene as noted in the mean percent of plaque among all subjects 41.0 (±28.1). Aggregate deposits were categorized as slight, moderate or heavy in range, with the majority of subjects exhibiting slight deposits. In the present investigation the amount of deposit was used to account for variations in treatment time based on patient condition. The extent of inflammation among subjects presenting for PM varied and was not measured beyond the dependent parameters listed.

The average time required for PM components (Table V) reveals total-time for completion of the PM visit was 1 hour, 16 minutes, 23 seconds (±19:25 minutes). Additionally, the average inter-appointment time needed for cubicle preparation and disinfection was 8.08 (±0.07) minutes, making the average overall appointment interval in this study 1 hour, 24 minutes, 31 seconds (±19:32 minutes). As expected, the greatest amount of time was spent on the treatment phase, averaging 29:34 (±7:21) minutes, followed by the periodontal examination at 14:23 (±4:26) minutes. Obtained radiology times were highly variable due to a variety of circumstances, e.g., differences in type/and or number of digital radiographs taken, institutional barriers, and differential time to evaluate existing radiographic films from past appointments.

Preliminary bivariate analyses were conducted to determine the relationship between patient-level factors and overall PM time and provide guidance in selecting predictors for the multiple regression analysis. Patient-level factors that had a significant

Table IV: Clinical characteristics of subjects

	All Participants	Periodontal Class III[33]	Periodontal Class IV[33]
Mean (SD)	(n=99)	(n=42)	(n=57)
Number Teeth/Implants	23.5 (4.4)	24.0 (4.0)	23.0 (4.6)
% Pockets 4 to 6 mm	25.3 (16.6)	22.4 (15.4)	27.5 (17.3)
% Pockets > 7 mm	1.1 (2.4)	0.1 (0.3)	1.8 (2.9)
% BOP *	16.4 (17.0)	16.3 (19.0)	16.5 (15.0)
Furcations	6.6 (5.5)	4.3 (4.0)	8.2 (5.8)
Caries/Defects	4.1 (3.6)	3.6 (3.3)	4.5 (3.8)
% Plaque	41.0 (28.1)	40.0 (30.0)	41.0 (27.1)
Clinical Findings	n (%)	n (%)	n (%)
Oral Hygiene			
Good	22 (22%)	10 (45%)	12 (55%)
Fair	35 (35%)	16 (46%)	19 (54%)
Poor	42 (42%)	16 (38%)	26 (62%)
Supra Calculus			
None	2 (2%)	1 (50%)	1 (50%)
Slight	62 (62%)	29 (47%)	33 (53%)
Moderate	29 (29%)	11 (38%)	18 (62%)
Heavy	6 (6%)	1 (17%)	5 (83%)
Sub Calculus			
None	18 (18%)	10 (56%)	8 (44%)
Slight	60 (60%)	27 (45%)	33 (55%)
Moderate	19 (19%)	5 (26%)	14 (74%)
Heavy	2 (2%)	0 (0%)	2 (100%)
Stain			
None	15 (15%)	10 (67%)	5 (33%)
Slight	50 (50%)	25 (50%)	25 (50%)
Moderate	14 (14%)	3 (21%)	11 (79%)
Heavy	20 (20%)	4 (20%)	16 (80%)
Medical/ Pathology Consult	12 (12%)	4 (33%)	8 (67 %)
Dentist Examinations	30 (30%)	10 (33%)	20 (67 %)
Fluoride Treatment	85 (85%)	35 (41%)	50 (59%)
Other Interventions †	16 (16%)	3 (19%)	13 (81%)

*BOP=% Bleeding on Probing
†INR, Blood Glucose, Nitrous Oxide, Local Drug Deliver, or Local Anesthesia

relationship ($p<0.05$) with mean appointment time were female gender, supragingival calculus deposits, radiographs, number of teeth, medical consultations, number of medications, percent BOP, percent pockets 4 to 6 mm, and dentist examinations. Data were subsequently entered into a multiple regression model using a backward elimination approach, with the criterion for variable removal set at $p>0.10$. The resulting model explained 57% of variance in overall treatment time ($p<0.05$; $r^2=0.569$) as a linear function of predictors (Table VI). The resulting model included the following predictors: radiographs, dentist examinations, number of teeth/implants, aggregate deposits (supra-gingival and sub-gingival calculus, stain), percent BOP, number of carious lesions/restorative defects, and gender (female). This demonstrated that these predictors contributed unique variance with part $r^2=0.09$, 0.02, 0.05, 0.05, 0.03, 0.02 and 0.02, respectively.

Discussion

The goal of this study was two-fold - to systematically evaluate the relative time requirements for each PM component and collectively considered the overall total duration time for a comprehensive

PM appointment, and to identify patient-level and appointment-level factors that have the greatest impact on treatment time variability. The estimated average comprehensive PM treatment interval for the PM visit was 1 hour, 16 minutes, 23 seconds (±19:25 minutes). Modeled separately was the average time needed to complete universal infection control procedures between PM appointments; 8.08 (±0.07) minutes. Not surprising, the variability in total treatment time was fairly large and most likely a result of tailoring care to each individual's needs, as recommended by AAP[26,32] and the CDC/OSHA.[27] Considering the mean (SD) total PM time, it is evident that a standardized appointment time for PM of 45 to 60 minutes is likely insufficient to achieve the goals of comprehensive PM for the majority of periodontal patients. Only 19 of the 99 subjects in this trial were treated in less than 60 minutes, despite the experience of the clinician-investigator, with over 40 years of clinical practice and exclusively treated periodontal patients in previous private practice, as well as this academic clinical facility. Moreover, none of these 19 patients required radiographs during the PM, which would have added considerably to treatment time (on average 22 minutes), as was demonstrated as explaining approximately 9% of unique variance in the regression model.

Table V: Periodontal maintenance component times*

(n=99)	Mean	SD
Greeting	2:57	1:21
Medical History	3:50	3:48
Radiology	6:06	9:33
Dental Examinations	3:23	2:06
Periodontal Examinations	14:23	4:26
Oral Hygiene/Assessments	5:25	4:44
Treatment Phase	29:34	7:21
Dentist Exams/Treatment Planning	6:21	2:42
Dismissal	3:22	2:38
Total PM Time	1:16:23	19:25
OSHA †	8:08	0:07
Appointment Interval	1:24:31	19:32

* Timing in hours: minutes: seconds
† OSHA Compliance Pilot Study

Results from the predictive model clearly suggest that PM scheduling schemas must be approached to address the patient-level characteristics, periodontal needs of the patient, expected standards of care in regards for periodic diagnostic assessment, as well as fit the characteristics of patients in the practice. Annual comprehensive examinations and/or the need for radiographs would likely require more extensive time allotted for the appointment than 2 or 3 month PM visits. A variety of models could be employed, including modifying the amount of time with the hygienist and/or scheduling a separate appointment for diagnostic evaluation with the dentist, depending on the patient's individual needs and the practice characteristics.

Although there is a small body of literature reporting time estimates for providing dental treatment,[37-39] the majority focused on initial periodontal therapy and did not specifically consider the PM appointment. Schallhorn et al is the singular study that reported on time needed for PM.[25] Furthermore, past studies relied on either dentists self-report of time needed or used crude assessments (e.g., using a wall clock) to evaluate time for care, and used multiple clinicians and/or multiple sites for collecting data.[37-39] Additionally, common standards for calibration among providers were not accounted for nor were practitioner experiences or differing treatment philosophies that may have influenced procedures and subsequent time variation. To confound findings further, some studies reported utilizing dental assistants, others did not, and yet other studies were inconclusive. In the current study, an assistant was not utilized to make results more generalizable to dental hygiene practice. Moreover, a recent review article by Tan identified the difficulty in estimating PM treatment time, reporting there will always be variations in terms of disease severity, number of teeth, training of the personnel involved and "degree of difficulty."[40] Consequently, the current studyis the only investigation to standardize procedures and clinician, and employ a system of accurately capturing time for each PM component while not interfering with patient care.

Results from this study indicate the greatest amount of unique variance in total-time, 0.09, was demonstrated when radiographs were required. On average and, not surprisingly, there was a 22 minute difference in total treatment time for the PM when any radiographs were obtained. In addition, the examination by the dentist added approximately 9.22 (SD=4.2) minutes to the overall time which is likely typical for other comprehensive examinations. The physical setting of this study (a graduate periodontics clinic within a school of dentistry) allowed for impromptu dental examinations

Table VI: Regression model parameters for predicting PM treatment time (excluding cubicle preparation and disinfection) by patient-level and appointment parameters. (r^2=0.569)

Variable	Coefficient	Std. Error	Part R2	p
Constant	19.69	9.77	–	0.047
Radiographs *	22.01	4.98	0.092	0.0001
Dentist Examination	9.17	4.20	0.023	0.032
Teeth/Implants †	0.99	0.31	0.048	0.002
Deposits ‡	2.11	0.66	0.048	0.002
Percent BOP	0.23	0.09	0.030	0.014
Caries/Defects §	1.24	0.61	0.019	0.046
Gender (female)	5.53	2.78	0.019	0.049

* Any radiographs taken
† Number of Teeth/Implants
‡ Aggregate of Deposits (Supragingival and Subgingival Calculus, Stain)
§ Number of carious lesions, (frank and incipient) and defective restorations

similar to that which would be expected in a busy private practice setting. The PM appointment time will vary considerably depending on whether a periodic exam and/or radiographs are needed or not. Variable exam times may also differ depending on whether the exam is performed by a general dentist versus a periodontist. A systematic review explored whether supportive care provided by a specialist practice produced different clinical outcomes than those provided in a generalist practice.[41] Collectively, results from the 14 studies that met criteria for inclusion demonstrated less attachment loss for patient treated by periodontists and concluded that these are likely a result of greater overall time being devoted to PM in the specialty practice.[41] It is noteworthy, however, that a recent study compared cost effectiveness of supportive periodontal care provided by periodontal practices in Spain, UK, Australia, U.S., Ireland, Germany Japan and Sri Lanka.[42] These authors' conclusions suggest that PM in private practice, at least in the U.S., may be cost effective if clinicians placed a greater value on preventing attachment loss in periodontal patients. In theory, preventing attachment loss will increase tooth retention and thus prevent the monetary costs associated with tooth replacement. One might also argue that the quality of life costs associated with unnecessary tooth loss should be part of the discussion. Irrespective, the financial impact of increasing the average appointment time does have implications for dental practices that must be considered relative to provider's philosophy on tooth retention over a person's lifespan. In particular, one must weigh the relative tradeoffs between allotting sufficient time to individualize care to achieve better patient outcomes and less dental disability over time, with the increased patient and practice liability from compromising care due to inadequate time.

Also, not surprisingly, the number of teeth/implants and the amount of deposits were significant predictors, both explaining 0.05 variance, as the more teeth an individual retains, and the heavier the deposits, the more time required to perform a comprehensive PM. This is particularly relevant because the aging U.S. population is living longer and retaining more teeth now than ever before. While age was not a significant predictor in this study, our sample was representative of older dentate adults. In the U.S., the older population has shifted from a predominately edentulous one in years past, to a contemporary one with an average of 20 teeth/person.[28,30] Epidemiological studies suggest that periodontal diseases are cumulative over time resulting in an increase from 6% among persons 25 to 34 years to 41% among those 65 years and older.[43] Tooth retention, coupled with other oral health related issues, suggests that the need to individually allot time for PM will continue to be an issue in rendering appropriate treatment.

Additionally, BOP was also a significant predictor contributing uniquely to time for PM at 3%. It is noteworthy that for each 1% increase in BOP there is a comparable increase of 0.23 minutes in treatment time. Clinically translated, this suggests that the predicted additional time needed for a patient with 80% BOP compared to a patient with 10% BOP would be approximately 16 additional minutes (0.23*70). The same is true for aggregate deposits in this study. A composite variable was created by summing the 0 to 3 ordinal rankings for plaque, supra- and subgingival calculus, and stain scores to

produce an aggregate score that ranged from 0 to 12. Extrapolating the regression coefficient for deposits to the clinical setting suggests that for each increase in deposit score, there is a concomitant increase of approximately 2 minutes in time needed for PM. While results from the study cannot definitely be used to develop a firm algorithm for appointment planning, it is clear that for patients with poor periodontal control (higher BOP and deposits scores), a longer appointment time should be systematically developed and implemented. Comprehensive PM is critical for creating a biologically compatible environment that patients can maintain during the PM interval. Whereas the absence of BOP is a reliable predictor for the maintenance of periodontal health,[44] the presence of BOP and/or deposits may suggest ongoing compromised periodontal status, or generalized or site-specific recurrent disease which could justifiably require additional treatment considerations. Obviously, removal of calculus or heavy stain from coffee/tea or tobacco is yet another time-consuming procedure compared to a well-maintained mouth.

The results also demonstrate the presence of carious lesions and defective restorations was a significant predictor in treatment time, explaining an additional 2% in unique treatment time variance. As with the deposit aggregate score, a dental defect score was computed by summing the number of incipient and frank carious lesions, and number of restorative defects. In our sample, 20% of the subjects had no defects and 35% had more than 6 defects. Clinically, for each 1 unit increase in defect score, there would be a concomitant increase in total-time of a little over 1 minute. The importance of allotting sufficient time for diagnosing and thorough debridement of dental defects cannot be overstated. Defective overhanging dental restorations (ODR) have been strongly implicated as an etiologic factor in the progression of periodontal disease and are alarmingly prevalent.[45] In one study, 59% of restorations had overhanging margins with 32% BOP.[46] In addition to promoting plaque accumulation, ODRs promote the aggregation of gram-negative anaerobic pathogenic microbes.[47] A fundamental aspect of PM is thorough assessment of local factors which results in the need for more time if there are multiple defects compared to intact and healthy dentition. Lastly, gender was a statistically significant predictor (0.02) of treatment time, with women having treatment times on average 6 minutes longer. The contribution of this variable to the model deserves special consideration. Our participants were largely an older (mean age 64.4 years) and less healthy population seeking care for Class III and IV[33] periodontal disease, with 76% having an ASA II classification,[34] and 23% reported taking >6 medications. However, women were more likely to be taking >6 medications (29.4%) compared to males (20.8%) despite the relatively even distribution of gender in the study. Moreover, women were more likely to have an ASA II or III classification than men.[34] Given these characteristics, it's likely that the gender may also have been confounded by health status or other potential factors. While oral health has been attributed to less education, less positive attitudes towards oral health, and environmental factors, data on these potential confounders were not acquired on subjects in this study; therefore, it is not possible to explore other reasons why women required more time for the PM.[48]

Although older adults are living longer and healthier lives, many present with complex medical histories, managing multiple chronic diseases, both physical and psychological that, in turn, require multiple medications.[49] Indeed, such medical histories frequently require time-consuming medical/dental management often resulting in consultations with other health care providers. A 2010 report shows the number of prescription drugs consumed increases with age, e.g., 40% of patients aged >65 years take 5.7 medications.[50,51] Medication use and age related chronic diseases, and their possible interactions with periodontal disease highlight the importance of a thorough medical history and consultation as necessary. Clearly this adds time to the PM appointment but is imperative for successful PM and overall health, safety and welfare of the patient.

