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- The Dental Hygiene Scholarly Identity and Roadblocks to Achieving It
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- Low-Income Parents' Perceptions of Oral Health and Acceptance of Mid-level Dental Providers
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- Oral Care for Pregnant Patients: A survey of Dental Hygienists' Knowledge, Attitudes and Practice
- Ultrasonic Instrumentation Instruction in Dental Hygiene Programs in the United States
- Oral Health Status of Older Adults Attending Senior Centers and Congregate Meal Sites in New Hampshire

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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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The Impact of Leadership and Research on Decision Making: Who Is Going to Lead the Transformation of Dental Hygiene?



Tami J. Grzesikowski, RDH, MEd

Think back to when you first entered the dental hygiene profession. Most of us didn't stumble upon the profession, independent of someone leading us here. Who guided you into dental hygiene? Some of us were led to dental hygiene because of previous dental experiences or a family member in dentistry. Many have guided others into the profession by sharing with their patients, friends and co-workers all that dental hygiene can offer.

Your passion for the profession and compassion for your patients make you an excellent role model and leader. We must continue leading others to our profession to replace retiring dental hygiene clinicians, educators and researchers. We need to equip future students with data that supports dental hygiene as an exceptional career path. The Bureau of Labor Statistics reports that employment of dental hygienists will grow 19% in the next decade.¹ In 2015, the American Dental Education Association reported 292 retirements for dental hygiene in the next 5 years representing approximately 2 faculty for each program.² A decision regarding one's professional journey is important and it's imperative that one uses evidence to support the decision.

As you entered the workforce or your current position, did you have a mentor? Perhaps your mentor was someone in your workplace advising you and assisting you with becoming a valuable part of the team. Perhaps it was a colleague from your component or even your "big sister or brother" from dental hygiene school. Would you have been in a different place today without a mentor? It is crucial that we provide leadership and guidance to our new team members regardless of the setting.

There are numerous opportunities to serve as a leader. Clinicians are educating and leading patients to optimal oral health and contributing to overall systemic health. Educators are leading the next generation of dental hygienists into the profession. Researchers must generate quality research that stimulates dental hygienists to produce valuable data in the years ahead. According to John Maxwell, leaders become great not be-

cause of their power but because of their ability to empower others. Are you ready and willing to empower others?³

Fortunately, dental hygienists have plenty of opportunities to develop leadership skills. Two outstanding programs for dental hygienists are ADHA's Unleashing Your Potential Workshop (UYP) and ADEA's Allied Dental Faculty Leadership Development Program (ADFLDP). Participants selected for UYP have the opportunity to network with fellow ADHA leaders, absorb a great deal of information regarding leadership skills, collaborative leadership and fiduciary responsibility. Likewise, ADEA ADFLDP participants are selected bi-annually to participate in a 4 day intensive training in leadership designed for allied dental faculty members and program directors. This interactive program includes self and peer-assessment exercises and presentations from experts in higher education. Individual coaching sessions are scheduled and a mentoring program established. Graduates from both of these programs develop bonds with classmates that often last a lifetime, and have defined these programs as life changing opportunities.

Currently, 8 dental hygiene leaders from the ADHA and ADEA are part of a collaboration titled the ADEA Curriculum Change and Innovation (ADEA CCI) workgroup with the ADHA. This group began working over 2 years ago with the goal to increase and enhance professional development and leadership opportunities for dental hygiene professionals for the future transformation of the dental profession. This workgroup collected data and information on voids in dental hygiene education. They established the priority of building a cadre of new leaders in dental hygiene education that are prepared to assume responsibilities and lead the profession into the next century of dental hygiene. The workgroup is creating a leadership development program. The target group for the program will be part-time dental hygiene faculty and recent graduates of advanced dental hygiene education programs pursuing a career in dental education. It will be a hybrid course that will provide an interactive online component and one face-to-face meeting. Some of the topics include

mentoring, principles of leadership, effective communication, and social and emotional intelligence.

According to Mark Yarnell, a leader is someone who demonstrates what's possible.⁴ As the dental hygiene profession continues to transform, so many things are possible for us that may not have been available decades ago. Each and every one of us has the opportunity to lead and it is our responsibility not to miss the opportunity to be a mentor and leader to the new generation of dental hygienists.

Sincerely,

Tami J. Grzesikowski, RDH, MEd
Senior Director for Allied Dental Education
American Dental Education Association

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Effectiveness of Professionally-Applied Silver Diamine Fluoride in Arresting Dental Caries

Denise M. Bowen, RDH, MS

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

The Bottom Line:

Silver diamine fluoride has been shown to be effective in preventing and arresting dental caries. It provides an economical, noninvasive mechanism for dental hygienists to manage caries in community-based programs. The first product was cleared for marketing by the Federal Drug Administration (FDA) in 2014 as a cavity varnish for treatment of hypersensitivity in adults over 21 years of age; therefore, its use as a caries preventive or arresting agent is off label. This FDA clearance parallels that of sodium fluoride varnish. Systematic reviews of clinical trials in children and elderly adults provide evidence for the effectiveness of silver diamine fluoride in arresting dentin caries when applied every 6 months for a period of 2 to 3 years. Without excavation of soft dentin, silver diamine fluoride reacts with protein in the dentinal tissue and deposits a layer of silver protein that resists acids produced by bacteria and promotes the formation of hydroxyapatite and fluorapatite. The silver is antibacterial, and the decayed tooth surface hardens, and the lesion becomes smaller.¹

Based on the findings of these 2 studies, the ensuing conclusions regarding silver diamine fluoride can be drawn:

- Silver diamine fluoride presents a noninvasive option for caries arrest and treatment when applied directly to dentin caries lesions
- Use of silver diamine fluoride should be combined in a preventive oral health program with use of sodium fluoride varnish for remineralization of early caries lesions and application of sealants for prevention of caries when resources are available
- Clinicians need to know the indications and contraindications, follow manufacturer directions for use, and obtain informed consent before using silver diamine fluoride
- From a public health point of view, silver di-

amine fluoride might provide an option for treating patients with barriers to care¹

Gao SS, Zhang S, Mei ML, Lo EC, and Chu CH. Caries remineralisation and arresting effect in children by professionally applied fluoride treatment – a systematic review. BMC Oral Health. 2016 Feb 1;16(1):12. doi: 10.1186/s12903-016-0171-6.

Abstract

Background: As a low-cost and easily operated treatment, the use of professionally applied topical fluoride was approved for preventing dental caries and remineralising early enamel caries or white spot lesions. It is also used to arrest dentine caries. The aim of this study is to investigate the clinical efficacy of professional fluoride therapy in remineralising and arresting caries in children.

Method: A systematic search of publications from 1948 to 2014 was conducted using four databases: PubMed, Cochrane Library, ISI Web of Science and Embase. The key words used were (fluoride) AND (remineralization OR remineralization OR arresting) AND (children caries OR early childhood caries). The title and abstract of initially identified publications were screened. Clinical trials about home-use fluorides, laboratory studies, case reports, reviews, non-English articles and irrelevant studies were excluded. The full texts of the remaining papers were retrieved. Manual screening was conducted on the bibliographies of the remaining papers to identify relevant articles.

Results: A total of 2,177 papers were found, and 17 randomised clinical trials were included in this review. Ten studies investigated the remineralising effect on early enamel caries using silicon tetrafluoride, fluoride gel, silver diamine fluoride or sodium fluoride. Seven studies reported an arresting effect on dentine caries using silver diamine fluoride or nano-silver fluoride.

Meta-analysis was performed on four papers using 5% sodium fluoride varnish to remineralise early enamel caries, and the overall percentage of remineralised enamel caries was 63.6% (95 % CI: 36.0% - 91.2%; $p < 0.001$). Meta-analysis was also performed on five papers using 38% silver diamine fluoride to arrest dentine caries and the overall proportion of arrested dentine caries was 65.9% (95% CI: 41.2% - 90.7%; $p < 0.001$).

Conclusion: Professionally applied 5% sodium fluoride varnish can remineralise early enamel caries and 38% silver diamine fluoride is effective in arresting dentine caries.

Commentary: Evidence indicates the application of fluoride gel results in a large reduction in dental caries.² Sodium fluoride varnish also has been shown to have a substantial effect in preventing caries in children and adolescents.³ Nonetheless, the CDC indicates 23% of children age 2 to 5 years had caries in primary teeth and 15% of adolescents aged 12 to 19 years had untreated tooth decay in 2011 to 2012.⁴ The prevalence of dental caries is significantly higher in low income children and children without access to conventional dental care. Alternative treatments are needed to address needs of these vulnerable populations. In this article, Gao et al. reported the results of a systematic review of the literature designed to evaluate the effectiveness of professionally-applied topical fluoride in remineralizing and arresting dental caries in children. The results of 2 meta-analyses to assess the remineralizing effects of 5% sodium fluoride varnish and the use of 38% silver diamine fluoride in arresting dentin caries also were reported in this article. A meta-analysis is a research approach which statistically combines results of several individual studies to increase the power of the results and strengthen the conclusions. These authors included clinical studies of the remineralizing and arresting effect of topical fluoride application in children and divided them into 2 groups: those that measured early enamel caries and dentin caries. The random effects model was used for the meta-analyses to allow for the weighted effect of each study based on sample size. Studies evaluating effectiveness of fluoride on prevention of caries or development of new carious lesions were omitted.

The number of high quality clinical trials evaluating the effectiveness of professionally-applied topical fluoride in arresting dental caries was small, and those studies included several different agents, methods, and outcome measures. Only

studies published in the English language were included in this systematic review. As a result, the number of studies included in the meta-analysis was minimal. Four studies of the clinical efficacy of sodium fluoride varnish were included in the meta-analysis because all of them measured the overall percentage of remineralization using the 5% sodium fluoride varnish. As indicated in the abstract, the combined data indicated a 63.6% remineralization of early enamel caries in children. The length of the studies ranged from 1 to 9 months; therefore, longer term trials are indicated. Apart from sodium fluoride varnish, little evidence was found to support other topical fluoride applications in the remineralization of early enamel caries in children.

Five studies measured the clinical efficacy of 38% silver diamine fluoride alone on arresting dental caries in children. Other concentrations or combinations of silver diamine fluoride were less common and were excluded from the meta-analysis. Three of these studies used a once a year application and indicated a rate of arrested dentin caries between 65.2% and 79.2%; one study demonstrated applications every 6 months increased the mean proportion of arrested caries to 84.8%; and, one study evaluated a single application arrested dentin caries at an average proportion of 31.2%. These differences suggest a need for future studies to evaluate the optimal time interval for application of silver diamine fluoride. The length of the studies included ranged from 18 to 30 months. One finding of particular relevance to dental hygienists practicing in alternative settings outside of the conventional dental practice or clinic was that studies indicated 38% SDF treatment is superior to sodium fluoride varnish in arresting dentin caries, and there is no need to remove the soft decay before silver diamine fluoride application. Two studies included in the review found silver diamine fluoride to be more effective than glass ionomer restorations in arresting dental caries.