As with most clinical studies, there are limitations to the current investigation. Subjects were treated according to AAP (2003) guidelines for care, within an academic health center clinic by a single clinician with 40 years of experience. While this reduced inter-clinician and multiple-site variance, it also limits generalizability to well-experienced clinicians who use the recommended standard of care for PM, as outlined by AAP. Future studies are needed that employ multiple clinicians with varying levels of experience from different settings (e.g., general and specialty practices) to evaluate the impact of these potential sources of variability. Well-designed, mixed-effects designs (patients clustered within clinicians, clustered within site), while expensive to conduct, would provide valuable insight and more generalizable findings with regard to treatment times. Furthermore, it is impossible to assess whether subjects in this study were substantially different than those seen in private practice. The difficulty in accurately capturing periodontal prevalence rates in the U.S. is highly dependent upon how "disease" is operationalized.[52] In our population, women had greater prevalence

of 4 to 6 mm pockets compared to men (29% vs. 22%), but men were more likely to have pockets >7 mm (2% vs. 0.7%). Severity of disease and oral hygiene status were not related to increasing age; however, participants were largely older with only 21% younger than 55 years old. Participants in this study varied according to periodontal severity, health status, tobacco use and adherence to PM intervals, thus representing a fairly wide range of periodontal patients. Dentist examinations were performed by board certified periodontists, who likely performed more thorough exams than would be typical by general dental practitioners. While many, but not all, of the AAP recommendations coincide with procedures used for PM in this study,[26,32] the relative mix of specific procedures that make up service categories shared by general and specialty practices is an important issue to explore for future research. Finally, it seems prudent to conduct studies on the effect of using an electronic patient chart (compared to paper record) on treatment time, as this could be an additional predictor of time duration variance on the PM appointment.

Conclusion

Results indicate the average duration time required 1 hour, 16 minutes, 23 seconds to achieve the goals of PM. Thus, the typical 45 to 60 minute appointment was insufficient for the average PM patient in this study. Clearly, each of the patient-level and practice factors have an impact on the amount of time needed to accomplish PM. Clinical significance and practical guidance from the results of this study suggests the need for clinicians to develop meaningful individual rubrics for estimating individual PM appointment times. While the data from this study may provide guidance in this respect, it is important to note that a one size fits all approach should be avoided. While our average total-time estimate of 1 hour, 25 minute PM appointment may be appropriate in this academic practice setting, it is not generalizable to all populations. Our results do suggest, however, the need for dental hygienists and dentists to engage in meaningful conversation regarding best practices and develop models that are individualized to fit their patient's needs and practice characteristics. These results may provide some guidance on which elements of the PM appointment are most variable. A systematic approach reflecting the individual's unique characteristics and goals for that PM appointment could justifiably contribute to improved time and stress practice management, while, improving cost effectiveness and reducing liability.

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Oral Health-Related Complications of Breast Cancer Treatment: Assessing Dental Hygienists' Knowledge and Professional Practice

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Abstract

Purpose: Approximately 200,000 women are diagnosed with breast cancer in the U.S. every year. These patients commonly suffer from oral complications of their cancer therapy. The purpose of this study was to assess dental hygienists' knowledge and professional practice related to providing care for breast cancer patients.

Methods: A pre-tested 43-item survey was mailed to a random sample of 10% of all licensed dental hygienists in the state of Michigan (n=962). The survey assessed the respondents' knowledge of potential oral complications of breast cancer treatments as well as their professional practices when treating patients with breast cancer. After 2 mailings, the response rate was 37% (n=331). Descriptive and inferential analyses were conducted using SAS.

Results: Many dental hygienists were unaware of the recommended clinical guidelines for treating breast cancer patients and lacked specific knowledge concerning the commonly prescribed anti-estrogen medications for pre-and postmenopausal breast cancer patients. Over 70% of the respondents indicated they were unfamiliar with the AI class of medications. Only 13% of dental hygienists correctly identified the mechanism of action of anti-estrogen therapy. Dental hygienists reported increased gingival inflammation, gingival bleeding, periodontal pocketing, xerostomia and burning tissues in patients receiving anti-estrogen therapies. Less than 10% believed that their knowledge of breast cancer treatments and the potential oral side effects is up to date.

Conclusion: Results indicate a need for more education about the oral effects of breast cancer therapies and about providing the best possible care for patients undergoing breast cancer treatment.

Keywords: breast cancer, anti-estrogen therapy, dental hygienist, oral health, knowledge, professional behavior, chemotherapy, education

This study supports the NDHRA priority area, **Clinical Dental Hygiene Care:** Investigate how dental hygienists identify patients who are at-risk for oral/systemic disease.

Introduction

Over 200,000 women are diagnosed with breast cancer in the U.S. annually.[1] Breast cancer occurs more frequently in postmenopausal women and the median age at diagnosis is 61 years.[2] The etiology of most breast cancers is unknown. However, risk factors for the disease have been established, including gender, increasing age, family history of breast cancer, early menarche, late menopause, ethnicity, alcohol use and genetic risk factors.[3] The majority of women diagnosed with breast cancer can expect an excellent outcome, with a 5 year survival rate above 80%.[2] Therefore, long-term survivorship issues, including those related to oral health, are important components of breast cancer care and follow-up.

Range of Breast Cancer Treatments

The rationale and selection of breast cancer treatments are complex and based on many prognostic and predictive factors, including tumor histology and grade, the clinical and pathologic stage, lymph node involvement, tumor hormone receptor content, tumor HER2 status, comorbid conditions, age and patient preference.[4,5] Table I highlights how menopausal status and hormone receptor status influence care. The National Comprehensive Cancer Network provides comprehensive descriptions of currently accepted approaches for breast cancer treatment.[4]

Surgery for breast cancer addresses local control and provides tissue for analysis of staging and biomarkers. Depending upon the cancer stage, the histologic and molecular profile of the tumor, systemic adjuvant therapy may be recommended to decrease the risk of developing distant metastases.[6] Systemic therapies may include chemotherapy, trastuzumab or antiestrogen therapy.[7,8] These therapies may be considered either before or after surgery based on the individual patient's

Table I: Broad treatment options for early stage breast cancer patients[4]

Menopausal Status	Estrogen Receptor Status*	Surgical Treatment#	Chemotherapy†	Radiation Therapy‡	Endocrine Therapy§
Premenopausal	ER+	Mastectomy or Breast conserving	Chemotherapy†	Radiation‡	Tamoxifen Ovarian suppression with or without an aromatase inhibitor
Postmenopausal	ER+	Mastectomy or Breast conserving	Chemotherapy†	Radiation‡	Tamoxifen or aromatase inhibitor
Premenopausal or Postmenopausal	ER-	Mastectomy or Breast conserving	Chemotherapy†	Radiation‡	–

*Estrogen-receptor (ER) status (ER positive (ER+) or ER negative (ER-)
#Surgical Treatment: Considered based upon tumor size
†Chemotherapy: May occur either before (neoadjuvant) or after surgical treatment depending upon a variety of clinical, pathologic, and genetic factors
‡Radiation Therapy: Considered based upon surgical procedures and stage of disease
§Endocrine Therapy: Considered when the tumor expresses either the Estrogen or Progesterone receptor

Table II: Oral Sequelae of common cancer treatments

Cancer Treatment	Oral Complications
Chemotherapy	Mucositis Xerostomia Fungal Infection (Candida) Viral infection (HSV) Gingival Bleeding Periodontal Infection
Radiotherapy	Transient xerostomia
Intravenous Bisphosphonates*	Osteonecrosis

*A rare condition which has generally been related to dento-alveolar surgery

needs and goals. Radiation therapy (radiotherapy) to the breast, chest wall and/or local lymph node regions may be provided as another means of obtaining local control, but does not replace surgery which is the foundation of the management of early stage breast cancer.

Approximately 75% of breast cancers express the estrogen and/or progesterone receptors (ER, PR).[9,10] Breast cancer can depend on ER/PR signaling for tumor growth and survival.[11] Targeting ER/PR with anti-estrogen therapies has been shown to decrease the risk of breast cancer recurrence.[7] In premenopausal women, therapy may ablate ovarian estrogen production by surgery, radiation or chemical means with luteinizing-hormone releasing-hormone inhibitors (goserelin or leuprolide). More commonly, oral adjuvant systemic anti-estrogens, such as Tamoxifen, are used. Postmenopausal women may be prescribed either Tamoxifen or an aromatase inhibitor (AI) (FDA approved drugs: anastrozole, exemestane or letrozole).[12] While breast cancer occurs in only 1% of males, nearly 90% of their tumors are ER+. Male breast cancer patients are typically treated similarly to women with surgery, followed by systemic therapy (chemotherapy and/or anti-estrogen therapy) plus or minus radiation based on the tumor stage and biomarkers.[13]

Risks of Breast Cancer Therapy

Acute side effects and long term complications of breast cancer therapies have a marked impact on the patients' oral health, oral health-related quality of life and on therapy compliance.[14-16] Cancer patients undergoing chemotherapy often suffer from oral complications including oral/pharyngeal mucositis, pain, xerostomia and dental caries, and are at an increased risk for opportunistic bacterial, fungal and viral infections as a result of chemotherapy-induced immune suppression.[17-19] Patients are also at risk for osteonecrosis and periodontal tissue changes including gingivi-

tis, gingival bleeding and periodontal infection.[20-24] Patients undergoing radiotherapy may complain of transient xerostomia. Table II displays common oral side effects of breast cancer treatments.

Breast cancer therapies can impact skeletal bone mass. Chemotherapy is associated with premature ovarian failure and results in accelerated loss of bone mineral density (BMD).[25-27] In addition, anti-estrogen therapies are associated with stimulating bone loss. Changes in BMD depend on menopausal status as well as on the class of drug used.[28,29] Premenopausal breast cancer patients taking the estrogen receptor antagonist Tamoxifen are at an increased risk for reduced skeletal BMD.[30] In postmenopausal women, Tamoxifen has been shown to maintain or slightly increase BMD.[31] In contrast to the bone-preserving effect of Tamoxifen in post-menopausal bone, AI use is associated with significant loss of BMD.[32] To mitigate the bone loss effect of cancer therapies, bisphosphonates may be prescribed.[33] Importantly, an association has been established between estrogen deficiency, decreases in skeletal BMD, and oral health. Estrogen deficiency among postmenopausal women may increase risk for periodontal diseases, tooth loss, decreased salivary flow, oral dysesthesia, alterations in taste and burning mouth syndrome.[34,35] As estrogen plays a key role in maintaining bone and soft tissues of the oral cavity, drugs that affect the production and/or binding of estrogen to its receptor may also affect bone and/or soft tissue of the oral cavity.[36]

Provision of Oral Care to Breast Cancer Patients

Dental hygienists often serve as primary oral health care providers for women undergoing breast cancer therapy.[37] As prevention specialists, dental hygienists are in a strategic position to provide information and care to women and men undergoing therapy for breast cancer.[37] Oral assessment prior to and during active treatment (chemotherapy and radiotherapy), and following therapy is a critical aspect of oral health care for cancer patients.[38-40] The National Institute of Dental and Craniofacial Research (NIDCR) indicates that an oral evaluation is necessary prior to cancer therapy for the identification of any outstanding dental needs that could increase the risk or severity of oral complications during breast cancer treatments. For patients undergoing chemotherapy, communication between the oncology and dental teams is essential for the safety of the patient.[41] It is important to determine the patient's hematologic status prior to treatment.[41] In addition, there are some cases where antibiotic prophylaxis may be recommended prior to dental procedures for patients with Port-A-Caths or indwelling central venous catheters to limit secondary infections associated with the immunosuppression produced by cancer therapies.[42,43] As there appears to be a void in clinically validated premedication guidelines specific to these devices, interprofessional communication and collaborative practice is needed.

Obtaining blood pressure measurement is another important aspect of dental care for the breast cancer patient. Breast cancer patients who receive axillary surgery and/or radiation are at risk for lymphedema. Clinical recommendations include the avoidance of blood pressure measurements on the affected arm(s) of patients who have undergone lymph node removal to mitigate the risk of lymphedema associated with squeezing the lymph channels by a blood pressure cuff.[44-46]

While oral health guidelines for cancer patients have been in place for over 20 years, research is scarce concerning dental hygienists' provision of dental care for breast cancer patients.[47,48] Currently, no information is available specific to dental hygienists' knowledge of the potential oral complications related to anti-estrogen breast cancer therapies. The aim of this study was to determine dental hygienists' knowledge and professional practice concerning care of patients undergoing treatments for breast cancer. In addition, this study also explored which demographic factors are associated with dental hygienists' knowledge of cancer therapies.

Methods and Materials

Study Design

This study was a cross-sectional survey of a random sample of licensed dental hygienists in the state of Michigan. Michigan was chosen due to the large numbers of registered dental hygienists residing in the state. This research was submitted and determined to be exempt from oversight by the Institutional Review Board for the Health and Behavioral Sciences at the University of Michigan.

Sample Selection

A list of the 10,126 dental hygienists licensed in Michigan was obtained from the Michigan State Board of Dentistry in March of 2011. Dental hygienists with out-of-state mailing addresses were excluded from the sample (n=502) as they did not fit the inclusion critiera. A 10% random sample was selected for this study (n=962) from the re-

maining licensed dental hygienists.

Instrument

The survey instrument was developed based on information from a literature search and the advice of several faculty members at the University of Michigan, School of Dentistry. Content experts in breast oncology, oral medicine and public health assessed the validity of the survey. The survey was pre-tested with 10 dental hygienists who worked in private dental practices in Michigan. The survey's test-retest reliability was evaluated by twice administering the survey 2 weeks apart. Pearson's correlation coefficient was used to determine the intra-class correlation (ICC) coefficient. Reproducibility was strong, with ICC values as follows:

- Anti-estrogen therapies - 0.76
- Provision of care - 0.83
- Breast cancer risk factors - 0.71
- Clinical recommendations - 0.81
- Overall - 0.88

The survey consisted of 43 questions concerning the respondents' demographic background, practice characteristics, care recommendations for breast cancer patients and a series of items assessing their knowledge concerning risk factors for breast cancer, knowledge of anti-estrogen cancer therapies and possible oral complications related to anti-estrogen cancer therapies, and the use of bisphosphonates as related to breast cancer therapy. Radiation therapy, other than for patients with head and neck cancer, has not shown a significant impact on oral health.[49] Therefore, no questions concerning potential oral complications or care recommendations were included. The survey contained both closed and open ended questions. Specific open-ended questions were asked concerning oral complications related to cancer therapy.

Data Collection

Data were collected using a self-administered questionnaire mailed with a cover letter and a return stamped, addressed envelope to a random sample of registered dental hygienists in Michigan in May of 2011. Alternatively, participants had the option to respond to a web-based survey. Respondents were asked to return the questionnaire within 9 days of receipt. By returning the questionnaire, the dental hygienists implicitly provided their consent to participate in this research. Confidentiality for hygienists responding to the web-based survey was assured by using an SSL encrypted data network. Before being mailed, the surveys were coded with a unique number so that one-follow up mailing could be sent to the non-respondents. This second mailing, containing a different cover letter, a second copy of the questionnaire, and a self-addressed stamped return envelope, was sent approximately 4 weeks after the first mailing to all non-respondents.

Statistical Analysis

The data were entered into Excel spreadsheets twice to allow for validation of correct data entry. The data were then imported into SAS for Windows, Release 11 (SAS). Frequency and percentile distributions as well as means were calculated for all responses. Chi–square values and probabilities were calculated for appropriate questions to determine the independence of variables from each other. To measure dental hygienists' knowledge, Likert type items were used with a 5-point answer scale ranging from "strongly agree," "agree," "neutral," "disagree" to "strongly disagree." A "don't know" answer category was provided for these questions. For purposes of this study, the "strongly agree" and "agree" responses were added to identify the degree of agreement with the statements and the "disagree" and "strongly disagree" responses were added to identify any disagreement with a statement. Statistical significance was judged at the level of $p<0.05$.

Results

Respondent Characteristics

Of the 962 surveys mailed to randomly selected dental hygienists in Michigan license list, 57 were returned due to invalid addresses. The total number of valid surveys returned was 331 (15 submitted by a secure web site and 316 hard copy surveys), which represented a final response rate of 37%. The demographic characteristics of the sample are summarized in Table III. The majority of the respondents were over 25 years of age, had a certificate/associate's level degree (69%), worked full time (72%) in a general dental practice (83%) and had graduated before 1999. Five percent of the respondents reported a diagnosis of breast cancer, and 21% had a family member with a history of breast cancer.

Knowledge of patient care and current breast cancer therapies

Approximately 51% of the respondents knew that breast cancer is the most common cancer among women in the U.S. Overall, dental hygienists were

knowledgeable about the risk factors for breast cancer and were aware that smoking, alcohol use and obesity were modifiable risk factors for breast cancer. Furthermore, only 6% of the respondents indicated distributing prevention literature related to breast cancer in their dental practice.

Knowledge of patient care and current breast cancer therapies

Ten items assessed the respondents' knowledge concerning the care for breast cancer patients (Table IV). These items had a Likert-style format and were formulated in such a way that an agreement with the statement indicated a correct answer. Considerable percentages of respondents, ranging from 7 to 80%, indicated that they did not know the answers to these questions. While 56% of the dental hygienists knew that a consultation with an oncologist concerning a patient's cell count should be done prior to dental appointments, and 55% knew that breast cancer patients should not have blood pressure measurements taken on the side where lymph nodes were removed, only 25% were aware that breast cancer patients may develop breast cancer-related metastases as radiolucent areas in the mandible or maxilla. Only 20% were aware that breast cancer patients may need to be pre-medicated prior to dental treatment while having a port for chemotherapy.

Table III: Overview of the respondent characteristics

Background Characteristic	Number* (n=330)	Percentages **
Age (Years)		
20-25	11	3%
26-35	66	21%
36-45	67	21%
46-50	49	15%
51-55	65	20%
>55	68	21%
Level of Education		
Diploma/Certificate/Associates	222	69 %
Bachelors	94	26%
Masters/Doctorate	15	5%
Year of Graduation		
Graduated before 1985	106	34%
Graduated between 1985-1998	101	33%
Graduated after 1998	104	33%
Currently Employed		
Yes - Full Time	238	72%
Part Time	73	22%
No	19	6%
Type of Practice		
General Practice	270	83%
Periodontal Practice	17	5%
Dental/Dental Hygiene School	12	4%
Community Health Agency	10	3%
Public School	5	2%
Hospital/Nursing Home	2	1%
Treated Patient with Breast Cancer		
Yes	314	95%
No	17	5%
Diagnosis of Breast Cancer		
Yes	18	5%
No	309	95%
CE Course with Breast Cancer component		
Yes	21	7%
No	298	93%
Assess Family History of Cancer		
Yes	65	21%
No	251	79%
Assess patient history of cancer		
Yes	288	90%
No	31	10%

*Frequencies for a characteristic may not add to N=330 due to missing data.
** Percentages for the characteristics may not add to 100% due to rounding.

In response to 4 statements concerning the respondents' knowledge of current anti-estrogen for breast cancer patients, only 21% knew that current guidelines indicate the use of Tamoxifen for pre-menopausal women with ER+ cancer, and that AIs and/or Tamoxifen are the current standards of care for postmenopausal breast cancer patients. The majority of the respondents did not know that potential side effects of AIs include increased musculoskeletal problems (83%), increased need for bisphosphonate use (77%), or that AIs act by severely decreasing anti-estrogen activity (87%).

Table IV: Dental hygienists' responses concerning their knowledge of breast cancer patient care and anti-estrogen cancer treatments

Patient Care	Strongly Agree/ Agree n (%)	Neutral n(%)	Strongly Disagree/ Disagree n(%)	Don't Know n(%)
Consultation with an oncologist concerning a breast cancer patient's white blood (neutropenia) cell count should be done prior to dental appointments to avoid potential dental infections.	180 (56%)	27 (8%)	33 (10%)	83 (26%)
Breast cancer patients should avoid having blood pressure measurements taken on side where lymph nodes were removed.	177 (55%)	16 (5%)	36 (11%)	93 (29%)
Breast cancer patients may develop breast cancer related metastases as radiolucent areas in the mandible or maxilla.	80 (25%)	27 (8%)	15 (5%)	198 (62%)
Breast cancer patients need to be pre-medicated prior to dental treatment while having a port for chemotherapy.	66 (20%)	14 (4%)	129 (40%)	113 (36%)
Anti-estrogen Therapy				
The current anti-estrogen therapy for premenopausal women with estrogen receptor + breast cancer is Tamoxifen.	69 (21%)	28 (9%)	19 (6%)	207 (64%)
The current anti-estrogen therapy for postmenopausal women with estrogen receptor + breast cancer is Tamoxifen and/or aromatase inhibitors.	66 (21%)	22 (7%)	10 (3%)	224 (70%)
Breast cancer patients may report increased musculoskeletal pain including decreased grip strength while on aromatase inhibitor drugs.	59 (18%)	24 (8%)	3 (1%)	235 (73%)
Aromatase inhibitors given to breast cancer patients act by severely decreasing anti-estrogen activity.	42 (13%)	13 (4%)	9 (3%)	257 (80%)
Bisphosphonate Use				
Bisphosphonates (Fosamax, Boniva, Actonel) are commonly prescribed for prevention and treatment of osteoporosis.	251 (81%)	13 (4%)	37 (12)	22 (7%)
Bisphosphonates are commonly prescribed to women prior/ while using aromatase inhibitors.	45 (14%)	21 (7%)	6 (2%)	249 (77%)

While 81% of the respondents were aware that bisphosphonates are commonly prescribed for the prevention or treatment of osteoporosis, only 14% knew that bisphosphonates are commonly prescribed to breast cancer patients using AIs.

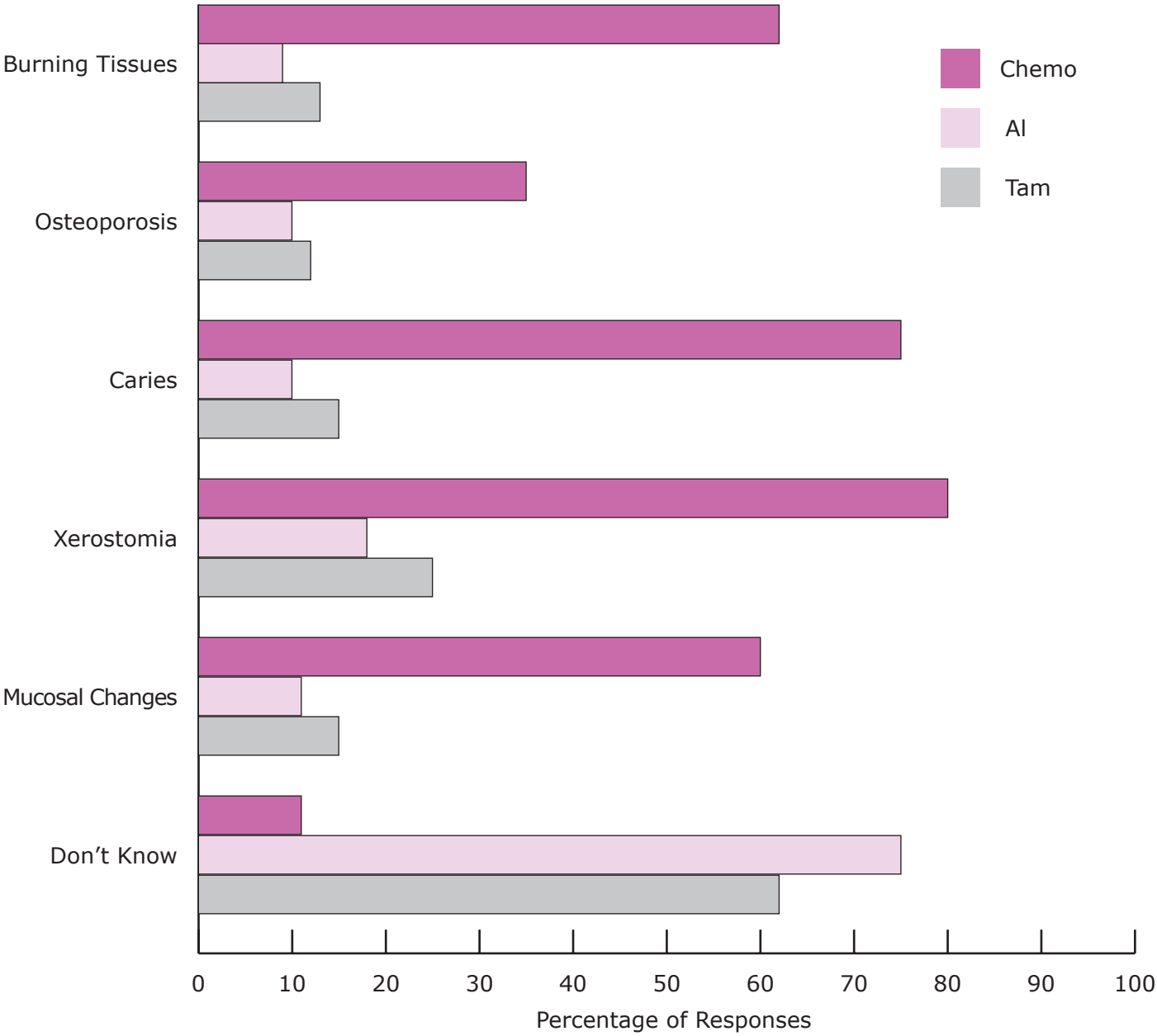
Treatment Recommendations for Breast Cancer Patients

Several questions were asked about oral care recommendations that dental hygienists provide for breast cancer patients at different stages of cancer treatment (Table V). For patients receiving dental care during chemotherapy, the majority of respondents reported provision of oral hygiene instruction, use of mouth rinses, palliative care for xerostomia and use of fluoride rinses. However, only half provided nutrition counseling for breast cancer patients during this segment of their therapy. The most frequently recommended mouthwash mentioned in the open-ended comment section was MI paste, a rinse containing the milk protein. Dental hygienists were less likely to provide treatment recommendations when providing care for breast cancer patients receiving anti-estrogen therapy. Oral hygiene instruction was provided by only 72% of the respondents and only 64% recommended mouth rinses or fluoride rinses for these patients.

Knowledge of Potential Complications Related to Breast Cancer Therapies

Figure 1 shows that 60% of dental hygienists knew that mucosal changes are a common oral complication of chemotherapy. Nearly 80% of respondents correctly stated that xerostomia was related to chemotherapy, and 71% noted a potential increased risk for gingival tissue changes during chemotherapy. While increased risk of osteoporosis was noted as a potential long-term complication of chemotherapy by only 32% of the respondents, even fewer respondents knew that osteoporosis could be related to

Figure 1: Dental hygienists' knowledge of possible complications associated with breast cancer treatments



Tamoxifen use (12%) or AI use (10%), depending on menopausal status. Few respondents knew that xerostomia or gingival changes, dental caries or mucosal changes are potential complications of the use of Tamoxifen or AIs.

Specific Reported Conditions Related to Anti-Estrogen Cancer Therapy

When respondents were asked to share specific oral/other complaints related to anti-estrogen therapy that either patients had reported or that they themselves had identified, 14% of dental hygienists reported oral side effects of Tamoxifen and only 7% reported oral side effects related to the use of AIs (Table VI). Common oral health-related complaints of patients using either an AI or Tamoxifen included increases in gingival inflammation, gingival bleeding, xerostomia, and burning sensations in oral tissues. An oral side effect unique to Tamoxifen use was the report of increased dental caries. Patient-reported complaints specific to AI use included generalized joint pain and hand and wrist pain. This type of pain was related to difficulties with tooth brushing. A specific patient complaint related to Tamoxifen use was jaw pain (Table VI).

Perceptions of Continuing Education

Less than 10% of respondents considered their knowledge about breast cancer risk factors and treatments up to date. Only 7% of dental hygienists re-

Table V: Dental hygienists' recommendations for breast cancer patients during chemotherapy and anti-estrogen therapy (n=330)

Provided/recommended treatment	Which clinical dental care do you provide/recommend for patients receiving:			
	Chemotherapy		Anti-estrogen Therapy (Tamoxifen and Aromatase Inhibitors)	
	n	Percentages	n	Percentages
Xerostomia alleviating strategies such saliva substitutes	293	93%	206	66%
Fluoride treatments/ toothpastes/ rinses	291	92%	200	64%
Oral Hygiene instruction	287	91%	224	72%
Nutrition counseling	180	57%	132	42%

Table VI: Responses concerning oral conditions associated with anti-estrogen therapy (n=276)

Anti-estrogen treatment	Dental Hygienists indicating treating patients with oral side effects		Specific reported side effects*
	n	Percentages	
Aromatase Inhibitors	17	7%	• Gingival inflammation, Xerostomia, Burning tissues/mouth • Joint pain, Pain in hands – difficulty brushing • Increase in periodontal pocketing
Tamoxifen	39	14%	• Gingivitis, Burning tissues/mouth, Bleeding on probing • Xerostomia, Increased caries, Pain in jaws • Increase in periodontal pocketing

*Specific oral/other complaints identified by the dental hygienist or reported by a patient with breast cancer using endocrine therapy.

ported having taken a continuing education class that had included information on potential oral complication of cancer treatments within the last 5 years. The majority of dental hygienists (95%) desired further education in this area. The most popular choices for updating knowledge were continuing education lectures (80%), reading journal articles (28%) and receiving specific topic booklets with self-tests (41%).

Socio-Demographic Characteristics, Practice Factors and Knowledge of Oral Consequences of Breast Cancer Treatment

To assess the impact of background characteristics on dental hygienists' level of knowledge related to the effects of breast cancer treatments on their patients' oral health, bivariate analyses were performed (Table VII). Respondents who had been diagnosed with breast cancer (p=0.004) and respondents who asked their patients about their family history with cancer (p=0.026) were more likely to indicate that their knowledge in this area was up to date than other dental hygienists.

Discussion

Over 2.5 million women in the U.S. have been diagnosed with breast cancer.[50] As the survival rate is increasing, long-term survivorship issues including oral health status are important components of breast cancer care and follow-up.[2] This is the first study examining dental hygienists' knowledge of anti–estrogen therapies and professional practice related to providing care for these patients.

Knowledge of Patient Care and Anti-Estrogen Therapies

While 95% of the respondents indicated that they had treated a patient with a diagnosis of breast cancer, just over half knew that breast cancer is the most common cancer among women, aside from non-mel-

Table VII: Associations between demographic/professional attributes and dental hygienists' knowledge of breast cancer and breast cancer treatments (n=318)

Background Characteristic	Knowledge of Breast Cancer Treatments on Oral Health Up-to-date				
	Yes (n=29)	Yes %	No (n=289)	No %	P-Value
Age					
20-25	1	10%	9	90%	0.45
26-35	6	9%	58	91%	
36-45	4	6%	62	94%	
46-50	5	11%	42	89%	
51-55	8	13%	56	88%	
56+	5	8%	60	92%	
Level of Education					
Diploma/Certificate/Associates	17	8%	200	92%	0.28
Bachelors	10	12%	71	88%	
Masters/Doctorate	1	7%	13	93%	
Year of Graduation					
Graduated before 1985	6	5%	97	94%	0.29
Graduated between 1985-1998	12	12%	87	88%	
Graduated after 1998	9	9%	93	91%	
Currently Employed					
Full Time	14	7%	196	93%	0.07
Part Time	13	13%	90	87%	
Type of Practice					
General Practice	25	7%	237	93%	0.67
Other	4	13%	48	87%	
Diagnosis of Breast Cancer					
Yes	5	28%	13	72%	0.004
No	24	8%	276	92%	
Knowledge of BCa prevalence					
Yes	13	8%	143	92%	0.16
No	6	16%	32	84%	
Unsure	7	6%	110	94%	
Assess Family Cancer History					
Yes	10	16%	53	84%	0.026
No	17	7%	227	93%	

Frequencies for a characteristic may not total N=318 due to missing data

anoma skin cancer.[1] In addition, quite a high percentage of respondents reported that they did not know the answers to the questions concerning patient care (26 to 62%), the consequences of using anti-estrogen therapy (64 to 80%) and bisphosphonate use (7 to 77%). A lack of knowledge concerning these issues can put patients at risk and should therefore be addressed both in dental hygiene programs, as well as in continuing education courses. For example, large percentages of dental hygienists were not aware of the recommended clinical guidelines for treating breast cancer patient when taking blood pressure readings, for consultation with an oncologist for determining patient white blood cell counts before treatment and for the need for possible premedication of breast cancer patients who have a port for chemotherapy.