Silver diamine fluoride application results in black staining of caries lesions, a disadvantage that may cause dissatisfaction for children and parents, and certainly an indication for informed consent. One study used an innovative product with nano-silver fluoride and found it effective in reducing caries without dark staining. None of the studies included in this systematic review reported other significant adverse effects, although additional study of the safety of all topical fluoride products is warranted.^{2,3}

Horst JA, Ellenikiotis H, Milgrom PL. UCSF Protocol for caries arrest using silver diamine fluoride: rationale, indications and consent. J Calif Dent Assoc. 2016 Jan;44(1):16-28.

Abstract

The Food and Drug Administration recently cleared silver diamine fluoride for reducing tooth sensitivity. Clinical trials document arrest and prevention of dental caries by silver diamine fluoride. This off-label use is now permissible and appropriate under U.S. law. A CDT code was approved for caries arresting medicaments for 2016 to facilitate documentation and billing. We present a systematic review, clinical indications, clinical protocol and consent procedure to guide application for caries arrest treatment.

Commentary: This article presents a clinical protocol for application of silver diamine fluoride for caries arrest treatment developed by researchers at the University of California at San Francisco (UCSF). Horst et al conducted a systematic review prior to creating this protocol and present the results of 9 randomized clinical trials conducted for at least 1 year as background information related to the protocol. These studies in this review met accepted criteria for a well-designed trial. In all of the studies, silver diamine fluoride was applied while the teeth were isolated with cotton, and caries was detected clinically with a mirror and explorer only. These studies involved both children aged 3 to 9 years and adults aged 60 to 89.

Findings of the systematic review indicated that caries arrest increased with re-application of silver diamine fluoride after 1 year of treatment, to 18 months, and again to 2 or 3 years, and results were not sustained after 1 year without reapplication. Silver diamine fluoride was more effective in arresting caries than sodium fluoride varnish. Applications at 6-month intervals were more effective than once a year. In 1 study, the combination of annual application of silver with oral hygiene instruction every 6 months resulted in arrested root caries in a group of community-dwelling elderly adults. The authors of the review identified darkening of the entire lesion as an indication of the success of the treatment in arresting caries at follow up, and a break in the black color was indicative of active caries or sensitivity at 6 months. This characteristic may facilitate diagnosis by dental hygienists working in school, community or long-term care settings.

The findings of the review also indicated that silver diamine fluoride was effective in caries prevention in children and the elderly. Two studies indicated that silver diamine fluoride applied to

active carious lesions for arrest also prevented caries in other tooth surfaces. Similar to use for caries arrest, however, silver diamine fluoride requires continued application because prevention is effective less than 1 year without repeat application. Sealants were more effective than silver diamine fluoride; however, application was reported 20 times more costly.

Based on the findings of the systematic review, Horst et al. provided a detailed clinical protocol and informed consent form in the article. They recommended application of silver diamine fluoride twice a year to carious lesions only, without excavation, for the first 2 years. Any patient with active caries should receive silver diamine fluoride rather than sodium fluoride varnish. Silver diamine fluoride does not stain sound enamel; therefore, localized application to arrest dentin caries would not result in generalized tooth darkening. Should caries progress, minimally invasive restorative techniques would be indicated.

The authors discuss 4 indications. In cases of extreme caries risk, traditional preventive care and restorative treatment fails to arrest caries. These patients include children with severe early childhood caries and patients with salivary dysfunction resulting from cancer therapy, Sjogren's syndrome, polypharmacy, or methamphetamine abuse. Patients with physical or mental conditions that preclude standard treatment including the elderly living in nursing homes or patients on hospice without access also are indicated. Numerous lesions that can not be treated in one visit or lesions that are difficult to treat conventionally may also be treated with silver diamine fluoride.

Additional studies are needed to determine long-term effectiveness after 2 to 3 years when regular application is discontinued. Following manufacturer's dosage guidelines based on body weight is critical to safe application of silver diamine fluoride. The authors set their recommended limit at 1 drop per 10 kilograms of body weight per treatment visit. This meets the Environmental Protection Agency's short- and long-term limits. The most frequent application studied was weekly for 3 weeks annually, and twice a year was shown to be effective. More frequent application of silver diamine fluoride requires additional studies of safety and efficacy. Argyria, a condition caused by exposure to chemical forms of silver, causes the skin to become blue or grayish as a result of accumulation of silver in the body over time. This condition has not been reported with the use of silver diamine fluoride. In fact, adverse reactions are rare and limited to a transient white mucosal lesion or gingival redness in only a few subjects of thousands studied. The soft tissue and gin-

gingiva should be avoided during application; thus, the authors have recommended use of petroleum jelly for protection of adjacent gingiva, using the smallest available microsp sponge, and dabbing the dampen dish to remove any excess solution before application. Silver allergy is a contraindication. Desquamative gingivitis or mucositis is a relative contraindication.

Summary: Dental hygienists are preventive professionals responsible for providing oral health care to patients in traditional dental settings, community settings, and primary care or medical settings. Among other preventive and therapeutic services, silver diamine offers an opportunity to address dental caries with an effective, economical, and noninvasive approach. The authors of these 2 articles concluded that evidence presented supports silver diamine fluoride application as a caries preventive and arresting modality. Clinicians should be aware that this use is off label; know the indications, contraindications, and recommended procedures before use; and, obtain informed consent prior to application. Repeated application at 6-month intervals is needed for sustained effectiveness. More research is needed to determine the optimal length of time for repeated application to sustain long-term effectiveness, reasons for subsequent caries progression, and when excavation may or may not be needed.

Denise M. Bowen, RDH, MS, is a graduate faculty member and Professor Emeritus in Dental Hygiene at Idaho State University. She has served as a consultant to dental industry, as well as numerous government, university and private organizations and presently is a member of the National Advisory Panel for the National Center for

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CRITICAL ISSUES IN DENTAL HYGIENE

The Dental Hygiene Scholarly Identity and Roadblocks to Achieving It

Margaret Walsh, RDH, MA, MS, EdD; Elena Ortega, RDH, MS; Barbara Heckman, RDH, MS

Abstract

Purpose: Progress in the dental hygiene discipline is predicated on the development of a community of scholars with a dental hygiene scholarly identity who explore questions central to the art and science of dental hygiene and in doing so create conceptual models to expand the discipline's structural hierarchy of knowledge. Graduate dental hygiene education is challenged to develop programs that stimulate and nurture dental hygiene scholars as well as scientists. The need for the development of dental hygiene doctoral education is critical to strengthening our discipline's scholarly identity.

The authors explore the tyranny of the "Queen-Bee" and the paralyzing nature of the "Imposter Syndrome," as pathologic non-productive behavior patterns that create roadblocks not only for the individual to move forward, but also for the discipline as a whole. Recognizing and eliminating these maladaptive syndromes will empower the individual as well as strengthen the collective to build a strong dental hygiene scholarly identity. The significance of dynamic "Follower-ship" as an often undervalued concept is offered as an antidote to overcome roadblocks and energize the collective's value of a scholarly identity for dental hygiene.

Keywords: scholarly identity, graduate dental hygiene education, dental hygienists, doctoral dental hygiene education, imposter phenomenon, queen bee syndrome, follower-ship

This study supports the NDHRA priority area, **Professional Education and Development:** Identify the factors that affect recruitment and retention of faculty.

INTRODUCTION

Scholarship development in dental hygiene is a very broad concept, but it can be thought of as existing on a continuum (Figure 1). At one end of the continuum scholarship begins in entry-level dental hygiene programs where students learn to review and evaluate the literature to inform clinical evidence-based decision-making. This continuum progresses to higher levels of scholarship in research-oriented dental hygiene master's degree programs where learners conduct pilot study-level original research, and in research-oriented dental hygiene doctoral degree programs that require more complex, large-scale original independent research.¹ For the purpose of this paper, the term scholarship will refer to that aspect of the continuum that relates to conducting original research.

In most disciplines, the doctoral degree is the terminal degree preparing scholars to conduct rigorous discipline-specific research.² Although the first dental hygiene doctoral program was established in 2013 at Namseoul University in South Korea, and there is one such program on the drawing board in the U.S. at Idaho State University, much of the responsibility for dental hygiene's higher level scholarship development falls to the dental hygiene master degree programs throughout the world.³ Indeed, graduate learners enrolled in dental hygiene research-oriented master degree programs develop competencies related to the research process needed for the development of dental hygiene scien-

tists. However, to further develop the dental hygiene discipline to promote the public's oral health, dental hygiene scholars are needed in addition to dental hygiene scientists. An underlying theme of this paper is that there is a difference between a dental hygiene scientist and a dental hygiene scholar.

Scientists systematically pursue answers to questions related to substantive areas of some discipline. Scholars, on the other hand, not only are research scientists, but they also have a dedicated and passionate commitment to how their science relates to their discipline's mission, its values and its effects on humanity. In this context, scholars have a sense of the discipline's history and have a life-long commitment to the development of the discipline's knowledge base through focused research programs.^{1,4,5} For example, many dental hygiene scientists often focus on isolated questions that may or may not be directly related to the dental hygiene discipline. Thus, we have scientists who are dental hygienists, rather than dental hygiene scientists who also are dental hygiene scholars. Although this nuance may appear to be trivial, it is an essential distinction when it comes to the advancement of the dental hygiene discipline as it moves through its scholarship development process. Therefore, the purpose of this paper is to:

- Define the dental hygiene scholarly identity

- Discuss the importance of the dental hygiene scholarly identity to advancing the dental hygiene discipline and its structural hierarchy of knowledge to promote the public's oral health
- Introduce potential roadblocks to developing the dental hygiene scholarly identity and strategies to overcome them
- Introduce the concept of follower-ship in developing a community of dental hygiene researchers with a dental hygiene scholarly identity

The Scholarly Identity

Dental hygiene researchers who have a scholarly identity are dental hygiene scientists who:

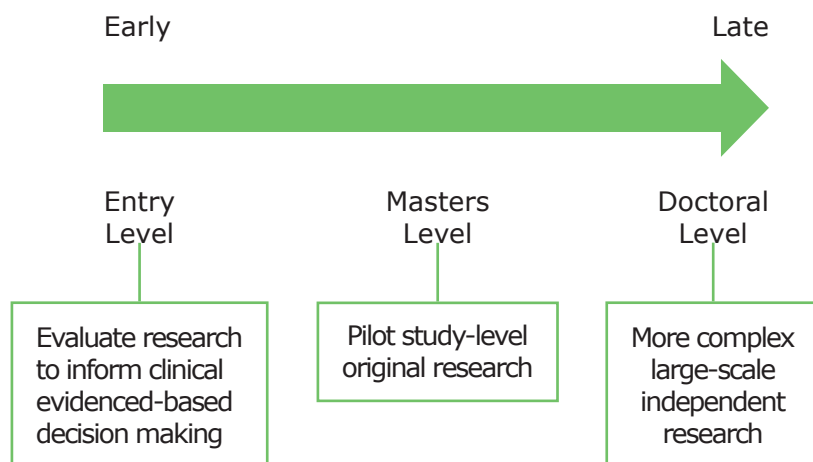
- Envision the dental hygiene discipline as a whole
- Conceptualize theory central to the discipline as the basis for further knowledge development
- Develop and test conceptual models from the dental hygiene perspective
- Incorporate the norms and values of the dental hygiene practitioners
- Ask and answer research questions central to the discipline while reaching across disciplines
- Focus on dental hygiene research priorities⁶
- See their research questions as part of the discipline's whole
- Have a commitment to the discipline's knowledge development
- Have a sense of belonging to a dental hygiene scholarly group
- Welcome philosophical debate about the discipline
- Dedicate themselves to mentoring other dental hygiene scholars
- Apply knowledge of existing dental hygiene theories to their research questions

Like other scientists, dental hygiene scientists with a dental hygiene scholarly identity also:

- Apply knowledge of research design, methodologies and statistics to guide the scientific process
- Use evidence to support their viewpoint
- Report one's own results in the context of those of others in the field as well as those in other disciplines
- Disseminate their research findings through scientific publication¹

Dental hygiene masters programs are challenged to do the above within a limited timeframe of 1 to 2 years. Nevertheless, developing a scholarly identity and community among master degree-level dental hygiene learners is a first step toward making progress in developing the dental hygiene discipline. Dental hygiene doctoral programs are needed to complete the journey

Figure 1: Continuum of Dental Hygiene Scholarship Development



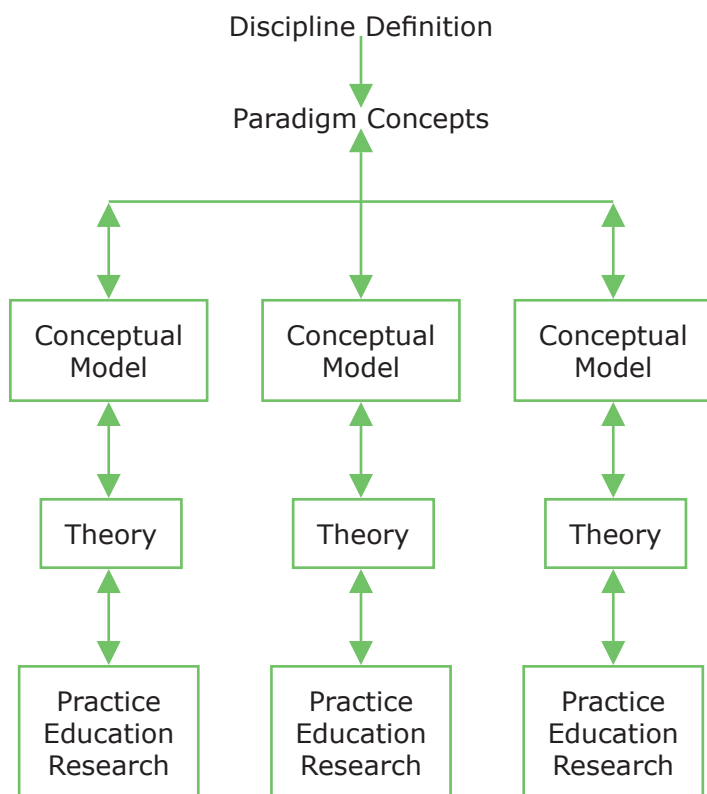
while at the same time reaching out to experts in other disciplines. Strategies for developing a scholarly identity in dental hygiene graduate programs have been published elsewhere.¹ Suffice to say, equating the development of a scholarly identity only with research methods, statistics and design courses in isolation from the context of the dental hygiene discipline constrains the development of the dental hygiene scholarly identity. Knowledge gained in research methodology courses needs to be augmented with a critical knowledge of the dental hygiene discipline's research priorities in conjunction with learning how interdisciplinary approaches can be used in addressing these priorities central to the dental hygiene discipline.¹ Moreover, professional socialization is critical for developing the dental hygiene scholarly identity. Professional socialization encompasses integrating course work with the norms and values of the discipline's culture that are fundamental to understanding the professional perspective.^{1,7-11} A dental hygiene scholarly identity is not fully realized unless a whole culture is created to promote and nurture it.¹ It must be acknowledged, however, that dental hygiene's scholarly identity requires the establishment of dental hygiene doctoral educational programs, and this evolution is essential for continued progress in the dental hygiene discipline.

So, how does the dental hygiene scholarly identity relate to the dental hygiene discipline's Structural Hierarchy of Knowledge?

The Structural Hierarchy of Knowledge

Most disciplines have a formal metaparadigm or Structural Hierarchy of Knowledge that is a widely accepted worldview of the discipline. Figure 2 represents a generic Structural Hierarchy of Knowledge for any discipline that is composed of the definition of the discipline, its major paradigm concepts the discipline has selected for study and conceptual models.^{12,13} The paradigm concepts are established by the discipline, specify the discipline's unique perspective and are the first level

Figure 2: Generic Diagram of the Structural Hierarchy of Knowledge for All Disciplines



of distinction between similar disciplines. Although the paradigm concepts are not subject to change by scholars, they are used by scholars to develop conceptual models. Conceptual models are also known as schools of thought. Each school of thought (i.e., conceptual model) relates to some theory and is designed to be tested by scholars to then either accept or reject the school of thought. A conceptual model (i.e., school of thought) shapes the direction and methods of the practitioners, educators and researchers who subscribe to that particular school of thought.

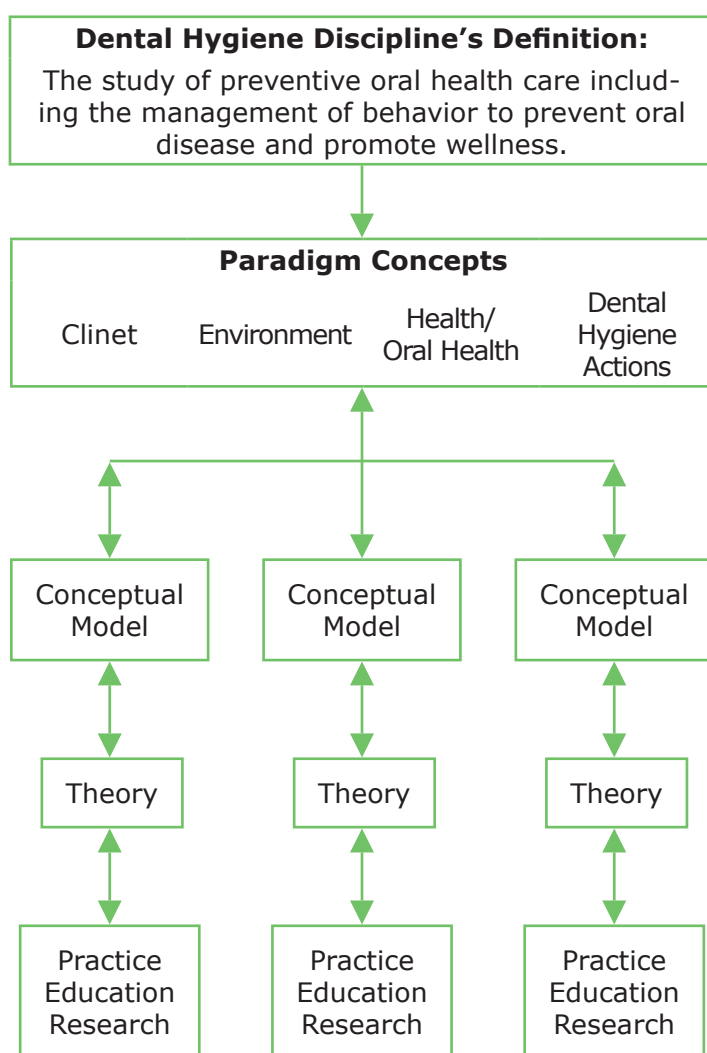
Figure 3 illustrates the Structural Hierarchy of Knowledge for the dental hygiene discipline.¹²⁻¹⁴ This hierarchy was approved by the ADHA House of Delegates in 1995,¹⁴ and consists of:

- The definition of the discipline
- Paradigm concepts
- Global definitions of the paradigm concepts
- Conceptual models (Open to innovative development by dental hygiene scholars as theory-based schools of thought)

The details of these components of dental hygiene's Structural Hierarchy of Knowledge are reviewed below.

Component #1: The Definition of dental hygiene. Dental hygiene as a discipline is defined as "the study of preventive oral healthcare including the management of behaviors to prevent oral disease and to promote health."¹⁴ This definition is unique because it focuses on

Figure 3: Dental Hygiene Discipline's Structural Hierarchy of Knowledge



oral disease prevention and health promotion from the dental hygiene perspective. That perspective promotes clients who are empowered to perform oral self-care, chronic oral conditions that are improved, quality of life that is enhanced and oral disease prevention with associated lower oral health care costs.¹¹

Note the phrase "the study of" in the definition because that is what all disciplines do - they study important concepts that contribute to the discipline's body of knowledge to inform practice and to enhance the public's oral health.^{13,14}

Component #2: Dental hygiene's Paradigm Concepts. Paradigm Concepts are the second component of any discipline's hierarchy of knowledge. The 4 concepts selected for study by the dental hygiene discipline are:^{11,12}

- The Client
- The Environment
- Health/Oral Health
- Dental Hygiene Actions

Component #3: Global Definitions of Each Paradigm Concept.^{13,14} A discipline's paradigm concepts always are defined very broadly to allow for the development of conceptual models about the concepts that are defined by specific theories.¹⁵ Therefore, the concept of the Client, has been defined by the ADHA, as "the recipient of dental hygiene actions who may be an individual, a family, a community, or a particular group." The term "Client" was selected as a paradigm concept, rather than the term "Patient," because the term "Client" is:

- Broad, not limited to an individual
- Implies wellness rather than illness
- Implies an active rather than a passive relationship with the provider

In contrast, the term "Patient" connotes:

- An individual
- Control by the health care provider
- A dependent passive recipient
- The need for therapy only
- A focus on biological problems with potential neglect of the individual's psychological, sociocultural and spiritual wellness

Although the term "Patient" is a correct clinical term widely used by dental hygienists to refer to the recipients of their care, it was not selected as a Paradigm Concept because of its more restrictive focus than that of the term "Client."

The concept of the Environment is defined as the milieu in which the client and dental hygienist find themselves.¹⁴ This concept includes dimensions such as socio-ethno-cultural, economic, political and educational factors that act as either barriers or facilitators to health, oral health and dental hygiene actions.

The concept of Health/Oral Health is defined as the client's state of well-being that exists on a continuum from maximum wellness to maximum illness.¹⁴ Oral health and overall health are interrelated because each influences the other.

The concept of Dental Hygiene Actions is defined as the interventions provided by a dental hygienist on behalf of, or in conjunction with, the client to promote oral wellness and prevent oral disease.¹⁴ These 4 global paradigm concepts central to the discipline of dental hygiene have been and continue to be further defined and expanded into various conceptual models that drive dental hygiene education, research and practice.