Dental hygienists' knowledge concerning anti-estrogen therapy for breast cancer patients showed significant deficiencies, with large majorities of respondents indicating that they did not know the answers to the questions concerning these issues.[21-25] Only a small percentage (21%) were aware of the current anti-estrogen treatment standards for pre and postmenopausal women (21%), and fewer still responded correctly to the questions about the mechanism of action of anti-estrogen therapy (13%). These findings are of concern because the American Society of Clinical Oncology (ASCO) has developed clinical practice guidelines on adjuvant anti-estrogen therapy

for postmenopausal women with hormone receptive positive (ER+ or PR+) breast cancer, which recommend that, for optimal adjuvant anti-estrogen therapy for postmenopausal women with ER+ disease, an AI should be used either as initial therapy or following a course of Tamoxifen.[51] At present, the recommended duration of initial anti-estrogen therapy is 5 years, and extended anti-estrogen therapy for an additional 5 year period has proven beneficial for some patients.[52] In consideration of this long duration of anti-estrogen therapies for breast cancer patients, treatment-related adverse effects are not only relevant, but absolutely crucial for assuring patients' long-term oral health.

Over 75% of dental hygienists were unaware that patients on anti-estrogen therapies may develop potential musculoskeletal issues related to the use of AIs. Musculoskeletal toxicities occur in up to 50% of patients. Symptoms include joint stiffness, myalgias and arthralgias, especially of the wrists, hands, and fingers.[53] The etiology of AI-associated musculoskeletal symptoms remains unclear, but may be a result, in part, of estrogen deprivation.[54] Patients with these side effects may find maintenance of oral health difficult because of pain or inability to brush and floss their teeth. Dental hygienists need to be aware of these issues to provide educational interventions and treatments to support these patients.

These findings concerning dental hygienists' knowledge about standard cancer treatments and potential adverse effects of anti-estrogen therapy should serve as a call to action for dental educators involved in dental hygiene programs as well as in continuing education courses.

Oral Complications and Care Recommendation Related to Breast Cancer Treatments

Most dental hygienists reported that chemotherapy places patients at an increased risk for xerostomia, and mucosal and gingival changes (Figure 1). Fewer respondents were knowledgeable about the oral complications associated with anti-estrogen therapies. A similar pattern emerged regarding patient care recommendations given to breast cancer patients during different stages of cancer treatment. While the majority of dental hygienists provided or recommended xerostomia alleviating strategies, mucosal rinses and oral hygiene education for patients undergoing chemotherapy, only about two-thirds of the respondents provided or recommended these treatments for patients undergoing anti-estrogen therapies.

Gingival inflammation, gingival bleeding, periodontal pocketing, xerostomia and burning tissues were reported by the small number of respondents who had been told by patients or had observed themselves consequences of using Tamoxifen (n=39) and AIs (n=17). More than twice as many dental hygienists reported Tamoxifen-related oral side effects as compared to AI side effects. The low number of responses may be attributable to the fact that 75% of the respondents indicated they were unfamiliar with AI medications, which may have limited the reporting of oral side effects related to their use.

As the majority of dental complications that occur in cancer patients are related to changes in saliva production and function, knowledge of potential side effects of anti-estrogen therapies is important.[55] Sex hormone receptors have been detected in the oral mucosa and salivary glands.[56,57] Estrogen deficiency among post-menopausal women has been associated with decreased salivary flow unrelated to medications.[58] Decreased saliva flow can result in xerostomia, gingival bleeding, increase in dental caries, and may be responsible for an increased prevalence of oral dysesthesia and alterations in taste.[59-62]

Breast cancer treatments, such as chemotherapy and anti-estrogen therapies, which may promote a low estrogen status, have also been linked to an increased risk of osteoporosis, which is known to be a risk factor for periodontitis.[31,63,64] Therefore, cancer therapies may be risk factors for periodontitis as well as for osteoporosis. Consequently, women with a diagnosis of cancer, especially postmenopausal cancer survivors, may experience higher levels of xerostomia and dental caries as well as a possible increase in their risk for periodontal disease due to the substandard estrogen levels associated with the use of AI medications.

An important finding in this study is that less than 10% of respondents believed that their knowledge of breast cancer treatments and their oral side effects are up to date. It is not surprising that nearly all respondents indicated an interest in taking a continuing education course on this subject. Educational interventions in which dental, dental hygiene, nursing and medical professionals learn about these issues together may be the optimal path to promoting understanding of the impact of breast cancer treatments on oral health and the treatment needs of these patients.

Overall, these findings suggest the need to increase the educational material about breast cancer survivorship issues in dental hygiene and continuing education programs. In addition, it would be helpful to conduct a study to determine the scope of information provided within the entry-level dental and dental hygiene curricula.

In this survey, dental hygienists with a diagnosis of breast cancer as well as those who assessed the patients' family history of cancer were more confident about breast cancer treatments and their impact on oral health. These dental hygienists may have more knowledge or may have a practice philosophy of incorporating systemic health evidence into their dental hygiene practice.

One limitation of this study is that only 37% of the dental hygienists who received a mailing responded to this survey. However, recent research concerning survey response rates in studies with dentists showed that this response rate is actually higher than the response rate in most surveys. This recent study compared the response rates of postal mail surveys and electronic surveys used to collect data from practicing dentists. It found that the response rates for mailed surveys were 28% and those for web-based surveys were 11%.[51] The response rate in this study is therefore acceptable. Nevertheless, future research should replicate this study in other geographical locations to assure that these findings can be generalized to dental hygienists in other parts of the U.S.

Conclusion

Our results suggest that dental hygienists lack knowledge concerning the oral health-related effects of common drugs used in breast cancer treatment, including AIs and Tamoxifen. Given the high number of women undergoing these treatments over the course of many years, it is important that dental care providers are aware of the issues related to breast cancer treatment and have the skills to provide the best possible care for these patients to assure their oral health in the long run. Careful monitoring of the oral health of women with breast cancer is important during all stages of cancer therapy to prevent, detect and treat complications as soon as possible.

The majority of dental hygienists surveyed thought that their own knowledge concerning the management of breast cancer patients was not current and wished to learn more about this topic. Developing interdisciplinary educational interventions for dental hygiene programs as well as continuing education courses about dental care and breast cancer treatments is important. Further research is needed concerning the long-term oral health-related consequences of breast cancer treatments, as is research into the best practices that would provide optimal care for these patients.

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Subjective Pain Perception During Calculus Detection With Use of a Periodontal Endoscope

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Abstract

Purpose: Periodontal endoscopes are relatively new to the dental field. The purpose of this study was to determine the amount of pain reported by subjects with periodontal disease after experiencing the use of a periodontal endoscope compared with the use of a periodontal probe during calculus detection.

Methods: A total of 30 subjects with at least 4 sites of 5 to 8 mm pocket depths were treated with scaling and root planing therapy in a split-mouth design. The 2 quadrants were randomly assigned to either S/RP with tactile determination of calculus using an 11/12 explorer, or S/RP treatment with endoscopic detection of calculus. Each subject's pain experience was determined by via a Heft-Parker Visual Analogue Scale (VAS), which measured perceived pain level during periodontal probing and during subgingival visualization via endoscopy. Since subjects expressing some level of dental anxiety generally express increased levels of pain, a pre-treatment survey was also given to determine each subject's level of dental anxiety in order to eliminate dental anxiety as a confounding factor in determining the expressed level of pain.

Results: The level of perceived pain was significantly lower with the periodontal endoscope versus the probe (mean VAS 33.0 mm versus 60.2 mm, $p<0.0001$). Subjects who indicated some level of dental anxiety did express increased pain levels, but these levels were not statistically significant.

Conclusion: Subjects did not find the periodontal endoscope to elicit significant anxiety or pain during subgingival visualization.

Keywords: dental pain, endoscopy, fear/anxiety, periodontitis, root planning, scaling

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

Pain is a multidimensional experience; therefore, the perception of pain is a subjective and individual response. It is associated not only with physical stimulation, but with emotional and psychological factors as well. Pain is described as an "unpleasant sensory and emotional experience associated with actual or potential tissue damage."[1] A physical stimulus causes an impulse to travel through the body's nerves and deliver a message of pain to the central nervous system. It has been suggested that psychological experiences, such as emotions, have an effect on the body's perception of pain by altering the pain threshold.[1,2] The result is that physical stimuli may feel more painful to an individual under stressful versus low-stress situations. Therefore, it would be expected that subjects with dental fear or anxiety would express higher levels of pain perception compared to patients who have no dental fear or anxiety.[2-4]

Endoscopic technology has been used in the medical field for years, but has only recently become available for use in dentistry. Currently, the use of periodontal endoscopy in dental practice is limited. Recent investigations has examined the use of periodontal endoscopy in an effort to improve the outcome of scaling and root planing. The bulk of this research has been conducted on sites that have been non-responsive to traditional therapy.[5-7]

A periodontal endoscope consists of a bundle of fiber optic strands measuring less than 1 mm wide through which light travels. The end of the fiber optic bundle is covered by a sterile, disposable sheath, which is attached to an "explorer." This explorer is inserted below the gingival margin into the periodontal pocket to provide illuminated subgingival visualization. A water lavage flushes biofilm, blood and other subgingival debris out of the field of vision. This enables the clinician to visualize intra-pocket tissue inflammation, subgingival plaque, root surfaces, calculus deposits and other structures within a periodontal pocket that normally would not be visible. The images are displayed in real-time video on a monitor allowing the clinician to view subgingival structures 15 to 46 times their actual size.[5,8]

The goal of scaling and root planing is to remove calcified deposits, plaque biofilm and endotoxins from the root and soft tissue pocket. Studies have shown

that incomplete deposit removal from the root surfaces impedes ideal healing of the periodontal tissues.[9-13] Therefore, it is important for clinicians to remove as much subgingival deposit as possible to ensure optimum healing. Unfortunately, clinicians do not always achieve this complete level of deposit removal during traditional scaling and root planing procedures.[11,14-22] With the aid of subgingival visualization provided by the periodontal endoscope, early research has shown the endoscope to enhance calculus removal by allowing the clinician to see the root structures during and after scaling procedures to see if and where calculus remains.[5-7,9,23] However, a pilot study conducted at the University of North Carolina Chapel Hill examined treatment outcomes on subjects treated for non-responsive sites of periodontal disease by comparing the control group, which received scaling and root planing, and the experimental group, which received scaling and root planing with Perioscopy. Subjects were followed for 3 months after treatment was completed. No statistically significant differences were found in the clinical and inflammatory assessments of subjects when the control sites and experimental sites were compared.[24]

Early users of the periodontal endoscope advocate the use of local anesthetics to ensure patient comfort.[8] However, the required use of anesthetics could be a deterrent for both the subject and the clinician. For the clinician, injection of local anesthetics adds to treatment time and involves potential risks associated with its use. For the subject, the discomfort of the injection itself may be a deterrent. It would be beneficial to both the subject and clinician to be able to use the endoscope without routinely administering local anesthesia.

The purpose of this study was to determine the amount of perceived pain reported by subjects during subgingival visualization utilizing the periodontal endoscope compared with the use of a periodontal probe. If the periodontal endoscope is to become widely accepted in the practice of dentistry, with the intent of improving outcomes of scaling and root planing, clinicians should be aware of the patients' perceptions of the device.

A review of the literature over the past 15 years was performed in order to find clinical research in the field of dentistry utilizing pain scales or surveys. Since the perception of pain is subjective, it can be difficult to get accurate or reliable measures of subjects' pain levels. Several surveys and indicators have been developed in an attempt to achieve standardized measures of pain and pain intensity.

The McGill Pain Questionnaire has shown high internal consistency and has been suggested that it is the best pain scale to use in research.[25] Due to its length, however, it has also been recommended that the McGill Questionnaire should be used as an adjunct to other simpler and quicker pain assessments.[26] The West Haven-Yale Multi-Dimensional Pain Inventory has also shown high internal consistency, but it was invented to assess general pain, not specific dental pain. Therefore, it has not been used frequently in dental studies.[2,27,28] The Pain Anxiety Symptoms Scale (PASS) has shown high internal consistency and validity.[4,29,30] The Descriptor Differential Scale (DDS) of Pain Intensity was developed to measure clinical pain by applying psychophysical components. The DDS has shown validity, reliabality and consistency, yet its use in dental research has been limited to this point.[31,32]

The Heft-Parker Modified Visual Analogue Scale (VAS) is a variation of the original VAS. It is a 170 mm horizontal line that has verbal descriptors as end anchors, but also includes other verbal guides (faint, weak, mild, moderate, strong and intense) along the scale in order to aid an individual in best describing his or her level of pain. The subject is instructed to make a dash on the line indicating their current level of pain. The pain level is the distance, in millimeters, from the endpoint on the left to the dash marked on the scale. Both the original VAS and the Heft-Parker VAS have shown rediability, validaty and sensitivity in numerous dental and non-dental pain studies.[25,33-38] Due to the ease of administration of the VAS and its high validity and reliability, it has been used most commonly for pain measurements in dental research.

Over the years, various aspects of dental related pain have been studied. Several studies found no significant difference in levels of perceived pain using different instruments or even different modalities of treatment.[1,39-42] One exception to these findings was a 2004 study in which subjects felt the Vector™ system scaler caused sigfificantdy less pain when coepared to a traditional piezo-electric ultrasonic scaler during periodontal maintenance appointments.[3]

Pain experienced in relationship to treatment provided by different clinicians or in different office settings has also been investigated.[43] Several studies showed that levels of discomfort experienced decreased with an increase in age.[42-44] Many study reports found women show more pain experience, more intense levels of pain and longer duration of pain as compared to men.[33,44-48] Although most studies in this review of the literature support differences in pain perception between ages and genders, other reports show no difference between these groups.[1,2,36,42,43]

Several studies have shown that there is a difference in the amount of pain a subject feels depending on the area of the mouth being probed, the presence

of gingival inflammation, differences in therapists' probing force, higher blood pressure measurements, cigarette smoking, and presence of dental or general anxiety.[1-3,30,33,34,42,49,50]

A Belgium study conducted on 268 subjects found there was a high correlation between the perceived pain of the current treatment and pain experienced during previous appointments. Both treatment groups reported issues or discomfort associated with use of local anesthesia during previous scaling procedures. In fact, 33% of group 1, and 64% of group 2 reported they would be willing to endure moderate pain in order to avoid use of local anesthetic, and 35% of 1 group reported that the most bothersome part of the treatment was the injection.[34] This supports findings of other research studies that show subjects experience high levels of pain or discomfort associated with dental injections, and one study where adults admitted that pain associated with dental injections is enough to make them avoid dental treatment altogether.[51-55] These statistics are a strong argument for utilizing the periodontal endoscope without relying on administering anesthetics.

As mentioned previously, it has been found that a subject's emotional status due to things such as stress, fear or anxiety can have an impact on the level or intensity of pain perceived.[1] A study conducted by Karadottir et al sought to see if the degree of pain experienced by periodontal maintenance patients during probing and scaling could be predicted by other factors including dental anxiety.[33] Prior to a periodontal maintenance appointment, the participants filled out 3 separate surveys. The first was the Dental Anxiety Question,[56] followed by Corah's Dental Anxiety Scale[57] and finally the Dental Fear Survey.[58] Subjects reported their pain levels on a VAS and verbalized pain frequency during the treatment. After assessment of the data, 4 items were found as significant predictors of pain perception. The first predictor was gender; as supported by previous studies, females were found to have a higher pain response than males.[33,44-48] The second predictor was a question from Corah's Dental Anxiety Scale ("When you are waiting in the dentist's office for your turn in the chair, how do you feel?"). The third and fourth predictors of pain perception were questions from the Dental Fear Survey ("How fearful are you about having your teeth cleaned?" and "In general, how fearful are you of having dental work done?").[33]

This was one of the first studies published that suggested using fear or anxiety markers in an attempt to predict pain in dental patients. The goal of these findings was to identify those subjects who may be at highest risk for dental pain, and in turn make appropriate accommodations in order to make them comfortable through their treatment.[59,60] In a follow up study to this one, it was found that a single question, "How fearful of having your teeth cleaned are you?" could be an effective predictor of pain perception. The review of the literature uncovered no research examining the perception of pain associated with the use of a periodontal endoscope. Therefore, the purpose of this study was to determine the amount of perceived pain reported by subjects undergoing treatment of periodontal disease with the assistance of a periodontal endoscope.