It must be recognized that early in its inception, dental hygiene drew heavily on knowledge from other disciplines such as dentistry, nursing, education and psychology.¹⁵⁻¹⁸ However, over the last 100 years, dental hygiene scholars have developed many of these bor-

rowed concepts into new conceptual models from the perspective of dental hygiene making them sufficiently distinct.¹⁹⁻²¹

Component #4: Conceptual Models. Conceptual models can be thought of as schools of thought. Just as in the discipline of psychology there are different schools of thought such as the Freudian school, or the Jungian school, so too in dental hygiene there are different schools of thought that affect research, education and practice. There can be as many conceptual models as there are scholars who can create them. Figure 4 shows 3 examples of dental hygiene conceptual models reported in the literature and each describes a unique process of care that is distinct for dental hygiene.¹⁹⁻²¹

The Oral Health-Related Quality of Life Conceptual Model is based on the premise that a satisfactory level of oral health, comfort and function, as defined by the client, is an integral component of general health.¹⁹ This model recognizes the oral cavity is a primary source of sensory input, and social discourse and functioning at all phases of life. It measures health and disease along a continuum that encompasses 6 domains of health, proposes a dynamic relationship among the domains and client characteristics, and serves as a foundation for the dental hygiene process of care (Table I).

The Client Self-Care Commitment Model is based on the premise that effectively involving clients as co-therapists in their oral health decisions, enhances motivation, commitment and compliance with oral self-care.²⁰ The model proposes 5 domains to encourage active client self-involvement in oral health maintenance. It also proposes that there is a relationship among the domains and the client and dental hygienist interaction that empower clients to make decisions to enhance their own health through commitment and compliance (Table I).

The Human Needs Conceptual Model is based on the premise that human behavior is motivated by human need fulfillment and defines the paradigm concepts in terms of human need theory.²¹ This model proposes that there are 8 human needs related to dental hygiene care that form the basis of the dental hygiene process of care: assessing the 8 human needs, diagnosing deficits, setting goals and dental hygiene interventions, implementing, evaluating, and documenting the extent goals are met (Table I).

It is important to note that there are other conceptual models being offered by scholars beyond the above examples that require testing for the on-going evolution of dental hygiene's body of knowledge and recognition of dental hygiene as a distinct profession.

For each conceptual model (i.e., school of thought), research questions are asked to test the model and findings contribute to the dental hygiene discipline's

body of knowledge to guide dental hygiene practice. The problem, however, is that none of these models have been sufficiently tested in the realities of dental hygiene practice settings to determine their effects on oral health and the quality of dental hygiene care.^{15,22-25} We need to ask the question, Why?

As we ponder this question, let us consider that Einstein once said: “No problem can be solved from the same level of consciousness that created it.”²⁶ The first step in solving a problem is to define the problem. It makes one wonder: Could it be that many of our dental hygiene educators, researchers and clinicians are not fully aware of the discipline’s hierarchy of knowledge and of the importance of developing a scholarly identity related to it? Could it be that there are unconscious, maladaptive behavior patterns among dental hygienists that create roadblocks to moving the discipline forward? And, if these threats are real, then what can be done to counteract them? To challenge our thinking about these questions and to provide some essential information needed for possible answers, a discussion of potential roadblocks to developing a dental hygiene scholarly identity follows.

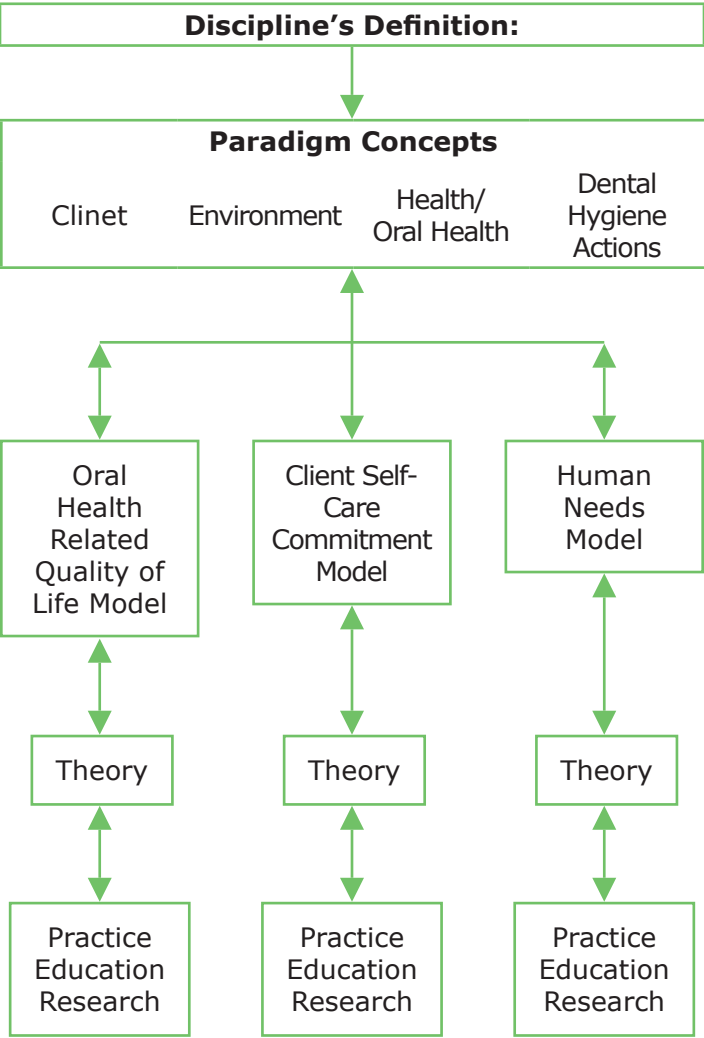
Potential Roadblocks to Developing a Scholarly Identity

Although in-roads have been made towards gender balance, to date dental hygiene remains predominantly a female profession.²⁷ Therefore, it is important to recognize 2 prevalent maladaptive behavior patterns prevalent among women who have succeeded in their careers that may be potential roadblocks to developing a dental hygiene scholarly identity. These behaviors are known as the “Imposter Phenomenon” and the “Queen Bee Syndrome.”²⁸ The central psychological feature of both the Imposter and the Queen Bee is a distorted self-image. Although it is important to recognize and explore other dysfunctions that also may hold back the on-going evolution of the profession, only the Imposter Phenomenon and the Queen Bee Syndrome are discussed in this paper as described below.

The Imposter Phenomenon

The Imposter Phenomenon, prevalent among high-achieving women, was first described in 1978 as the perception of oneself as having an “intellectual phoniness.”²⁹ Although studies report that men experience the phenomenon as frequently as women, the Imposter Phenomenon’s characteristics have a more deleterious effect upon a woman’s career.²⁹ Women who experience the impostor phenomenon believe that, despite outstanding academic and professional accomplishments, they really are incompetent, and that anyone who believes otherwise has been fooled.^{29,30} Symptoms they experience are anxiety, self-doubt, inability to accept positive feedback, fear of failure and guilt about success undermine their ability to function at their

Figure 4: Dental Hygiene Discipline’s Structural Hierarchy of Knowledge with 3 Examples of Dental Hygiene Conceptual Models



highest level. The Imposter Phenomenon also can be applied to a group.³¹

One explanation for a higher prevalence of this disorder among women than men is that society sometimes imposes contradictory values upon children, so that what is socially desirable in men may be different from what is socially desirable in women.²⁹ Contrary to the male perspective, for a woman, claiming power may be accompanied by fears of selfishness, destructiveness and abandonment. This negative perception is an image that few women can bear; consequently, some women are more comfortable feeling inadequate than feeling successful. The Imposter Phenomenon becomes a defense mechanism that allows these women to deal with ambivalence about their successes by keeping their achievements out of self-awareness.²⁹ For example, a high achieving dental hygiene leader who suffers from the Imposter Phenomenon may not be able to find her voice to defend her support of a dental hygiene doctoral program proposal, or of a new conceptual model unique to dental hygiene practice when confronted by skeptical questions from members of a more dominant group

Table I: Examples of 3 Dental Hygiene Conceptual Models That Describe a Unique Process of Care that is Distinct for Dental Hygiene

Conceptual Model	Domains	Process of Care
Oral Health-Related Quality of Life Model ¹⁹	6 Domains of Health: <ul style="list-style-type: none"> • Health/Preclinical Disease • Biological/Clinical Disease • Symptom Status • Functional Status • Health Perceptions • General Quality of Life 	A dynamic relationship between domains and client characteristics serve as a foundation for assessing, planning, implementing, evaluating and documenting outcomes of dental hygiene care
Client Self-Care Commitment Model ²⁰	5 Domains relate to Client Self-Involvement in Oral Health Maintenance: <ul style="list-style-type: none"> • Initiation • Assessment • Negotiation • Commitment • Evaluation 	Relationship among the domains and the client/dental hygienist interactions empower clients to make decisions to enhance their own health through commitment and compliance
The Human Needs Conceptual Model ²¹	8 Human Needs: <ul style="list-style-type: none"> • Protection from Health Risks • Freedom from Fear and Stress • Freedom from Pain • Wholesome Facial Image • Skin and Mucous Membrane Integrity • Biologically Sound Dentition • Conceptualization and Problem Solving • Responsibility for Oral Health 	Serves as the foundation for the dental hygiene process of care <ul style="list-style-type: none"> • Assessing the 8 Human Needs • Diagnosing Deficits in the 8 Human Needs • Setting Goals and Planning Interventions to Address the Deficits • Evaluating and Documenting the Extent Goals are Met

that the dental hygienist perceives as having greater prestige, power and status. This situation is compounded in academic settings, where dental hygiene leaders may be rewarded for being marginal and taking on the characteristics of the dominant group, rather than advocating for the values and advancement of the subordinate group.