Methods and Materials

Two study examiners were trained on the use and techniques of the periodontal endoscope by a periodontist who was experienced with the instrument. After training sessions were completed, the examiners were tested with a calibration session to determine both intra- and inter-examiner reliability. The examiners assessed 6 periodontal subjects with the presence of subgingival calculus using both the periodontal endoscope and an 11/12 explorer. The post-training calibration showed high intra- and inter-examiner consistency and reliability was achieved with both methods of calculus detection.

Existing prophylaxis or periodontal recall patients within the University of Minnesota dental clinics were screened for inclusion and exclusion criteria during appointments at the school. After potential subjects were identified, 1 of 3 study investigators reviewed the study protocols and procedures with the subjects, and obtained informed consent. A total of 30 subjects (n=30) were selected as part of a larger research study at the University of Minnesota. The primary objective of the larger research study was to determine if the use of a periodontal endoscope improves periodontal outcomes of scaling and root planing when compared to scaling and root planing alone.

Inclusion criteria required each subject to be at least 18 years of age and have 4 to 6 sites in each of 2 quadrants with pocket depths measuring 5 to 8 mm. The test sites were selected to receive scaling and root planing therapy regardless of the subject's previous treatment history. Exclusion criteria included any antibiotic use within the past 30 days, the need for antibiotic premedication for dental procedures or any other significant chronic medical or health problems that would generally contraindicate dental treatment (example: uncontrolled hypertension).

In order to eliminate dental anxiety as a confounding factor in determining the expressed levels

of pain, each subject's level of dental anxiety was measured prior to treatment. The questions used to obtain this information were the Dental Anxiety Question,[56] and modifications from Corah's Dental Anxiety Scale[60] as based on the finding from Karadottir et al study[33] on pain experienced during periodontal maintenance treatment, which determined specific questions as significant predictors of pain.

The Heft-Parker Modified Visual Analogue Scale (VAS) was selected based on its established reliability, validity and sensitivity in numerous dental and non-dental pain studies.[25,33-38] Additionally, it is easy to administer and it measures pain on a continuum.

The study was a randomized, split-mouth design to scale and root plane (S/RP) specified sites within quadrants with or without the use of the periodontal endoscope. Study quadrants were randomly assigned by utilizing the program S-PLUS 8.0. The benefits of using a one-time, split-mouth design when examining subjects' pain perception are: both instruments are used during the same treatment session eliminating confounding effects that may occur from utilizing different subjects for different treatments, and the potential for the emotional status of the subject to change from one treatment day to the next is eliminated.[1]

Prior to treatment, subjects were given a pre-treatment survey that consisted of a Single-Item Dental Anxiety Question, as well as 4 other questions pertaining to anxiety (modifications from Corah's Dental Anxiety Scale) to determine each subject's level of dental fear or anxiety. Subjects were shown the periodontal endoscope and informed that it would allow the clinician to see the subgingivial structures, which was otherwise not an option when scaling unless a flap surgery was performed. Baseline data was then collected, which included gingival indices, full mouth periodontal probing, clinical attachment levels, bleeding upon probing, tactile detection of subgingival calculus with an 11/12 explorer and visual detection of subgingival calculus using the periodontal endoscope in the randomly assigned endoscope quadrant.

Full mouth periodontal probing was completed by 1 of 2 calibrated examiners, using a UNC 15 probe to measure 6 sites on each tooth. After probing was complete, subjects were given a Heft-Parker Modified VAS to measure their perceived pain in response to the probing. This initial VAS served to determine the approximate level of pain each subject was experiencing during a "normal" component of the periodontal exam or treatment. Immediately after the examiner used the periodontal endoscope for subgingival calculus visualization, the subject was given a second identical Heft-Parker Modified VAS, in addition to specific questions relating to the use of the periodontal endoscope. The post-visualization survey was used to determine the amount of perceived pain participants felt while the endoscope was being used as compared to the perceived pain felt during probing.

Descriptive statistics were calculated using SAS V9.1.3 to analyze the data for the questions (counts and percentages) and the VAS pain scores (means, standard deviations and range). One-sample t-tests were used to compare the mean probe VAS pain score, the mean periodontal endoscope VAS score and their mean difference (within patient) to zero. Two sample t-tests were used to compare the mean VAS pain scores between levels of anxiety from the pre-treatment questions. P-values less than 0.05 were deemed statistically significant.

Results

Six of the subjects did not completely answer all follow-up questions on the VAS administered after use of the periodontal endoscope, so the percentages are based on the total number of responses, not the total number of subjects for a few of the items on the post-treatment questionnaire.

The mean VAS score during probing was 60.2 mm (Table I). This measurement falls closest to the verbal descriptor of "mild" discomfort as an aid on the VAS. The mean VAS score for the periodontal endoscope was 33.0 mm (Table I). This measurement falls closest to the verbal descriptor of "weak" discomfort as an aid on the VAS. The level of pain perceived was found to be significantly lower with the periodontal endoscope ($p<0.0001$) (Table I).

Overall, 93.4% of the subjects experienced little or no pain during periodontal endoscope use (Table II). A total of 37% of respondents reported no pain or discomfort with the use of the periodontal endoscope, 56.7% reported slight pain or discomfort and only 6.7% reported moderate pain or discomfort (Table II). Of those that reported some pain for discomfort, 89.5% stated the pain was felt in the gums, while 10.5% felt it in the tooth being visualized with the endoscope. All of the subjects who experienced some pain or discomfort with the use of the periodontal endoscope felt that the potential benefits of enabling the clinician to visualize the subgingival area outweighed the discomfort felt. One subject (6.3%) stated that sight of the periodontal endoscope elicited slight levels of anxiety or fear, while 1 additional subject (6.3%) found the

Table I: Probe and Periodontal Endoscope Pain VAS

Variable	Mean (SD)	Range	95% Confidence Interval	P-value†
Probe	60.2 (42.1)	0, 148	44.5, 76.0	<0.0001
Periodontal endoscope	33.0 (28.6)	0, 92	22.3, 43.7	<0.0001
Difference‡	-27.3 (32.0)	-103, 22	-39.2, -15.3	<0.0001

†From t-test. The mean pain score for the probe and the periodontal endoscope are significantly greater than zero ($p<0.0001$ and $p<0.0001$ respectively). The level of pain was significantly lower with the periodontal endoscope ($p<0.0001$).
‡Individual patient's Periodontal endoscope VAS minus Probe VAS

Table II: Periodontal Endoscope Questionnaire (n=30)

Question	Responses	n (%)
2	a. No pain or discomfort b. Slight pain or discomfort c. Moderate pain or discomfort d. Extreme pain or discomfort	11 (36.7) 17 (56.7) 2 (6.7) 0
3	a. Gums b. Tooth c. Jaw Joint d. Lip e. Other	17 (89.5) 2 (10.5) 0 0 0
4	a. No discomfort or pain b. Yes, I feel the benefits of using the Perioscope™ outweigh the discomfort c. No, I do not feel the benefits of the Perioscope™ outweigh the discomfort	11 (45.8) 13 (54.2) 0
5	a. No b. Yes, slight anxiety or fear c. Yes, moderate anxiety or fear d. Yes, extreme anxiety or fear	22 (91.7) 1 (4.2) 1 (4.2) 0
6	a. The two felt the same or very similar b. There was more pain with the Perioscope™ c. There was less pain with the Perioscope™	4 (16.7) 2 (8.3) 18 (75.0)
7	a. No pain or discomfort b. Having mouth open too wide (e.g. jaw got tired) c. Laying back for too long d. Discomfort during scaling with instruments e. Discomfort in area not being treated f. Other	18 (75.0) 1 (4.2) 0 4 (16.7) 0 1 (4.2)

Question 3: Only patients who answered b, c or d for question 2.
Questions 4-7: 6 patients did not answer.
Question 6 was consistent with comparing the pain scores of the probe and the periodontal endoscope.

level of anxiety or fear elicited by the sight of the scope was more moderate. Overall, 75% of subjects said the level of pain felt was less with the periodontal endoscope than the probe, and 16.7% thought the two felt very similar. Only 2 respondents (8.3%) thought there was more pain experienced with the use of the scope versus the probe (Table II).

Mean VAS scores for both the probe and the endoscope were compared with the subjects' level of anxiety as assessed from the pre-treatment questionnaire. A total of 26.7% of subjects responded that they were afraid of going to the dentist (Table III). With the exception of the compared VAS score for the probe and item #2 from the questionnaire ("If you had to go to the dentist tomorrow for a check-up how would you feel about it?"), all other

Table III: Pre-Treatment Questionnaire (n=30)

Question	Responses	n (%)
1	a. I would look forward to it as a reasonably enjoyable experience.	9 (30.0)
	b. I wouldn't care one way or the other.	13 (43.3)
	c. I would be a little uneasy about it.	4 (13.3)
	d. I would be afraid that it would be unpleasant and painful.	4 (13.3)
	e. I would be very frightened of what the dentist would do.	0
3	a. Relaxed.	17 (56.7)
	b. A little uneasy.	6 (20.0)
	c. Tense.	4 (13.3)
	d. Anxious.	2 (6.7)
	e. So anxious that I sometimes break out in a sweat or almost feel physically sick.	1 (3.3)
4†	a. Relaxed.	13 (44.8)
	b. A little uneasy.	8 (27.6)
	c. Tense.	5 (17.2)
	d. Anxious.	1 (3.5)
	e. So anxious that I sometimes break out in a sweat or almost feel physically sick.	2 (6.9)
5	a. Relaxed.	15 (50.0)
	b. A little uneasy.	11 (36.7)
	c. Tense.	2 (6.7)
	d. Anxious.	0
	e. So anxious that I sometimes break out in a sweat or almost feel physically sick.	2 (6.7)

†1 person did not answer

mean VAS scores were higher for subjects who indicated some level of fear and/or anxiety (Table IV). The differences in VAS scores between the fear/anxiety and no fear/anxiety groups, however, were not found to be statistically significant.

Discussion

Periodontal endoscopy is an emerging technology in dental practice. There has been no previous research published examining the levels of perceived pain with the use of a periodontal endoscope. The results of this study may help expand the knowledge and use of this instrument in the fields of dentistry and dental hygiene.

Based on the findings from the current study, subjects did not find the periodontal endoscope to elicit significant anxiety or pain. Early users of the periodontal endoscope advocate the use of local anesthetics to ensure patient comfort.8 However, since the amount of discomfort expressed by the current study subjects was low, it may be possible for clinicians to use the periodontal endoscope for subgingival visualization without the use of local anesthetics. As revealed by the literature review, studies have shown many subjects find an injection of local anesthetic to be a stressful and painful experience.[34,51-55] Therefore, the ability to use the endoscope throughout the mouth without the use of local anesthetics is of great advantage to the clinician.

Previous studies examining pain experience found that levels of perceived pain decreased as age increased, and that women expressed more perceived pain than men.[33,42-48] The current study, however, showed no significant difference in reported pain experience between ages or sexes. This supports several other previous studies, which showed no difference in pain experience among such groups.[1,2,36,42,43] It appears that past findings are conflicted on the issue of age and gender playing a role in pain perception. More definitive statistics need to be obtained in the future in order to determine if either of these items are of significant impact on pain perception.

It has also been previously suggested that a subject's emotional status due to stress, fear or anxiety can have an impact on the level or intensity of pain perceived.[1] The current study based a portion of the subject questionnaire on findings from a study conducted by Karadottir et al, which found specific questions from Corah's Dental Anxiety Scale and the Dental Fear Survey to be effective predictors for increased pain perception.[33] The current study found that all individuals that expressed some level of fear and/or anxiety did, in fact, report higher levels of perceived pain than those with no fear or anxiety. Although the current findings supported the concept of predictors of pain experience, the findings were not, however, deemed statistically significant. The ability to identify those individuals who may express a higher pain experience would be an important tool

Table IV: Comparing Mean (SD) Pain VAS between Levels of Anxiety

Question	Variable	No Fear/Relaxed [Responses]	Some Fear/Anxiety [Responses]	p-value†
1		[No: n=22]	[Yes: n=8]	
	Probe	57.5 (46.0)	67.9 (30.1)	0.5584
	Endoscope	30.0 (26.8)	41.3 (33.6)	0.3480
	Difference‡	-27.5 (35.6)	-26.6 (21.1)	0.9486
2		[a, b: n=22]	[c,d,e: n=8]	
	Probe	60.2 (46.8)	60.3 (27.8)	0.9990
	Endoscope	33.8 (28.7)	30.6 (30.4)	0.7923
	Difference‡	-26.4 (35.6)	-29.6 (20.9)	0.8125
3		[a: n=17]	[b,c,d,e: n=13]	
	Probe	49.1 (46.3)	74.8 (32.0)	0.0972
	Endoscope	27.9 (22.5)	39.5 (35.0)	0.2790
	Difference‡	-21.1 (31.5)	-35.3 (32.0)	0.2352
4		[a: n=13]	[b,c,d,e: n=16]	
	Probe	42.7 (46.3)	70.4 (32.4)	0.0694
	Endoscope	20.1 (22.3)	44.1 (30.1)	0.0242
	Difference‡	-22.6 (34.7)	-26.3 (24.8)	0.7407
5		[a: n=15]	[b,c,d,e: n=15]	
	Probe	47.3 (50.6)	73.1 (27.6)	0.0939
	Endoscope	24.1 (21.0)	41.9 (33.0)	0.0886
	Difference‡	-23.3 (37.9)	-31.3 (25.5)	0.5032

Questions are from the pre-treatment questionnaire. For question 2, a and b responses were combined for the 'No Fear/Relaxed column'.

†From t-test; ‡Periodontal endoscope VAS minus Probe VAS

*Though only periodontal scope and question 4 was statistically significant ($p < 0.05$). If it were adjusted for multiple comparisons (tests) it would become non-significant.

for clinicians; this is an issue that future research could expand upon in an effort to improve treatment experience for both subject and clinician.

Limitations

This was a pilot study with a relatively small sample of the population (n=30). It is a preliminary step in expanding the knowledge base of how periodontal endoscopes could be more widely utilized in periodontal and general dental practice. However, further research with larger populations should be performed in the future to determine patient acceptance and pain experience of this tool among a greater variety of individuals.

Achieving an accurate measurement of anxiety is extremely difficult, and therefore may also skew research outcomes. Since pain and anxiety are subjective, it is difficult to measure in quantitative terms. A subject may express anxiety to one aspect of treatment, but not to another - it is not necessarily a consistent level. With that in mind, although the periodontal endoscope did not elicit significant pain or anxiety during subgingival visualization, if calculus is detected and scaling and root planing is recommended, the use of local anesthetics may be necessary, therefore, eliciting different levels of anxiety.

An additional limitation is that this study compared the pain perception felt with simple visualization with the periodontal endoscope to that of periodontal probing. These both have similar methods of subgingival "instrumentation," however, they are not performing the same task. Also, pain measurements were taken for full mouth periodontal probing, but the pain measurements for the periodontal endoscope were obtained after use in only 2 quadrants, not the entire mouth.