In such situations where we find ourselves having to defend a foreign idea to a more dominant group, it is important to anticipate the potential for the Imposter Phenomenon to derail success.³² Conducting a mock presentation to practice responding to difficult questions before presenting the proposal is a suggested preventive strategy. Employing the counsel of the “5 P’s” is helpful in that “Proper Preparation Prevents Poor Performance.”³³

Most importantly, to counteract the potential for the Imposter Phenomenon, each of us must realistically assess our traits and celebrate our individual strengths and successes while forgiving our imperfections and mistakes.²⁹ The goal is that when we find ourselves in a position of acceptance by the more dominant culture, we will be self-aware, confident in our achievements, clear in our dental hygiene identity and able to overcome Imposter Phenomenon symptoms if they arise. Being aware of the Imposter Phenomenon allows one to establish control driven by inner strength and commitment, not fear.³² A good cognitive strategy to cope with the self-doubt characteristic of the Imposter Phenomenon is for an individual to re-direct her focus from herself and her own shortcomings to that of the needs

of the task at hand and of being of service to others.³² It is normal to have fear, but it is important not to allow fear to drive our decisions about taking action when opportunity presents itself.³⁴

The Queen Bee Syndrome

Another threat to success in achieving a dental hygiene scholarly identity and in establishing dental hygiene doctoral programs is the Queen Bee Syndrome.³⁵ The Queen Bee Syndrome, first defined in 1974, describes a woman in a position of authority who views or treats subordinates more critically if they are female. The “Queen Bee” is one who has succeeded in her career, but refuses to help other women do the same. This condition has been documented by several studies.³⁶ The Queen Bee protects her status by developing behaviors that are entrenched with self-centered motivation. She shuns subordinates, avoids competition and associates with the male-dominated management group rather than female peers.³⁶ Unlike other types of alpha females in a position of power who engage in collaboration and compromise, the Queen Bee lacks compassion and feels the need to aggressively destroy other females who are perceived as competition to her and potential threats to her hard-earned elite position.³⁵

Like the Imposter Phenomenon, the Queen Bee Syndrome is a defense mechanism. By assuming Queen Bee behaviors, she copes with the conflicting demands of her professional role and the role women have traditionally held in the family. She operates on a double standard; what is right for her is not always right for

other women.²⁸ The tragedy is that these talented but maladaptive women leaders often have the opportunity to support the goals of female groups, but frequently may not.²⁸ Instead of being supportive, the Queen Bee becomes a barrier to power and achievement for other women, especially if they are members of a subordinate group from which the Queen Bee originally was a member.^{28,37}

Many academic dental hygienists have considerable influence on academic decision-making within their academic institutions about whether or not to develop innovative academic programs such as dental hygiene doctoral degree programs. Although it is important to be clear that most high achieving dental hygienists who advance in the academic system are not Queen Bees, it is critical to recognize a Queen Bee when one is encountered and not be blind-sided because of trusting naiveté. Instead, once we recognize a Queen Bee who has the power to influence others negatively regarding any proposal for which we seek approval on behalf of the dental hygiene discipline, the best practice is to seek the endorsement of someone else in the dominant culture that has more prestige than she before seeking her support. Even then, she may not become an advocate, but she will keep her aggression at bay to comply with her superiors. The Queen Bee always is controlled by forces outside herself that have greater prestige, power and status.³⁵

Certainly, all high achieving women can fall prey to becoming a Queen Bee if they are unaware of this syndrome and its adverse consequences.³¹ Some useful strategies to minimize the effect of a Queen Bee are to:³⁸

- Stop giving away personal power by thinking or acting like a victim - instead, look for alternative pathways to get what is needed accomplished
- Focus on objectives and maintain dignity and integrity while striving to do what is best for the group
- Find a mentor who not only is successful in human relationships, but also is someone with whom you are confident you can share intimate details

Indeed, dental hygienists must engage in self-reflective processes and look beyond the role of the Queen Bee for other leadership styles that will complement not only the needs of the leader, but also those of the dental hygiene profession and its clients. Leadership behaviors needed may lie in the concept of "Followership" discussed below.³⁹

Followership

Taking action to be a more effective follower is a potential antidote to the roadblocks created by the Imposter and Queen Bee syndromes. But what do we mean by Followership? According to Followership Theory, there are 5 follower roles that are determined by

levels of activity and critical thinking.^{39,40} These roles are: sheep, yes people, alienated followers, survivors and effective followers. Taking action to develop and adopt effective follower characteristics in dental hygiene is key to counteracting the destructive results of maladaptive behavior patterns of leaders and in developing a "scholarly identity" to move the discipline forward. Effective Followers are active rather than passive. They can and should initiate change and engage in problem-solving and ethical behavior. Followership theory describes the role of "Followership" as a component of leadership,⁴¹ and views leaders and followers as "two sides of one process, two parts of a whole."⁴² Effective follower's work hard to overcome the Imposter Syndrome. They actively listen without interrupting, ask a lot of questions, display an attitude of service by looking for opportunities to share their expertise, focus on solution when there is a difference of opinion, and are inclusive sharing not only the workload but also the recognition.⁴⁰ When a Queen Bee is identified, effective followers take responsibility for using alternative paths to achieving the group's goals. In doing so, they often emerge as alternative leaders when the situation demands it. In other words, passive people are not followers.⁴³ Rost goes as far to say that effective "followers do not do followership, they do leadership."⁴⁴

Thus, the term Followership honors and recognizes the crucial role Followers play in organizational life. The term Followership recognizes that followers and leaders are dynamic roles that can be exchanged, and that performance challenges, not position, determines when one follows and when one leads.^{40,41} Effective followership prepares one to be an effective leader, as demonstrated in the video clip entitled the Leadership Lessons and the Dancing Guy.³⁸ This video illustrates the importance of followership to leadership and that being a "first follower" is an under-appreciated form of leadership.^{45,46} Dental hygiene needs to get past an elitist view of leadership that supports the Queen Bee, and a passive conformist view of followership that coincides with the Imposter Phenomenon. Much of a leader's success depends on effective followers and both roles deserve equal weight.⁴⁴

CONCLUSION

There is a critical need for a community of passionate dental hygiene researchers with a dental hygiene scholarly identity to ask and answer questions related to the discipline's whole while reaching across disciplines for assistance. These dental hygiene scholars are essential for the advancement of the dental hygiene discipline's knowledge base to promote the public's oral health. This paper has reviewed 3 dental hygiene conceptual models, however, there can be as many conceptual models and frameworks as there are scholars who can develop them. As more conceptual models evolve beyond what is offered in this paper, they should be tested and examined as well.

Recognizing the potential for the Imposter Phenomenon and the Queen Bee Syndrome to undermine dental hygienists' ability to function at their highest level, will empower the individual as well as strengthen the dental hygiene collective. Future research is needed to study these and other dysfunctions as impediments to achieving a professional scholarly identity. Such strategies as effective followership also are needed to take action to build a strong dental hygiene scholarly identity. In addition, the development of dental hygiene doctoral programs is critical to nurturing the dental hygiene scholarly identity, and to participate fully in interdisciplinary research. Moreover, doctoral dental hygiene education will expand the profession's opportunity to engage in health care workforce discussions, the development of innovation in educational programs, and in general to help address the oral health challenges of our nation and elsewhere.²³

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CRITICAL ISSUES IN DENTAL HYGIENE

A Comprehensive Oral Preventive Care Protocol for Caring for the Renal Transplant Population

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Abstract

Purpose: Candidates and recipients of kidney transplants are at high risk for oral infections due to systemic co-morbidities, and disease and drug-induced immunosuppression. Developing oral infections while on the waiting list can jeopardize candidacy for receiving a kidney, and post-operatively increases the chance for organ rejection. Therefore, it is imperative to minimize oral disease risks in this population. A comprehensive, oral preventive care protocol is presented to guide dental professionals with patient management throughout the process of care. Proper dental and dental hygiene care can help to prevent oral infections, optimize oral health, and enhance overall health and quality of life for the renal transplant population.

Keywords: kidney transplant, oral care protocol, oral infections, process of care

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

INTRODUCTION

Currently, there are approximately 96,000 people in the U.S. waiting for a kidney transplant.¹ The waiting list is long because there are limited renal donors, and dialysis prolongs the lives of individuals with end stage renal disease (ESRD) allowing patients to wait a longer period of time before an organ becomes available. The waiting period for a kidney ranges from 5 to 10 years depending upon the state in which the transplant will take place. In spite of the odds, a renal transplant is the preferred treatment for patients with ESRD.^{2,3}

Patients with ESRD are at high risk for oral infections due to use of immunosuppressants and from complications related to comorbidities and/or from secondary developing medical conditions. These conditions include diabetes mellitus, hypertension, chronic glomerulonephritis, systemic lupus erythematosus, anemia and hyperparathyroidism, all of which may compromise both oral and overall health and longevity.^{1,4,5} Therefore, to provide safe, high-quality care to candidates and recipients of a kidney transplant, it is critical for dental and medical providers to be current in the best oral care practices for managing this population.³

A dental hygienist's knowledge and expertise in oral health can be beneficial to prepare, educate and support the oral health of the patient before, during and after transplantation, and to help ensure long-term organ success. A comprehensive, standardized oral care preventive protocol for use with renal transplant candidates and recipients was developed to guide dental professionals with decision-making throughout the process of care. Preventive care is essential to minimize and/or prevent oral infections, which may

decrease risk of organ rejection and enhance overall health and quality of life.

There are recommendations in the literature that can be used as guidelines to follow when treating kidney, and other transplant populations.^{2,3,6-10} However, these recommendations lack consistency, and currently, there is no comprehensive dental care protocol in place that focuses on prevention.^{2,3,11} Further, dental care protocols can vary across institutions, as well as within a given hospital center according to the type of organ being transplanted.^{2,3,9,12,13} Dental professionals will benefit from having a comprehensive oral care protocol that is specific to renal transplant patients that can be used as a guide to help optimize patient care outcomes.

Use of an oral care preventive protocol for this patient population also provides the foundation for a well-informed collaboration between dental and medical providers. Dental professionals will understand what information is needed from the medical team for use with treatment planning to ensure the safe provision of quality oral health care. Following a protocol also may help to reduce patient mismanagement due to lack of adequate knowledge, training and experience with treating this medically-complex population. More dental professionals will encounter patients who are either awaiting renal transplant or who have received a transplant due to end-stage renal disease associated with diabetes.

During the pre-transplantation period, it is recommended that dental professionals consult with the pa-

Table I: Pharmacological Considerations for Managing Patients With End-Stage Renal Failure^{4,5,14}

Drug	Type	Dosage Adjustment (End-stage renal failure – GFR <10 mL/min)	Range of Dosage
Analgesics/ Anti-inflammatory	Acetaminophen	GFR <10 mL/minute/1.73 m ² : Administer every 8 hours	325 to 650 mg
	Aspirin	Avoid	-
	Ibuprofen	Avoid	-
	Naproxen	Avoid	-
Anesthetics	Lidocaine (Xylocaine)	No adjustment required	N/A
	Mepivacaine	No adjustment required	N/A
Antimicrobials	Amoxicillin	Use with caution in patients with renal impairment; dosage adjustment recommended. In addition, use of certain dosage forms (eg, extended release 775 mg tablet and immediate release 875 mg tablet) should be avoided in patients with CrCl <30 mL/minute or in patients requiring hemodialysis.	250 to 500 mg
	Cephalexin	Administer every 12 to 24 hours (dialyzable 20%-50%); give dose after dialysis; if CrCl <10 mL/min, give 250 to 500 mg every 12 to 24 hours	250 to 500 mg
	Clindamycin	No adjustment required	N/A
	Azithromycin	Use with caution in patients with renal impairment (GFR <10 mL/min); administer 250 to 600 mg once daily or 1 to 2 g as a single use; no supplemental dosage required. In addition, use of 2 g as a single dose for the extended release suspension (Zmax)	250 to 600 mg or 1 to 2 g

tient's nephrologist prior to initiating any dental treatment to determine medical stability and the need for treatment modifications, such as antibiotic prophylaxis, corticosteroid supplementation and/or erythropoietin replacement therapy.^{2,3,5,6,8-10} Contraindications for use of dental-related medications that are metabolized and excreted by the kidneys should be addressed. These medications include, but are not limited to, anti-inflammatory drugs, analgesics and some opioids (Table I). In addition, renal function values should be obtained to determine the need for dosage adjustment for drugs used during dental procedures (Table II).^{2-5,8-10} Other relevant laboratory values needed to assess risk for infection and bleeding include complete blood cell count (CBC), absolute neutrophil count (ANC), and platelet count (Table II).^{2,4,8-10}

Oral health professionals should examine the patient to detect any signs of oral pathology, infection and acute and/or chronic inflammation. Any active dental disease should be eliminated, non-elective restorative and periodontal work should be completed, faulty dental appliances should be adjusted, and thorough oral hygiene education should be given to the patient to avoid possible infections.^{2,3,9} It is also important that

dental professionals maintain communication with the treating nephrologist and transplant team before and after the transplant procedure so that the patient's oral health can be properly monitored, as poor oral health increases risk for systemic complications.