Due to the nature of the study, there was no way to blind the subjects or the examiners. There is no placebo for the periodontal endoscope, so both subjects and examiners knew if it was used or not. Lack of blinding could potentially cause bias among examiners.

Conclusion

The subjects of this study expressed the level of perceived pain or discomfort with the periodontal endoscope was significantly less than that ex-

perienced during periodontal probing. Therefore, administration of a local anesthetic was not necessary for subgingival visualization of the pocket environment during this study.

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Evaluation of Resources for an Interactive Infection Control Instructional Program

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Abstract

Purpose: To evaluate educational resources used in developing and implementing an interactive infection control instructional program for first year (n=26) and second year (n=26) dental hygiene students in a baccalaureate program.

Methods: An educator's toolkit was used to develop online and interactive learning modalities for teaching infection control content. Descriptive statistics were used to evaluate responses on a post instruction opinion survey on a 5-point Likert-type scale.

Results: Following the instructional program, most students reported on an opinion survey that they understood infection control principles (92% first year, 100% second year), felt prepared to work safely in clinic (96% first year, 100% second year) and liked working at their own pace (88% first year, 100% second year). First year students valued the online learning components and were less favorable toward supplemental textbook readings and the limited time to complete all 10 modules. Most second year students valued the interactive workshop but did not take the time to complete the online videos and did not watch all of them. Seventy-nine percent of second year students (n=20) preferred the interactive workshop method over traditional lecture instruction completed during their first year.

Conclusion: This paper describes 1 institution's process of developing and implementing an infection control instructional program utilizing an educator's toolkit.

Keywords: blended-learning, dental hygiene education, infection control, dental education

This study supports the NDHRA priority area, **Professional Education and Development:** Validate and test measures that evaluate student critical thinking and decision-making skills.

Introduction

Demonstration of student competency in infection control is required by the American Dental Association Commission on Dental Accreditation (ADA CODA) for all dental, dental hygiene and other allied dental education programs.[1] This instructional program was designed to provide junior (first professional year) and senior (second professional year) students didactic support needed for clinical application and competency-based evaluation of infection control principles in a baccalaureate dental hygiene program.

Traditionally, dental hygiene students learn the didactic portion of infection control content via classroom instruction, and then they are expected to apply their knowledge in the clinical setting for delivering safe client care. Active learning strategies are necessary components for enhancing deep learning, synthesis of lecture course materials and critical thinking skills.[2] Synthesis of didactic course content requires taking what was learned in the classroom and then demonstrating or applying that information in the real world setting. Active learning happens through involvement and participation with others, and with thoughtful reflection.[3] Today's millennial learners have been characterized as "sheltered'" having difficulty taking risks and being high achievers, but lacking critical thinking skills.[4] Teachers must provide opportunities for students to interact with each other and critically reflect on their learning.[3] Interaction is considered a necessary component for students to become critical thinkers.

Blended learning (BL) approaches have been shown to be equally as effective as traditional approaches or to increase learning outcomes, motivation and student satisfaction,[5-8] and are defined as "thoughtful fusion of face-to-face and online learning."[3] BL is a combination of self-paced e-learning (web-based) activities and classroom learning with interaction.[2,9] Some institutions label a course "blended" if a certain percentage of the content is online, but there is no defined percentage of online content which constitutes blended learning.[4] Facts or items requiring memorization would be delivered best in a self-directed way (online), whereas other content is best taught in a traditional classroom setting (lab or clinical work). This project utilized some components of BL and was designed to be interactive (Table I).

Table I: Blended learning (BL) methodology for both groups

First-Year Students (Initial Instruction)(n=26)	Second-Year Students (Refresher Instruction) (n=26)
Attended mandatory orientation session	Orientation letter sent with instructions (three weeks prior to fall semester classes)
Completed 10 modules (first week of semester) [OSAP workbook reading, supplemental textbook reading, watched online videos, brief online quiz at the end of each module]	Completed 10 modules: online videos only (prior to workshop)
Attended (2) 1-hour classroom lecture sessions (first week of semester)	n/a
Attended 2-hour interactive workshop (end of first week of semester)	Attended 2-hour lecture/interactive workshop (end of second week of semester)
Examination & opinion survey at the end of the workshop	Examination & opinion survey at the end of the workshop

The purpose of this project was to evaluate educational resources used in a BL interactive infection control instructional program for first and second year dental hygiene students in a baccalaureate program. This paper describes 1 institution's process of developing and implementing this interactive infection control program.

Methods and Materials

Over the past several years at Idaho State University, a variety of methods have been used to teach infection control content (initial and refresher), such as traditional classroom instruction, e-learning and a BL method. Questions arose regarding which of these methods was effective in promoting critical thinking skills, preferred by students and saving time. Data previously collected and analyzed indicated course outcomes for e-learning and traditional classroom instruction in infection control was equally effective when free online modules were used.[10] This program evaluation was conducted to evaluate educational resources used in teaching infection control content and to describe 1 institution's process of implementing these resources. An exemption for this study was granted from the institution's Human Subjects Committee.

The course director utilized an educator's toolkit developed by the Organization for Safety, Asepsis, and Prevention (OSAP) (OSHA and CDC Guidelines: Interact Training System 3rd Edition-School Program) to enhance infection control instruction.[11] The toolkit was purchased for $300 and provided several resources to develop infection control curricula, including a CD-ROM with 10 video modules and a corresponding workbook, a sample course syllabus, sample test questions, charts, posters, checklists, suggested supplementary readings, and suggested interactive class activities. The toolkit was a helpful template for developing and implementing the redesigned instructional program which included some components of online learning and interactive activities for a BD approach.

Table I outlines the methods and timeline employed for each group. First-year students in the 2010 fall semester (n=26) had initial infection control instruction with the revised content developed from the OSAP toolkit. They attended a mandatory orientation session including instructions on accessing the online course materials on Moodle (an online teaching platform) and had an opportunity to ask questions. Students had 1 week to work through 10 online course modules, which included a combination of workbook and supplemental readings, online videos, and brief online post-module study questions.[12] The modules could be accessed as many times as the students desired, and they could email the course instructor if questions arose; however, none did. Students attended 2 classroom sessions lasting 1 hour each, which included lectures and interactive educational activities as suggested by the OSAP toolkit (a Glo-germ™ exercise and an informal experimentation with a range of personal protective equipment (PPE) checking fit and dexterity) during the first week of classes, and a 2 hour interactive workshop at the conclusion of the first week of classes. The workshop included a discussion, and interactive learning exercises, such as "What's wrong with this picture?" activities and case study scenarios provided in the OSAP kit and developed by the course instructor. At the conclusion of the workshop, students took a multiple-choice examination on the curricular content to demonstrate competency as required by ADA CODA. Examination results were not utilized as data in this program evaluation. Examination results were for student grading and competency purposes only. Students also completed an opinion questionnaire that was developed in collaboration with a statistician at this institution. Questionnaire items were

simply worded, stated in the positive, and geared toward undergraduate student's knowledge level. The survey items were not formally validated, but were designed to assess student's opinions of the educational resources that were used in teaching infection control content.

Second year students (n=26) completed their initial infection control instruction in the 2009 fall semester by a traditional classroom lecture method prior to the development of the new instructional program. These students were required to have annual refresher education in the fall semester 2010. Prior to the start of the academic year, the students received orientation letters including information on the required annual refresher. Instructions were provided on accessing and completing the online course content (10 video modules) which was required prior to the workshop scheduled 2 weeks after the start of the semester. Supplemental readings were not required for second year students. The students attended a required refresher workshop 2 weeks after the start of the semester, and the content was the same as the first year students (discussion and interactive activities). At the conclusion of the workshop, students took a multiple choice examination on the curricular content to demonstrate continued competency as required by ADA CODA. They also completed an opinion questionnaire.

Respondents were provided with an opportunity to comment on the most and least beneficial components of the infection control instructional program through 3 open-ended questions. Descriptive data analysis was performed on the opinion surveys. Qualitative thematic analysis of participants' comments identified predominant themes which emerged in response to the open-ended questions.

Results

Table II shows descriptive data (self-reported) for first year students (n=26). The vast majority of first year students (97%) did complete all of the assigned OSAP workbook readings. The students agreed or strongly agreed that the interactive workshop was easy to understand (88%) and useful for clinic (96%). First year students also agreed or strongly agreed that they understood infection control principles (92%), felt prepared to work safely in clinic (96%) and liked working at their own pace to learn infection control curricular content (88%). Only 75% watched all of the videos. This information was self-reported and was not confirmed via Moodle utilization. Open-ended comments indicated the online videos were valued by the students because they could work at their own pace and could watch the videos as many times as they wanted. The assigned readings, and particularly the supplemental textbook readings, were not well received because students perceived the information was "contradictory," "hard to understand," "unnecessary," "repetitive" and "a lot of work in a short period of time."

Descriptive data from the opinion survey items indicated that the majority of the second year students (n=26) disagreed or strongly disagreed that the online videos were quick to complete (73%), although only 12% viewed all of the videos (Table III). The majority of the second year students agreed or strongly agreed that the interactive workshop was easy to understand (96%), interesting (73%) and useful for clinic (96%). They also agreed or strongly agreed they understood infection control principles (100%), felt prepared to work safely in clinic (100%) and liked working at their own pace (100%). The majority (79%) preferred the new interactive method to the traditional instruction used the previous year for initial infection control training.

Comments and suggestions for improving the instructional program were made by both groups of students. First year students needed more time to complete the program and recommended eliminating the repetitive supplemental readings. They enjoyed being able to watch the online videos as many times as they desired. Second year students thought the most beneficial aspect was the interactive workshop and preferred this method of instruction over the traditional method employed in their first year. They commented it was a "good refresher." These students reported that they valued the interactive workshop exercises and learning activities because they could see the clinical relevance of these learning modalities. Most of the second year students (69%) did not watch all of the videos, whereas most of the first year students did (75%). These results might have been related to the fact that these students had seen the videos during initial infection control training, and/or possibly related to the nature of novice versus more experienced learners. Novice learners need detailed information and visual instructional approaches, and they are less able to apply principles in interactive case-based activities. More experienced learners, like the second year students, with the goal of attaining competence need application and synthesis for deeper meaningful learning.[13]

Discussion

Understanding the various aspects that worked or did not work for each group of students was important in evaluating this infection control program and

Table II: Descriptive Statistics of First-Year Students (Post-Instruction Opinion Survey)

Question	n	SA	A	N	D	SD
I found the online component (videos) easy to access and use.	27	16 59%	11 41%	0	0	0
I found the online component (videos) quick to complete.	27	6 22%	12 44%	6 22%	3 11%	0
I found the online component (videos) interesting.	27	1 4%	8 30%	14 52%	4 15%	0
I think the content of the online component (videos) will be useful for clinic.	27	4 15%	19 70%	3 11%	1 4%	0
I watched all of online videos.	27	15 56%	5 19%	1 4%	5 19%	1 4%
I found the OSAP workbook easy to read.	27	5 19%	9 33%	4 15%	6 22%	3 11%
I found the OSAP workbook quick to read.	27	1 4%	9 33%	7 26%	7 26%	3 11%
I found the OSAP workbook interesting to read.	27	0	11 41%	7 26%	9 33%	0
I think the OSAP workbook will be useful for clinic.	27	7 26%	13 48%	5 19%	2 7%	0
I completed all of OSAP workbook readings.	27	15 56%	11 41%	0	1 4%	0
I found the supplemental textbook readings easy to read.	26	4 15%	12 46%	7 27%	2 8%	1 4%
I found the supplemental textbook readings quick to read.	25	2 8%	5 20%	8 32%	8 32%	2 8%
I found the supplemental textbook readings interesting to read.	25	2 8%	9 36%	11 44%	2 8%	1 4%
I think the supplemental textbook readings will be useful for clinic.	25	3 12%	12 48%	7 28%	3 12%	0
I completed all of the supplemental textbook readings.	25	5 20%	10 40%	3 12%	6 24%	1 4%
I found the interactive workshop easy to understand.	25	11 44%	10 40%	4 16%	0	0
I found the interactive workshop interesting.	25	5 20%	12 48%	6 24%	2 8%	0
I think attending the interactive workshop will be useful for clinic.	25	12 48%	12 48%	1 4%	0	0
I understand infection control principles after completing this material.	26	13 50%	11 42%	1 4%	1 4%	0
I feel prepared to work safely in the clinic setting after completing this material.	26	11 42%	14 54%	1 4%	0	0
I liked being able to work at my own pace.	26	17 65%	6 23%	3 12%	0	0

Likert Scale Used: 1=Strongly Agree (SA), 2=Agree (A), 3=Neutral (N), 4=Disagree (D), 5=Strongly Disagree (SD)

has helped to target content and activities specific to each group of learners. The aspects that worked well for the first year students receiving initial infection control content included the OSAP workbook and online videos which could be watched as many times as the student desired. The interactive workshop with activities was most valuable to the second year students receiving refresher infection control content for application and synthesis. They clearly preferred the new interactive method of instruction.

Table III: Descriptive Statistics of Second-Year Students (Post-Instruction Opinion Survey)

Question	n	SA	A	N	D	SD
I found the online component (videos) easy to access and use.	26	4 15%	15 58%	3 12%	3 12%	1 4%
I found the online component (videos) quick to complete.	26	0	1 4%	6 23%	13 50%	6 23%
I found the online component (videos) interesting.	26	1 4%	6 23%	14 54%	3 12%	2 8%
I think the content of the online component (videos) will be useful for clinic.	26	2 8%	18 69%	4 15%	1 4%	1 4%
I watched all of online videos.	26	1 4%	2 8%	5 19%	12 46%	6 23%
I found the interactive workshop easy to understand.	26	14 54%	11 42%	1 4%	0	0
I found the interactive workshop interesting.	26	5 19%	14 54%	7 27%	0	0
I think attending the interactive workshop will be useful for clinic.	26	13 50%	12 46%	1 4%	0	0
I understand infection control principles after completing this material.	26	13 50%	13 50%	0	0	0
I feel prepared to work safely in the clinic setting after completing this material.	26	16 61%	10 39%	0	0	0
I liked being able to work at my own pace.	25	11 44%	14 56%	0	0	0
As a first-year student last year, I understood the infection control material and felt prepared for clinic.	26	12 46%	11 42%	2 8%	1 4%	0
Which method would you prefer if you had a choice in learning initial infection control material?	24	*Traditional Method 5 21%		*New Method 19 79%		

*New Method consisted of workbook reading, online activities, supplemental readings, and interactive workshop
*Traditional Method consisted of workbook reading and lecture
Likert Scale Used: 1=Strongly Agree (SA), 2=Agree (A), 3=Neutral (N), 4=Disagree (D), 5=Strongly Disagree (SD)

These aspects have been retained in the instructional program for both groups. The aspects that did not work well included supplemental readings for first year students, and the online videos for second year students. Subsequently, these aspects have been deleted from the instructional program.

The OSAP educators' toolkit provided a useful framework for development and implementation of this revised infection control instructional program and allowed face-to-face classroom time for interactive learning strategies. Class activities as suggested from the toolkit, examination items and online preparatory components may be helpful to faculty responsible for teaching infection control content to dental hygiene students. OSAP also has a variety of infection control resources available at no charge for both educators and practitioners who are not seeking continuing education credits.[14] OSAP's free online modules "Ask Lily - From Policy to Practice: OSAP's Interactive Guide to the CDC Guidelines" are useful for teaching students, training staff and refreshing infection control knowledge during annual updates required by OSHA.[14] An examination covering these modules worth 10 hours of continuing education credit can be completed for a $100 fee for non-members and $85 for OSAP members for those individuals desiring credits for re-licensure. These materials have the potential to assist educators in teaching and evaluating infection control curricular content.

Conclusion

Data from this program evaluation suggests the use of OSAP educational resources was a helpful template in redesigning the infection control curriculum at this institution. Dental hygiene educa-

tors could use these resources to develop blended learning instruction, as well as interactive and critical thinking activities necessary for today's students. The use of supplemental readings should be minimized as they may provide little benefit for students. Recommendations for dental hygiene educators that teach infection control content include:

- Review available resources from OSAP
- Minimize supplemental readings
- Provide adequate time for students to complete the course materials
- Include hands-on, practical "real life" activities with clinical relevance

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Oral Health Promotion: Knowledge, Confidence, and Practices in Preventing Early-Severe Childhood Caries of Virginia WIC Program Personnel

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Abstract

Purpose: This study assessed the oral health knowledge, confidence and practices of Virginia personnel in the Special Supplemental Food Program for Women, Infants and Children (WIC).

Methods: In 2009, 257 WIC personnel were electronically emailed via an investigator-designed 22-item Survey Monkey® questionnaire. Descriptive statistics, Chi-square and Fishers Exact tests compared personnel demographics and oral health knowledge, confidence and practices at the $p \leq 0.01$ and 0.05 significance level.

Results: Response rate was 68%. WIC personnel were knowledgeable about basic oral health concepts. More than half of those reporting were not confident assessing for visual signs of dental decay and do not routinely assess for visual signs of decay. Only 4% of personnel apply fluoride therapy.

Conclusion: Findings support the need for health promotion/disease prevention at WIC.

Keywords: early-severe childhood caries (E-SCC), fluoride varnish therapy, oral health promotion knowledge confidence and practices, WIC personnel

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

Early-severe childhood caries remains a significant public dental health issue in the U.S. and internationally.[1] The most common chronic disease in children, dental caries is 5-times more prevalent than asthma and 7-times more prevalent than hay fever.[2] Approximately 19% of U.S. children aged 2 to 4 have experienced visually detectable dental decay. Data from the National Health Nutrition Examination Survey (NHANES) reveal that the number of children aged 2 to 5 with dental caries increased from 24 to 28% from 1999 to 2004.[3] Nineteen percent of U.S. children aged 2 to 4 have visually detectable dental caries.[4] Overall, children of poverty experience more extensive dental disease and have less access to dental care.[5,6] For example, 25% of children living in poverty have not seen a dentist before the age of 5, experience twice the dental caries as their more affluent peers and are more likely to have untreated oral disease.[4-6]

In 2005, the Virginia Department of Medical Assistance Services introduced the Smiles For Children (SFC) program, providing coverage for diagnostic, preventive and restorative/surgical procedures, as well as orthodontic services for Medicaid, Family Access to Medical Services Plan (FAMIS) and FAMIS Plus children.[7] The program also provides coverage for limited medically necessary oral surgery services for adults age 21 and older. Reasons cited by parents for not involving their children in preventive dental programs or establishing an ongoing dental provider or dental home include the inability to take time off from work, living a transient lifestyle and being unable to find a dentist who participates in the SFC program.[7-11] Dentists are reluctant to participate in SFC because of the perceived low fee-for-services reimbursement, and high no-show rates for appointments undermining profit margins.[12] Since 2005, provider participation has more than doubled. Children receiving dental services has increased, from 24 to 45%.[7]

The U.S. Public Health Service and Department of Health and Human Services (DHHS) also documented substantial barriers to oral health preventive measures. These barriers include lack of access to community water fluoridation in rural areas. Although 95% of Virginia residents are receiving the recommended community fluoridated water levels, others living in rural areas have difficulty in accessing SFC.[13,14] Lack of dentists, and the need to expand access to professional oral health care services, has led to training of non-dental providers and dental

hygienists in public health programs to screen children for oral disease, educate parents on nutrition, encourage use of preventive modalities and refer children to participating dentists who can prevent or treat early-severe childhood caries.[13-15]

A population-based health program to improve children's overall health is the Special Supplemental Nutritional Program for Woman, Infants, and Children (WIC). Originated in 1972 from the Federal Assistance Program of the Food and Nutrition Service (FNS) of the United States Department of Agriculture (USDA), WIC provides food to supplement the diets of millions of lower income women, infants and children under the age of 5, breastfeeding promotion and support strategies, dietary counseling, and referrals for welfare/social services and health care.[16] The WIC program benefits pregnant and breastfeeding women during critical times of their infant's growth and development and encourages health promotion practices in the prevention of childhood obesity, infant mortality, and other lifestyle, diet-related or chronic diseases. Some participants may receive more frequent health and nutritional counseling from WIC program personnel (nutritionists, dieticians and nurses) than from their children's pediatricians. Participation, eligibility requirements and the complicated application process vary by state.[16]

The purpose of this study was to assess the current oral health promotion knowledge, confidence and practices of WIC personnel to improve the oral health of WIC participants. Does Virginia WIC personnel knowledge, confidence and practices provide insight to build programs and extend training to both dental and non-dental health professionals?

Severe–Early Childhood Caries

The Centers for Disease Control (CDC) uses the term early childhood caries (ECC) or severe-early childhood caries (S-ECC) for the occurrence of rampant decay in infants and toddlers.[17] S-ECC is the most common chronic, preventable dental disease affecting smooth surfaces of primary teeth (Figure 1).[18] The American Academy of Pediatric Dentistry (AAPD) defines S-ECC as the presence of 1 or more decayed noncavitated or cavitated decayed lesions, missing teeth, or filled tooth surfaces in any primary tooth in a child 71 months of age or younger, or any sign of smooth-surface decay in children younger than 3 years of age.[19]

S-ECC is caused by a complex interaction among cariogenic microorganisms, fermentable carbohydrates and susceptible teeth.[20-22] Using selective detection, Tanner et al identified Scardovia wiggsiae in the mouths of children with severe ECC when other pathogens were not detected.[23] Microorganisms play a major role in tooth demineralization and vertical transmission of caries from a mother or caregiver to child through close contact, shared food utensils and saliva.[24-27] The earlier the microorganism colonizes the primary teeth, the more likely the demineralization process begins.[27]

Figure 1: Clinical Signs of Severe–Early Childhood Caries[17]

Li and Caufield's[27] longitudinal study of 34 mother-infant pairs determined how infants acquire pathogenic bacteria.[6] Bacterial samples were obtained at 3-month intervals from mothers and their infants to approximately 3 years of age. Almost 71% of infants and toddlers showed DNA patterns harboring genotypes of bacterial microflora identical to those of mothers. Female infants were 6-times more likely to match their mother's genotypes. Male infants and toddlers were 13-times more likely to exhibit dental decay and the MS strain than female children, even though male infants usually have later tooth eruption. This finding remains unexplained until future immunology research is conducted. Researchers strongly suggest that mothers are the major source of MS transmission to their infants and toddlers and recommended future immunology studies.[23-27]

Palmer et al found food frequency, cariogenicity and bacterial pathogenesis to be associated with S-ECC and caries recurrence.[26] Bacteria metabolize carbohydrates or liquids, initiating acid demineralization of tooth enamel. A combination of bacteria, saliva, defective tooth about the transmission of bacteria enamel, parental behaviors and attitudes increases S-ECC risk.[26]

Oral Health Promotion

Caries control should start prenatally with screening and treating the mother. Following birth, the in-

fant should be screened and parent and child provided with continued preventive care throughout childhood.[24-26] First dental care visits for infants and toddlers should occur by 12 months of age or when the first tooth erupts.[19,20,25] To monitor the caries balance, infant's knee to lap examinations are recommended biannually by the American Academy of Pediatrics (AAP).[28] Periodic fluoride varnish therapy, parental counseling and establishing a relationship with a dental provider has been shown to be effective in reducing S-ECC.[28-31] Fluoride varnish frequency is recommended every 6 months for children at high risk for dental caries, according to the Medicaid Early and Periodic Screening, Diagnosis, and Treatment Benefits Program (EPSDT).[31] Varnish therapy can also be applied up to 4 times annually.

According to Bandura's Social Learning Theory, human behavior is acquired through observation, experience, modeling, self-efficacy, confidence and positive reinforcement.[32] Self-efficacy and self-confidence are qualities for promoting behavioral change.33 Positive reinforcement of oral health concepts and behavior by WIC educators and parents results in positive behavioral and clinical outcomes for children and parents.[33-34] Oral health education aimed at parents or caregivers in the WIC program can improve children's dental and overall health.[35-39]

Schick and Rozier conducted a 1 year study of North Carolina nutritionists' effectiveness in oral health promotion among WIC participants.[40] Researchers found nutritionists with a greater sense of self-efficacy and outcome expectancy were more confident in oral health promotion. The nutritionists were more likely to perform oral risk assessments, counsel parents and make dental referrals than those who lacked confidence.[40] One study revealed nurses and dental hygienists were more likely to discuss oral health promotion if they were more confident in oral health practices.[41] Pediatricians with greater confidence in oral health screening for dental decay were more likely to make referrals of Head Start children than those with lower self-confidence.[42] Physicians' confidence in ability to screen for risky health behaviors was positively related with the promotion of disease preventive practices.[43] WIC nutritionists often see children before they see a dental health professional.[37-41] Therefore, WIC nutritionists' ability to examine for caries, promote oral health practices, and make referrals is important in preventing S-ECC in low-income populations.

Yost and Li suggested that nurses apply anticipatory oral health guidance for infants and children.[24] For example, this guidance includes teaching caregivers to use a damp, warm washcloth to clean infant's gums after eating and before bedtime, putting an infant to bed with a bottle containing water rather than one with fermentable carbohydrates, and avoid on-demand breastfeeding during night. After tooth eruption, caregivers should clean their infant's mouth with a washcloth and slowly progress to a soft child toothbrush. A pea-size or smear of toothpaste should be introduced at approximately 18 to 24 months of age and hands-on parental or caregiver toothbrush instruction should be taught and reinforced.[25] Researchers emphasize the importance of making the first dental visit within 6 months of tooth eruption or by 12 months of age.[19,25,28]

Weinstein, Harrison and Benton demonstrated that motivational interviewing (MI) techniques are helpful in reducing or preventing S-ECC by counseling mothers during the first year following the birth of a child.[34] MI is a collaborative, client-centered form of guiding to elicit and strengthen motivation for change.[33,34,36] MI focuses on skills to educate and motivate others in making health-promoting behaviors based on a client's stage of readiness.[34,35] Children in the MI group exhibited significantly less new caries. The guardians and/or parents of 2 year olds displayed greater compliance with recommended fluoride varnish treatment regimens than the control group without the MI. Weinstein and associates concluded that MI intervention improves health-promoting behaviors of mothers and their young children at high risk for dental caries.[34]

Freudenthal and Bowen examined MI techniques to decrease parental risk-related behaviors for S-ECC.[36] Positive changes in valuing oral health, permissiveness, change difficulty and openness to health information were studied in a population of WIC mothers in Southeast Idaho using a pre- and post-test questionnaire. Avoidance of sharing utensils during feeding and number of times per week mothers brushed or cleaned their child's teeth significantly increased in the group of mothers exposed to the MI counseling techniques. Researchers concluded that using MI with diverse populations at WIC sites would most likely have a positive impact on oral health practices.[36]

Oral Health Confidence

Oral health confidence among WIC providers studied by Butani et al found those with some oral health training are more likely to counsel mothers and their children about dental disease prevention than WIC providers void of confidence and oral health training.[37] Nurses were most likely to discuss oral health issues with WIC clients when compared to other WIC providers. Furthermore, the researchers observed that providing appropriate oral health training to WIC providers increases their confidence

and encourages discussion of oral health issues and S-ECC prevention with clients.[37] Researchers recommend oral health training for WIC personnel so that they are comfortable with current dental concepts for improving the oral health status of their WIC clients.[37]

Nurko et al compared the prevalence of caries in children (n=120) of parents or caregivers who had participated in the WIC Infant Oral Health Educational Program (IOHEP) to children of parents who never participated.[38] Participants were mostly of Hispanic descent, ages 1 to 5. Parents at the WIC program received counseling and participated in a survey and children in both groups had their decayed and filled teeth (DFT) scores evaluated by pediatric dental faculty and pre- and post-doctoral students. Findings revealed that children whose parents participated in an IOHEP experienced significantly fewer overall caries from 57 to 39% following a 5 year IOHEP community-based program. Findings support oral health promotion by WIC personnel on oral hygiene instructions, proper diet and nutrition, and periodic fluoride applications aimed at reducing the incidence of S-ECC.[37-39]

Underserved preschool-aged children rarely visit a dentist, and often receive their first oral screening and dental referral through a public health program such as WIC or Head Start. Virginia Division of Dental Health implemented a Maternal and Early Childhood Oral Health Program called Bright Smiles For Babies.[44] This program followed the structure used by North Carolina's Into the Mouths of Babes program.[39,40,44,45] Virginia's's Bright Smiles For Babies program offers oral health training to non-dental personnel in occupations who legally can apply fluoride varnish and bill Medicaid, i.e., physicians, physician assistants, pediatric nurse practitioners, family nurse practitioners and registered nurses.[44] Effective July 2008, the Pharmacy Act allows dentists or physicians to provide standing orders for dental hygienists or nurses to place fluoride varnish on the teeth of children 6 months to 3 years of age at home visits, pediatric and immunization clinics, WIC clinics, and other health district programs.[45] To operationalize the Pharmacy Act, WIC personnel should first be trained on the demineralization-remineralization process, caries risk and protective factors, oral health risk assessment and screening, oral health information documentation, and prevention guidance to WIC children and families.[45]

Bright Smiles For Babies training is comparable to the Open Wide training for health professionals available through the National Maternal and Child Oral Health Resource Center.[44,46] In 2009, Virginia's Division of Dental Health began a pilot project allowing dental hygienists who hold a Virginia license issued by Virginia Board of Dentistry (Sec.54.1-2722) under a remote oral health care model to provide educational and preventive dental care in designated dental professional shortage areas.[45]

California has the nation's largest number of WIC sites (n=82). In 2001, WIC began First Smiles with dental services provided once a week using portable dental equipment. After 2005, the application of fluoride varnish was introduced. First Smiles' goal is to significantly reduce the incidence of dental decay in young children. Dental and medical providers are trained to increase the number of dental visits for at-risk 1 year olds. Since few dentists treat low-income one year olds, California WIC programs collaborate with dental providers to treat the WIC participants at selected WIC sites.[15]

Lee and Rozier compared dental services among children enrolled at WIC to those not enrolled at WIC.[39] Children participating in WIC programs are more likely to use preventive and restorative services and less likely to use emergency services than non-WIC participants. Since WIC program participants fall below the 185% Federal Poverty Level, all are considered high risk for dental decay.

Methods and Materials

After approval from Old Dominion University College of Health Sciences Human Subjects Committee, a pilot study of 15 nursing students and 32 dental hygiene students was conducted to determine reliability of a test-retest procedure for a 22-item investigator-designed questionnaire. Content validity was established involving a panel of experts (20 dental hygiene graduate students and faculty). Once revisions were made and validity and reliability were established, a cover letter and questionnaire were electronically mailed via Survey Monkey® to a convenience sample of 257 WIC personnel provided by the Virginia Department of Health Services WIC director.[48] For inclusion, participants had to be professional staff members with direct contact with WIC clients (children, prenatal or postpartum women, or children's guardians). Anonymity was insured by not requiring names on the questionnaire instrument, and data were reported in group-form among districts only. A questionnaire was selected as the instrument of choice as the large geographically diverse sample could be assessed cost effectively, respondents' anonymity could be maintained and the questionnaire completed at their own leisure.

Questionnaire content was guided by the knowledge, confidence and practice objectives of the

overall study and the review of the literature. The objectives investigated WIC personnel oral health knowledge, confidence and practices to help improve access to care for underserved communities. Some questions were derived from previously developed and tested questionnaires.[36,37,41] The instrument asked WIC personnel about their demographic characteristics: age, sex, race, educational level, job title, WIC district and years employed at WIC. Lickert-type questions obtained information on oral health knowledge, confidence and practices.