Transplant recipients are placed on immunosuppressant therapy to prevent organ rejection. Patients are typically managed with a combination of multiple immunosuppressants, which may include cyclosporine, azathioprine, mycophenolate, tacrolimus and prednisone.^{2,3,6,14} These medications suppress the host immune system, producing a chronic inflammatory response to bacterial plaque biofilm. Gingival enlargement, though most commonly observed with cyclosporine, also has been shown to occur in patients taking tacrolimus.¹⁵

Oral candidiasis and herpes simplex virus are other common oral infections in recipients of renal transplants, especially immediately after transplantation, which can lead to systemic infections.^{2,3,6,12,16} In particular, Candida infections are linked to bloodstream, esophagus, and other organ infections. A previous study showed that prevalence of oral candidiasis in pa-

Table II: Laboratory Screening Tests for Dental Treatment Modifications for Renal Patients^{4,5,8,10,20}

Test	Normal Range	Abnormal Range Affecting Dental Treatment (End-stage renal failure)
Creatinine clearance	85 to 125 mL/min (women)	<10 mL/min (dialysis) requires drug dosing modification
	97 to 140 mL/min (men)	
Glomerular filtration rate (GFR)	100 to 150 mL	<10 mL/min (dialysis) requires drug dosing modification
Complete blood count (CBC) with differentials	White CBC: 4,400 to 1,000/mL	Leukopenia <4,000/mL When WBC count <2,000 cells/mL, increased risk of systemic infection: antibiotic prophylaxis is recommended.
	Platelet count: 150,000 to 450,000/ μ L	Significant bleeding risk when the platelet count <60,000/ μ L
	Absolute neutrophil count (ANC): 1,500 to 7,200 cells/mL	<1,500 cells/mL When ANC <500 cells/mL, increased risk of systemic infection: antibiotic prophylaxis is recommended.

tients with renal transplants ranged from 7.7 to 46.7% as compared to healthy controls.^{16,17}

Research supports a relationship between oral disease and malnutrition.¹⁸ Candidates for renal transplants should adhere to a restricted diet, which limits sodium and fluid intake. This diet can promote dry mouth and the resultant loss of natural antibacterial, antiviral and antifungal properties of saliva. The loss of protective salivary immunoglobulins increases risk for caries, gingival disease, herpetic lesions and fungal infections. Patients also may experience increased trauma due to the decreased amount of saliva lubricating the oral mucosa.^{2,3,19} A dental hygienist has expertise to guide treatment decisions and recommendations on various oral care products that can reduce oral disease risks and improve comfort and function.

The purpose of this short report is to disseminate a new comprehensive oral care protocol created to assist oral health professionals with proper assessment, management and maintenance steps that are essential to safely care for candidates for and recipients of a renal transplant. Dental hygiene actions associated with each phase of the process of care are illustrated in Figure 1, located at the end of this manuscript.

DISCUSSION

A comprehensive oral care preventive protocol identifies special considerations and provides clear guidance for tailoring a treatment plan for candidates for and recipients of a kidney transplant. Use of this protocol will help dental care providers to adequately address the complexity of diseases, oral conditions and medications that are commonly encountered in pre- and post-renal transplant. When these considerations are addressed for this population, oral infections that can jeopardize candidacy for and longevity of renal transplants can be minimized or prevented.

A comprehensive, oral care preventive protocol is now available to help guide decision-making throughout the process of care when treating the renal transplant population. Use of this evidence-based protocol supports best practices by dental professionals so that they can safely care for this growing medically-complex population. Optimizing oral health helps to ensure candidacy while awaiting renal transplant, decreases risk of organ rejection post-transplant, and enhances overall health and quality of life.

CONCLUSION

Collaboration between medical and dental care providers is critical while caring for candidates for and recipients of a kidney transplant. This oral care preventive protocol provides a framework that addresses special considerations pertaining to this specific transplant population. Dental professionals are encouraged to use this protocol as a checklist while caring for patients with end-stage renal disease and post-transplant. Further, dental professionals may use this protocol to initiate collaboration with medical providers, encourage discussion with the patient, and the planning and delivery of comprehensive oral care. Research is needed to assess the impact of use of this protocol on patient outcomes.

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Figure 1: Dental and Dental Hygiene Actions According To the Process of Care

Assessment	Special Considerations
Health Risks	
Identify and document medical diagnoses and status including comorbidities, stability and risk factors for medical complications	<ul style="list-style-type: none"> • Pre- and Post-Transplant: Determine level of risk for systemic complications due to pre-existing comorbidities and/or from secondary developing medical conditions (e.g. diabetes mellitus (DM), hypertension (HTN), congestive heart failure, chronic glomerulonephritis, systemic lupus erythematosus (SLE), polycystic disease, anemia, hyperparathyroidism)^{2-7,21} • Document the reason for renal failure • Post-Transplant: Higher incidence of viral infections due to immunosuppression (e.g. herpes simplex virus (HSV), cytomegalovirus (CMV), Epstein-Barr virus (EBV), hepatitis B and C (HBV and HCV), and human immunodeficiency virus (HIV))^{2,22} • Other side effects of immunosuppressive agents are major complications that cause higher susceptibility to bacterial and fungal infections, poor wound healing, excessive bleeding, Cushingoid reaction, Addison's reaction, tumors and osteoporosis^{4,14} • Note that anemia post-transplantation remains a concern for patients with chronic renal disease²³
List medications and their usage (match with patient's existing medical diagnoses and comorbidities)	<ul style="list-style-type: none"> • Pre- and Post-Transplant: Assess systemic/oral side effects of the medications • Post-Transplant: Cyclosporine, a common immunosuppressive agent used to prevent rejection of the transplanted organ may cause major changes in the kidney that can lead to hypertension, bleeding problems, and anemia³ • Use of prednisone can cause hypertension, diabetes mellitus, impaired healing, and increased risk for infection^{2,14,24} • Corticosteroid use and persistent hyperparathyroidism can be contributing factors for osteoporosis and bone loss²⁴
Identify type and frequency of dialysis	<ul style="list-style-type: none"> • Pre-Transplant: Recommend dental treatment one day after hemodialysis because of heparin use during treatment and potential complications with hemostasis⁴
Identify date of planned transplant surgery (if known)	<ul style="list-style-type: none"> • Pre-Transplant: Identify timeline to reach either acceptable or optimal oral health
Date of transplant surgery and type of kidney donor	<ul style="list-style-type: none"> • Post-Transplant: Document type of kidney patient received: deceased or living donor
Determine need for medical consultation with nephrologist and identify pertinent questions involving dental treatment <ul style="list-style-type: none"> • Need for antibiotic prophylaxis • Laboratory reports for renal function and other comorbidities • Dental Procedure: bleeding & bacteremia concerns • Medication considerations: anticoagulants, immunosuppressants, antihypertensives, oral hypoglycemics, diuretics • Contraindications to dental treatment • Systemic comorbidities that complicate/contraindicate dental treatment 	<ul style="list-style-type: none"> • Pre- and Post-Transplant: Consult the patient's nephrologist prior to initiating any dental treatment to determine medical stability and the need for precautions, such as antibiotic prophylaxis, corticosteroid supplementation and/or erythropoietin replacement therapy^{2,3,5,6,8,10,12} • Post-Transplant: Six months may be required before renal organ transplant recipients are deemed stable enough to receive dental treatment; therefore, no elective dental treatment should be performed during this timeframe unless it is a dental emergency^{2,6}

Figure 1: Dental and Dental Hygiene Actions According To the Process of Care (continued)

Review laboratory values to ensure that the patient is stable to treat (white blood cell count (WBC), absolute neutrophil count (ANC), platelet count)	<ul style="list-style-type: none"> • Pre- and Post-Transplant: Determine whether the patient has an adequate white cell count to prevent post-dental treatment infections. Assess risks for bleeding, including platelet count, to ensure that the patient can be managed safely during treatment. For guidance on treatable laboratory values, refer to Table II • Request recent/new laboratory values when planning to perform any invasive dental procedures • Post-Transplant: WBC, ANC, and platelet count should be done every 6 months during the first year post-transplant and annually thereafter^{2,23}
Determine the need for dosage adjustment of medications commonly used for dental pain management and treatment of oral infections	<ul style="list-style-type: none"> • Determine drug dosage adjustment required for medications used during dental procedures according to renal function values (glomerular filtration rate (GFR) and creatinine clearance) • Identify contraindications for use of commonly prescribed medications that are metabolized and excreted by the kidneys (some antibiotics, anti-inflammatory drugs, analgesics, and some opioids) • Refer to Table I
Assess psychosocial health	<ul style="list-style-type: none"> • Assess patient's risk behaviors: Alcohol, tobacco and/or recreational drug use • Assess presence of psychiatric conditions (e.g. anxiety, depression)
Identify risk factors for oral infections and oral complications	<ul style="list-style-type: none"> • Pre-Transplant: Determine level of risk for oral infections and oral complications due to medical condition, pre-existing comorbidities and/or from secondary developing medical conditions prior to renal transplantation (DM, HTN, chronic glomerulonephritis, SLE and other factors) and from medications (e.g. reduced salivary flow) • Post-Transplant: Note higher incidence of new onset DM, which is common in the first year post-transplantation²⁵ • Note higher incidence of oral manifestations due to side effects of over-immunosuppression, use of immunosuppressive agents and/or chronic rejection² • Note that any infection is a serious concern as it may lead to organ rejection • Immediately refer patient to treating nephrologist and/or dentist if oral complications are observed
Vital signs	
Ensure values are within treatable range	<ul style="list-style-type: none"> • According to recent evidence-based guidelines for the management of high blood pressure from JNC8, the blood pressure goal should be below 140/90 mmHg for patients with chronic kidney disease²⁶ • Blood pressure is considered uncontrolled when $\geq 180/110$ mmHg - elective dental care should be deferred and immediate referral for evaluation and treatment is recommended²⁷ • Pre-Transplant: As renal function decreases, likelihood of hypertension increases - monitor blood pressure before and during dental treatment due to high incidence of hypertension^{4,5} • Refer patient to treating nephrologist if blood pressure is elevated • Avoid taking blood pressure on arm where arteriovenous shunt is placed in patients receiving hemodialysis⁴ • Post-Transplant: Note that patients taking cyclosporine and prednisone can have elevated blood pressure²

Figure 1: Dental and Dental Hygiene Actions According To the Process of Care (continued)

Radiographic Examination	
Presence/absence of pathology	<ul style="list-style-type: none"> • Pre-Transplant: Monitor and assess the need to treat oral conditions that were apparent on previous radiographs and diagnosed prior to renal transplantation • Assess radiographs for osteodystrophy causing jaw bone alterations and demineralization and increasing risk for tooth mobility, giant cell lesions, and fracture (risk for fracture while performing dental treatment, especially extractions) • Assess narrowing of the pulp chamber in teeth as a side effect of impaired calcium and phosphate metabolism²² • Pediatric considerations: Assess for enamel hypoplasia, which may result from interference in calcium and phosphate metabolism and/or long-term corticosteroid use^{22,28}
Extra-oral and Intra-oral Head and Neck Examination	
Assess the patient for the following conditions:	
Bacterial, viral (herpes simplex) and fungal infections (candidiasis)	<ul style="list-style-type: none"> • Pre-Transplant: Identify and treat oral infections that can jeopardize candidacy for receiving a kidney should a donor become available¹² • Post-Transplant: Identify and treat oral infections that can jeopardize long-term success of renal transplant • Identify and treat oral conditions associated with over-immunosuppression, side effects of immunosuppressants and/or chronic rejection^{2-4,6,8,16,17,22}
Petechiae, gingival bleeding	<ul style="list-style-type: none"> • Pre- and Post-Transplant: Note high risk of excessive gingival bleeding due to thrombocytopenia, infection, medication usage and use of anticoagulants such as heparin^{2,4}
Reduced salivary flow	<ul style="list-style-type: none"> • Pre- and Post-Transplant: Note increased risk for caries, gingival disease, herpetic lesions and fungal infections due to loss of protective salivary immunoglobulins and lubrication • Assess patient for signs of oral discomfort and dryness associated with diminished salivary flow^{2,5,21,22,29}
Gingival hyperplasia	<ul style="list-style-type: none"> • Pre- and Post-Transplant: Assess presence of gingival hyperplasia associated with use of calcium channel blockers, poor oral hygiene • Post-Transplant: Assess presence of gingival hyperplasia associated with use of immunosuppressants such as cyclosporine^{3,10,22}
Ulcerations	<ul style="list-style-type: none"> • Pre- and Post-Transplant: Assess for presence of disease and/or drug-induced ulcerations
Uremic stomatitis	<ul style="list-style-type: none"> • Pre-Transplant: Assess mucosa for a red appearance that later can become ulcerative; patient may report burning sensation (Four types: erythemo-pultaceous, ulcerative, hemorrhagic and hyperkeratotic)^{8,22}
Red-orange discoloration of the cheeks and mucosa	<ul style="list-style-type: none"> • Pre-Transplant: Assess for carotene-like pigments that appears when renal filtration is decreased^{2,22}
Metallic taste	<ul style="list-style-type: none"> • Pre-Transplant: Ask patient about metallic taste associated with high concentrations of urea in the saliva^{5,8,22}
Pallor of the mucosa	<ul style="list-style-type: none"> • Pre-Transplant: Examine the mucosa for pale appearance due to anemia
Precancerous/cancerous lesions	<ul style="list-style-type: none"> • Post-Transplant: Note higher incidence of squamous cell lip carcinoma and Kaposi's sarcoma due to immunosuppression^{2,22}

Figure 1: Dental and Dental Hygiene Actions According To the Process of Care (continued)

Periodontal and Dental Examination	
Acute/chronic signs of infection or inflammation (e.g. periodontal or endodontic abscesses, dental caries, periodontitis)	<ul style="list-style-type: none"> • Pre-Transplant: Identify and treat oral infections that can jeopardize candidacy for receiving a kidney should a donor become available • Note high incidence of attachment loss due to poor oral hygiene, and dental calculus formation due to uremic status and duration of renal disease^{3,11,21,28} • Address any active acute/chronic oral infections prior to clearance for transplantation • Post-Transplantation: Address any active acute/chronic oral infections and inflammation as soon as possible due to systemic immunosuppression which can increase risk for kidney dysfunction¹⁰
Assess for dental erosion of lingual surfaces	<ul style="list-style-type: none"> • Pre-Transplant: Observe that enamel erosion is commonly associated with regurgitation and vomiting from high levels of uremia^{4,5,22}
Pediatric dental considerations	<ul style="list-style-type: none"> • Pre-Transplant: Red-brown discoloration can be observed on developing teeth as well as delayed tooth eruption • High levels of uremia decrease incidence of dental decay by minimizing end by-products of bacterial plaque, especially in children^{8,11,21,28}
Oral Hygiene Assessment	
<ul style="list-style-type: none"> • Assess oral hygiene status and risk factors for oral disease • Assess oral health knowledge and values • Assess physical and cognitive ability to maintain optimal oral health • Assess tobacco use and other habitual behaviors 	<ul style="list-style-type: none"> • Assess level of biofilm • Assess need for oral health education to promote knowledge and value for oral health in relation to systemic health status • Assess dexterity • Encourage cessation of tobacco use and other behaviors that are detrimental to oral and systemic health
Nutritional Assessment	
Assess nutritional status and indications for fluid restrictions	<ul style="list-style-type: none"> • Pre-Transplant: Note that dietary restrictions which limit sodium and fluid intake can promote dry mouth, and result in loss of natural antibacterial, antiviral, and antifungal properties of saliva^{3-5,8,22} • Consult with the patient's dietician about the impact of food choices on oral health status • Post-Transplant: Note fewer dietary restrictions in post-transplantation period

Figure 1: Dental and Dental Hygiene Actions According To the Process of Care (continued)

Planning	
Preventive Care Plan	
Develop a plan of prevention to minimize oral infections pre- and post-renal transplantation	<ul style="list-style-type: none"> • Caries: Determine the need for fluoride therapy, including type, strength and frequency of use based on risk factors for caries (xerostomia, diet, medications, other) • Systemic fluoride supplements are contraindicated in patients with chronic renal insufficiency and failure¹⁴ • Recommend xylitol containing products. Dosage frequency should be at least 2 times per day and not exceed 8 grams per day^{30,31} • High dosages of oral xylitol can cause gastrointestinal discomfort and/or diarrhea when exceeding 40 to 50 grams per day¹⁴ • There is insufficient evidence to support safety of use of remineralization products containing phosphate and calcium; caution is advised with use due to altered metabolism of these substances in patients with renal disease • Soft tissues: Prevent medication-induced complications that increase risk for infection; determine the benefits of using palliative agents to manage complications and discomfort associated with dry mouth and oral ulcerations • Salivary stimulants: Use of a sonic toothbrush may mechanically stimulate salivary flow in some users³² • Salivary Substitutes (moisturizing agents): Look for products that are alcohol-free, contain xylitol, contain carboxymethylcellulose or hydroxyethyl cellulose, such as oral mouthrinses, oral sprays, gels, lozenges or pastilles • Prevention of fungal infections: Twice daily use of antimicrobial mouthrinses with essential oils or 0.12% chlorhexidine gluconate show efficacy against fungal organisms and may be beneficial to reduce risk for fungal infections³³⁻³⁵ • Periodontal: Prevention of acute periodontal infections and management of chronic periodontal conditions can be achieved by reducing biofilm level through use of therapeutic antimicrobial mouthrinses and therapeutic dentifrices • Biofilm: Evaluate patient's manual dexterity and ability to remove dental biofilm effectively in his/her mouth; determining the patient's manual dexterity will enable the dental professional to recommend optimal oral hygiene aids for use with oral self-care • Mechanical: Review interdental and toothbrushing techniques for biofilm removal and recommend appropriate devices (interdental cleaning, irrigation devices, soft or extra-soft manual toothbrushes); evaluate benefits of using a power toothbrush; Remind the patient to replace toothbrush at least every 3 months or sooner if oral infection or sickness occurs (e.g. cold); recommend tongue cleaning • Chemical: Recommend use of antimicrobial mouthrinses (essential oils, cetylpyridinium chloride, 0.12% chlorhexidine gluconate) and/or a therapeutic dentifrice (triclosan, stannous fluoride) to reduce oral biofilm and to promote a healthy oral ecosystem^{2-4,19}
Treatment Planning	
Develop a patient-centered dental hygiene care plan <ul style="list-style-type: none"> • To treat existing oral infections/disease • To stabilize oral health during pre- and post-transplant stages 	<ul style="list-style-type: none"> • Care must be taken to understand the limitations of the patient's abilities, time and access to proper tools, given that the patient may be overburdened by medical and financial concerns, as well as the time demands of undergoing dialysis and medical treatment

Figure 1: Dental and Dental Hygiene Actions According To the Process of Care (continued)

Educate the patient about his/her systemic condition and the relationship to oral health	<ul style="list-style-type: none"> • Pre-Transplant: Discuss that early detection of oral complications and timely interventions are critical to reduce systemic threats that could jeopardize candidacy for transplant • Post-Transplant: Emphasize that infections are a serious concern due to risk for possible organ rejection
Set number of dental hygiene visits, sequencing and type of appointment, including time requirement for each visit (e.g. patient education, nonsurgical periodontal therapy, prophylaxis as needed)	-
Determine the need to refer to dental providers for care outside of the dental hygiene scope of practice (e.g. prescribing medications, sedation, restorative care)	<ul style="list-style-type: none"> • Refer to provide necessary restorations, eliminate endodontic infections, correct restorative/iatrogenic factors, and diagnose/treat oral lesions/infections
Share proposed dental hygiene treatment plan with the consulting nephrologist and other health providers who care for the patient	<ul style="list-style-type: none"> • Communicate current oral health status, presence of acute/chronic conditions, planned treatments for oral health conditions, time required to complete dental hygiene treatment, and planned preventive care to optimize and maintain oral health
Coordinate dental hygiene treatment according to medical recommendations made by the consulting nephrologist	<ul style="list-style-type: none"> • Postpone dental hygiene treatment when necessary due to systemic health status when advised to do so by the nephrologist
Review any changes to the dental hygiene and dental care plan with the patient and discuss any considerations for treatment modifications	<ul style="list-style-type: none"> • Manage pain and anxiety as part of a stress reduction protocol to minimize risk for medical emergencies (e.g. administration of local anesthetics, length and time of appointments, analgesics, sedation)
Propose dental hygiene treatment plan to the patient and obtain informed consent	<ul style="list-style-type: none"> • Informed Consent: Review procedures, alternatives to proposed treatment, identify and address risks, and answer all questions • Observe the patient for level of understanding of proposed preventive dental hygiene treatment plan • Should the patient find the preventive care plan overwhelming, discuss alternative care suggestions, and focus on developing a plan that will ensure long-term compliance
Implementation	
Review and implement tailored dental hygiene care plan to achieve a level of oral health that is acceptable for transplant candidacy and/or to prevent rejection of renal transplant <ul style="list-style-type: none"> • Treat acute/chronic oral infections/disease (prioritize treating acute oral infections/disease first) • Prevent oral infections/disease 	Engage the patient in strategies to help ensure compliance
Provide dental hygiene services according to the treatment plan	<ul style="list-style-type: none"> • Treat all oral infections quickly and to completion using appropriate interventions to reduce risk for systemic complications and to restore oral health • Treat acute infections first (e.g. abscess), followed by chronic infections (e.g. periodontal disease) • Emphasize the importance of minimizing high levels of biofilm accumulation to reduce degree of drug-induced gingival hyperplasia • Management of oral ulcerations: Topical OTC products with benzocaine help to reduce severity and pain of ulcerations; use 0.12% chlorhexidine gluconate mouthrinses or refer to dentist for prescription strength anesthetic and analgesic preparations¹⁹