Four items on oral health knowledge were self-ranked as: knowledgeable, not knowledgeable or no opinion. Five items measuring confidence on oral health confidence were self-ranked as: confident, not confident and no opinion. Six items on oral health promotion practices were ranked as: frequently, never and no opinion. For the last question, item 23 (not included in Survey Monkey®), respondents were emailed in October 2010 asking if they received any oral health training at WIC.

Statistical analysis was performed using Survey Monkey® and SPSS 18 (Statistical Package for Social Science, Inc., Chicago).[48] Data were nominal or ordinal scaled and discrete. Descriptive analysis was calculated within Survey Monkey®. Inferential analysis between respondent demographics and their oral health knowledge, confidence, and practices were identified using bivariate analysis with Pearson Chi-square and Fisher's exact test. The test of independence was set at one and the level of significance was $p \leq 0.05$ in knowledge, confidence and practices (Table I, II and III) and $p \leq 0.01$ (Table I and III).

Results

Respondents were dispersed uniformly throughout Virginia. The 42 Virginia districts were categorized as either rural or urban for comparison purposes (Table IV).[49] An incentive Target gift card raised the response rate from 64 to 68%. The first analysis of 176 subjects revealed no statistically significant difference in subjects' demographics and oral health knowledge, confidence and practices. A total of 17 subjects were eliminated because they completed less than 75% of the questionnaire or were WIC office service specialists or administrators who worked indirectly with WIC clients, and 159 participants were used in the final statistical analysis resulting in a 62% final response rate. The sum of percentages reported may not equal 100% due to rounding.

Descriptive statistics identified that, except for 4 male respondents, the WIC respondents (n=153) were female with 2 respondents' sex unreported. The predominated age range was between 50 to 59 (n=61) (Figure 2).

The majority of WIC personnel were White (n=105), followed by Black (n=36), Asian (n=8), multi-racial (n=5), American Indian (n=1), Native Hawaiian (1) and 3 ethnicities unreported. Office service specialists (n=58) and nutrition associates or assistants (n=50) were the predominant occupations followed by registered dieticians (n=32), dietetic technicians (n=8), licensed practical nurses (n=6) and registered nurses (n=2). No registered dental hygienists were in the sample; however, there were 2 former dental assistants and 3 respondents not reporting occupation (Figure 3).

Respondents predominately reported earning a bachelor's degree (n=66), followed by a high school diploma (n=29), master's degree (n=26), associate's degree (n=22), other (n=15) and non-reporting (n=1). The majority of respondents (n=90) were employed at WIC for over 10 years followed by 6 to 10 years (n=26), 3 to 5 years (n=18), 1 to 2 years (n=16), less than 1 year (n=8) and 1 non-reporting.

Knowledge: A total of 94% of WIC respondents who were aged 40+ years indicated they were significantly more knowledgeable about oral bacterial transmission compared to 83% of respondents aged 18 to 39. A total of 97% of WIC respondents who had 10+ years of experience were significantly more knowledgeable about oral health transmission compared to 87% of WIC respondents aged 18 to 39. A total of 87% of WIC respondents who were aged 40+ years indicted they were knowledgeable about the dental decay process compared to 72% of aged 18 to 39 respondents. Respondents ages 40+ and 10+ WIC experience were 0.01 significantly more knowledgeable (Table I).

Confidence: A total of 90% of WIC personnel with education beyond high school were significantly more confident in explaining oral health-related dietary habits compared to 75% of WIC respondents with a high school diploma. A total of 64% of respondents (n=101) reported they were not confident in performing oral assessments, while 31% (n=49) were confident in their ability to perform an oral assessment. No statistically significant difference ($p>0.05$) was found between confidence and WIC personnel demographics, their performing oral health assessments for dental decay, their referrals made to dentists, their providing oral hygiene instructions and advising families about fluoride supplements or treatments. The researchers were 95% confident the results did not occur by chance and that WIC person-

Table I: Self-Reported WIC Ages and Experience with Knowledge and Practices

n=159 Degrees of Freedom=1	Ages 18 to 39	Ages 40+	<10 years experience	>10 years experience	Chi square; Fisher Exact p-values
Knowledgeable of:					
Oral Bacteria	83%	94%	87%	97%	0.04, 0.05 * 0.02, 0.02 *
Dental Decay Process	72%	87%	81%	86%	0.04, 0.04 *
Practice Frequency in:					
Assessing for dental decay	28%	53%	45%	49%	0.01, 0.01 ** 0.56, 0.34
Toothbrush Counseling	73%	86%	86%	79%	0.09, 0.05 * 0.05, 0.04 *

Note: *p<0.05, **p<0.01

Table II: Self-Reported Oral Health Promotion Confidence

n=159 Degrees of Freedom=1	Ages 18 to 39	Ages 40+	High School Diploma	All other education levels	Chi-Square p–value	Fisher Exact p–value
Oral Health Promotion Confidence in:						
Assessing for dental decay	33%	30%	38%	29%	0.66 0.36	0.40 0.24
Explaining oral health dietary habits	83%	88%	75%	90%	0.03* 0.03*	0.04* 0.04*

Table III: Self-Reported Districts and Practices

n=159 Degrees of Freedom=1	Rural Districts	Urban Districts	Chi square; Fisher Exact p-values
Practice Frequency in:			
Advising parent/guardian on fluoride supplements or treatments	58%	42%	0.004; 003**
Referring to a dentist	46%	54%	0.006, 0.003**

**p<0.01

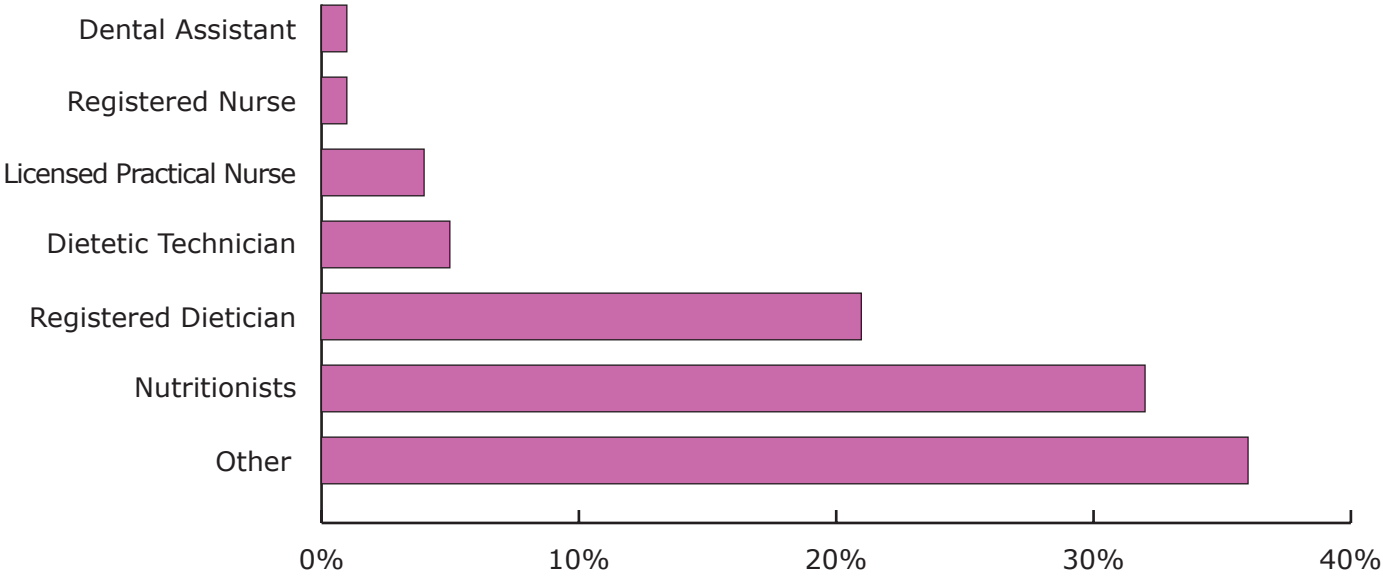
nel aged 40 and over or possessing education beyond high school were confident in explaining oral health dietary habits (Table II).

Practices: Less than half of WIC respondents assessed their children for visual signs of dental decay. About 53% of WIC respondents aged 40+ years assessed clients significantly more than 28% of respondents in the 18 to 39 year bracket at the 0.01 level. About 87% of WIC respondents who had 10+ years of WIC experience provided significantly more parental counseling on toothbrushing than those with less than 10 years of experience. WIC respondents who were significantly more likely to refer participants to dentists were over aged 40 years, and had greater than 10 years of experience at WIC. Rural WIC respondents were significantly advising parent/guardian on fluoride supplements or treatments more than urban WIC respondents. Urban WIC respondents significantly referred WIC participants to a dentist more than rural WIC respondents at the 0.01 level (Table III).

Discussion

Results suggest that the majority of WIC personnel who responded to the convenience survey are knowledgeable about oral health and confident

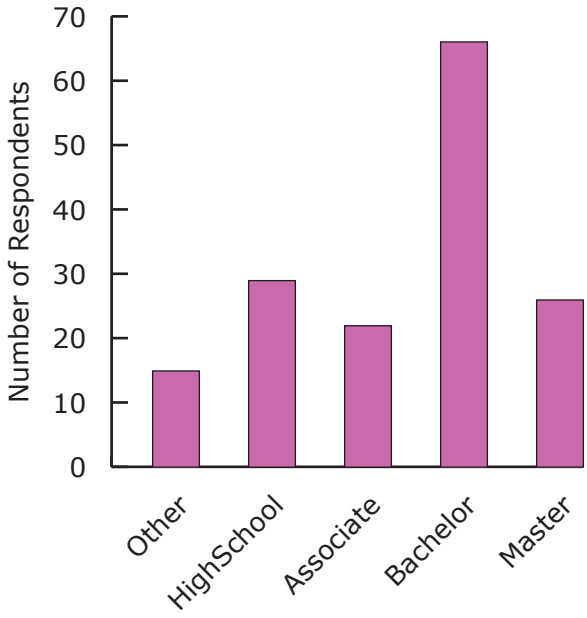
Figure 2: Percentages of WIC Respondents Occupations



in making dental referrals for infants and children as needed. Findings also suggest that WIC personnel are familiar with AAPD referral guidelines.[19] A noteworthy finding of this study is the majority of WIC personnel who were not confident in performing visual oral assessments to identify dental decay in children. Less than half of WIC personnel stated they assessed for visual signs of dental decay suggesting that this is an important area for future training. This finding can be explained by the Bandura self-efficacy social cognitive theory, which states that the greater one's self-efficacy for successfully completing a task, the more likely that a person is to engage in the task.[32,33] Training in dental caries assessments is indicated to increase both oral health knowledge and confidence of WIC personnel in identifying dental decay.

Few studies have focused on confidence and oral health promotion behaviors by WIC personnel, however, a number of studies in pediatric medicine and nursing demonstrate the effects of practitioner self-confidence on professional practices.[37,41,43] For example, one study revealed nurses and dental hygienists more likely promoted oral health if they were more confident in the process, supporting the need to build confidence in oral health promotion and disease prevention in WIC personnel.[39] Silverstein found that pediatricians with greater confidence are more likely to make dental referrals at Head Start program populations than those with lower self-confidence.[42] Also, Ozer found that physicians' confidence in their ability to screen for risky health behaviors was positively related with their promotion of disease preventive practices.[43] If WIC personnel are to help decrease dental disease in their clients, then the research evidence supports the need for additional and regular training to boost confidence and oral health promotion practices.

Figure 3: Educational Levels of WIC Respondents



Only 4 out of the 176 respondents apply fluoride varnish on WIC children since registered nurses, dental hygienists, physicians and dentists are permitted to apply fluoride varnish. Given that most WIC personnel were office service specialists and nutritionists, and not nurses or dental hygienists, it is understandable that fluoride therapy is not routinely provided to WIC clients in some WIC programs. The Health Resources and Services Administration (HRSA), California Healthcare Foundation, Institute of Medicine (IOM) and National Research Council (NRC) experts believe separating

Table IV: Virginia Health Districts and WIC Personnel Frequencies (n=42)

Virginia Health Districts	Urban/Rural	Percent	Frequency
Aberle/Charlottesville/Thomas/Jefferson	Urban	1.7	3
Alexandria	Urban	0.6	1
Alleghany/Covington	Urban	0.0	0
Arlington	Urban	4.0	7
Bland/Bristol/Carroll/Galax/Grayson/Mount Rogers	Rural	5.7	10
Carroll County	Rural	0.6	1
Chesapeake	Urban	2.9	5
Chesterfield	Urban	5.1	9
Culpeper/Rapidan	Rural	0.6	1
Cumberland/Tazewell	Rural	0.0	0
Eastern Shore/Accomack	Rural	1.1	2
Fairfax	Urban	9.1	16
Frederick/Winchester	Rural	0.6	1
Goochland County	Rural	0.6	1
Halifax/Southside County	Rural	2.9	5
Hampton	Urban	2.3	4
Henrico East	Urban	1.1	2
Henrico West	Urban	1.1	2
Lenowisco/Wise/Norton	Rural	2.3	4
Lord Fairfax	Rural	2.9	5
Loudon	Urban	0.0	0
Lynchburg/Central Virginia	Urban	4.0	7
Montgomery County	Urban	0.0	0
New River	Urban	2.9	5
Norfolk	Urban	0.0	0
Peninsula	Urban	5.1	9
Petersburg	Urban	0.6	1
Piedmont	Rural	1.7	3
Pittsylvanvia/Danville	Urban	0.0	0
Portsmouth	Urban	3.4	6
Prince William	Urban	3.4	6
Rapahannock	Urban	2.3	4
Rapahannock/Rapidan	Rural	2.3	4
Richmond	Urban	5.1	9
Roanoke	Urban	4.6	8
Smyth County	Rural	1.7	3
Three Rivers	Rural	2.3	4
Virginia Beach	Urban	5.7	10
Washington/Wythe County	Rural	2.3	4
Western Tidewater	Rural	4.0	7
West Piedmont	Rural	3.4	6

oral health care from overall care is limiting access to oral care for many Americans.[15,47,50]

Recommendations include proper training of non-dental health professionals to assess for dental diseases and implement preventive oral care services in a variety of settings. Some alternative training models to help improve access to oral care in underserved communities include Minnesota Advanced Dental Therapist (DT), Dental Therapist (DT), Alaska Dental Health Aide Therapist (DHAT), California Registered Dental Hygienists in Alternative Practice (RDHAP), Oregon Expanded Practice Dental Hygiene Permit (EPP), Oral Preventive Assistants (OPAs) and Community Dental Health Coordinators (CDHCs).[50] These allied dental health models were designed to promote oral care for the underserved and dental professional shortage areas. Strategies to recruit dental providers in underserved communities include: option for new graduates with loan repayment, gaining experience working with the underserved and expanding the scope of practice for dental auxiliaries. Clearly, if more health professionals employed at WIC could apply fluoride varnish, caries activity in the infant and children population would decrease.

Future research could include surveys for WIC clients and other allied health providers to assess their oral health knowledge, beliefs and practices. Additional studies about the use of fluoride varnish knowledge and practices should also be conducted. A cost-effectiveness study to explore the value of other allied health professionals and dental health providers in reducing the need for expensive dental care in WIC populations is also indicated. This line of research may lead to identifying potential cost saving programs for states whose budgets are already depleted by Medicaid, SCHIP, and other entitlement programs.

Conclusion

There is a need for WIC personnel and other allied health professionals in the state of Virginia to receive oral health promotion and dental disease prevention training. Topics to consider include oral health assessments, basic evidence-based practices such as hands-on toothbrush instruction, fluoride varnish and referring to dentists. This could also be accomplished by employing more dental providers at WIC. This study and current literature suggests that oral health training among non-dental professionals such as WIC personnel could reduce the incidence and prevalence of dental decay in the high-risk population of infants and children. WIC personnel make logical partners to collaborate with Virginia Division of Dental Health and the HRSA for support in providing oral health education and basic preventive services to WIC participants.

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