Figure 1: Dental and Dental Hygiene Actions According To the Process of Care (continued)

Evaluation	
Evaluate response to dental hygiene treatment and the need for additional interventions	<ul style="list-style-type: none"> • Pre-Transplant: Evaluate attainment of an acceptable level of oral health to ensure candidacy for renal transplant • Evaluate patient's ability to maintain this status while on the wait list (determine maintenance interval) • Post-Transplant: Evaluate attainment of an acceptable level of oral health to minimize risks for oral infections that could lead to renal transplant failure
Assess the effectiveness of the oral care plan on improving the patient's health outcomes during routine dental hygiene appointments	<ul style="list-style-type: none"> • Assess patient compliance with recommended oral hygiene care • Assess for recurrence of oral infections and/or oral manifestations of medications or systemic conditions (status of oral health: dental, mucosal, periodontal)
Reassess any patient concerns with the oral care regimen and oral health goals/expectations	<ul style="list-style-type: none"> • Give positive feedback to encourage continued daily care
Emphasize importance of continuing daily self-care and maintaining frequent maintenance intervals (e.g. 3 months)	<ul style="list-style-type: none"> • Emphasize the importance of oral health to candidacy for organ transplant and to ensure organ transplant longevity
Documentation	
Record all communication with the patient and health care providers in the treatment record	<ul style="list-style-type: none"> • Document communication between all treating medical and dental providers and the patient to optimize patient care
Communicate issues of concern in writing with collaborating dental, medical and other health providers who care for the patient	
Document the patient's response to dental hygiene treatment and compliance with recommendations	
Record recommendations for future dental hygiene treatment modifications	
Place copies of pertinent laboratory test results in the dental hygiene treatment record	

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Low-Income Parents' Perceptions of Oral Health and Acceptance of Mid-level Dental Providers

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Abstract

Purpose: The purpose of this study was to explore low-income parents' perceptions of oral health and of mid-level dental providers as a means of improving access to care. As states increasingly consider adding mid-level providers to the dental workforce, understanding the views of potential patients toward such providers is important, since the success of this strategy will depend, in part, upon the willingness of potential patients to be treated by them.

Methods: Because little is known about the social acceptability of mid-level dental providers, the researchers employed a qualitative methodology, conducting in-depth interviews with 20 low-income parents in order to assess their perceptions of oral health, access to and need for dental care, and potential acceptance of mid-level dental providers. Interview transcripts were analyzed by a team of researchers using interpretive research methods.

Results: Respondents' descriptions of experiences with oral health and dental care demonstrate their strong desire to maintain their families' oral health, as well as their perception that they face significant barriers to receiving needed care. The vast majority of respondents expressed positive inclinations toward the introduction of mid-level dental providers, particularly once they understood that such providers would be fully trained professionals. Though in reality the cost to a patient would likely not vary, many respondents expressed increased interest in treatment by mid-level providers if it were less expensive than treatment by dentists, indicating the significant barrier that cost posed for many in the sample.

Conclusion: The low-income parents in this sample would likely seek care from mid-level dental providers if such providers were introduced in the U.S. The success of mid-level providers in meeting the needs of this population would potentially be even greater if public education clearly explained their training and professionalism.

Keywords: oral health, dental care, health services needs and demand, poverty, vulnerable populations

This study supports the NDHRA priority area, **Health Services Research:** Investigate how alternative models of dental hygiene care delivery can reduce health care inequities.

INTRODUCTION

Unmet oral health needs are a major public health problem in the U.S. More than one-third of American households report failing to access needed dental care in a given year because of cost, and dental problems are an increasing cause of emergency room visits.^{1,2} In addition, poor oral health has been linked to a number of other serious health conditions, including pneumonia, diabetes, cardiovascular disease, cancer and other chronic conditions.³⁻⁸ As is so often the case, those living in or near poverty are disproportionately impacted. In a landmark 2000 report, the Surgeon General observed "profound and consequential" oral health disparities in this country, and this remains largely the case today.⁹

In acknowledgment of this problem, public health advocates, along with policy makers at the federal

and state levels, are increasingly discussing new workforce strategies, including the addition of mid-level providers to the dental team.¹⁰⁻¹³ Currently employed in only 2 U.S. states (Alaska and Minnesota) and recently approved in a third (Maine), mid-level dental providers (often referred to as dental therapists) work in New Zealand, Australia, the Netherlands, the United Kingdom and Canada, with the main objective of improving access to care for underserved populations.¹⁴

Mid-level dental providers work under collaborative agreements with dentists and provide care within a limited scope of practice. In addition to the services included in the scope of practice of dental hygienists, mid-level dental providers can also perform routine extractions, and preparing, placing and carving restorations.¹⁴ Adding such providers

has the potential to increase the number of practitioners and promote cost-effective treatment by freeing dentists to concentrate on more complex cases, while mid-level providers handle simpler procedures.

As states continue to explore the possibility of adding mid-level providers to the dental team, it is important that the opinions and perceptions of those likely to utilize such providers, particularly those lacking the resources necessary to obtain adequate dental care, are adequately understood. Those opposed to introducing mid-level providers, including many state dental associations as well as the American Dental Association, often cite concerns that this would create a "two-tiered" system of care as one objection.¹⁵

To gauge likely users' acceptance of mid-level dental providers, a team of researchers conducted semi-structured interviews with 20 low-income individuals in southeastern Michigan, exploring their thoughts about dental care. Although the researchers were specifically interested in respondents' ideas about receiving care from mid-level providers, a variety of oral health-related subjects were discussed in hopes of developing a better understanding of how respondents perceived their need for and access to dental care, for themselves and their children, and what implications this might have for the future of mid-level dental providers in the U.S.

Although the issues surrounding access to and use of dental care are complex, most analysts believe that a key component is the inability of the dental workforce to meet the existing need.^{16,17} The U.S. currently has more than 4,500 federally designated dental health professional shortage areas, many of which are in rural areas but some of which are in more densely populated regions where an insufficient number of providers are available to serve needy populations.¹⁸ A recent survey of dental school seniors found that only 8.5% say they definitely plan to work in an underserved area.¹⁹

The high cost of dental care, even for those with insurance, has also been cited as a major factor in oral health disparities.²⁰ Low reimbursement rates and the perception of high administrative burden have resulted in the unwillingness of dentists to accept significant numbers of publicly insured patients, particularly adults.^{21,22} According to a 2010 Government Accounting Office report, in the majority of states for which statistics were available, fewer than half of the practicing dentists treated any Medicaid or State Children's Health Insurance Program patients.²³ As a result, Medicaid participants (and even some patients with private insurance) find it difficult to locate dental care providers and, when they do, dental procedures often require

out-of-pocket contributions that patients perceive as unaffordable.

Despite the lack of familiarity with mid-level dental providers in the U.S., and the skepticism of many U.S. dentists, evidence indicates that such practitioners provide safe care, that their clinical competence (within their limited scope of practice) is comparable to that of dentists and that they improve access to care.^{24,25} Like nurse practitioners and physician assistants in the early years of their practice, mid-level dental providers are not well understood by the general U.S. public, but if research related to mid-level medical providers is any indication, it is likely that patients will become more comfortable with such providers once they understand their role and experience their care.²⁶⁻²⁹

When the United Kingdom expanded the training and practice of dental therapists in 2002, it was estimated that 10 to 15% of adults were aware of dental therapists' existence, and virtually none knew their permitted duties.^{30,31} Once described, however, roughly 60% of study participants were comfortable with the idea of receiving restorations from therapists. This finding mimics the public's early attitude toward nurse practitioners.²⁹ Likewise, literature on patients' post-appointment satisfaction with mid-level dental providers, similar to earlier findings about mid-level medical providers, concludes that patients who have been treated by dental therapists are satisfied with the experience.³²⁻³⁴

Though previous research suggests that, for certain procedures, mid-level dental providers offer (or could offer) a safe and acceptable alternative to dentists, very little research has focused specifically on the views of potential patients.^{30,31} A 2011 survey conducted for the WK Kellogg Foundation did find that 78% of adult respondents in a nationally representative sample supported the idea of training a new "licensed dental practitioner" to provide "preventive, routine dental care to those who are going without care."³⁵ This report did not, however, assess respondents' perceptions of such providers or the factors used to determine whether or not to receive care from them. Better understanding how potential patients perceive their oral health needs, the care they currently receive and the possibility of receiving care from mid-level providers will enable oral health professionals and policy-makers to approach the potential introduction of mid-level providers in ways that reflect the interests of those most likely to be served.

The purpose of this study was to explore low-income parents' perceptions of oral health and of mid-level dental providers as a means of improving access to care. As states increasingly consider adding mid-level providers to the dental workforce, un-

derstanding the views of potential patients toward such providers is important, since the success of this strategy will depend, in part, upon the willingness of potential patients to be treated by them.

METHODS AND MATERIALS

Beginning with the understanding that low-income individuals face a variety of barriers to accessing health care in general, and oral health care in particular,^{1,18} the researchers sought to understand how people in such situations perceive not only their need for dental care but also their access to and desire for care from various provider options, including the potential future option of mid-level dental providers. Because a lack of research exists on which to base specific testable hypotheses, a qualitative approach was chosen, enabling the researchers to access respondent perceptions that may otherwise have been left out of a survey but that, from the respondents' perspective, are key components in how they think about dental care.³⁶

To gain this more nuanced perspective, the researchers conducted face-to-face interviews with low-income individuals, combining open-ended questions about respondents' oral health and dental care with more targeted discussion of mid-level dental providers. Drawing on interpretive methodologies in the interviews and analysis,³⁷ the research team sought to develop new insight into how low-income individuals' make sense of their experiences with dental care, with an eye toward the implications for innovations in policy and practice.

Participants

Respondents were initially recruited through a Head Start program, resulting in interviews with 6 low-income parents. Additional respondents (14) were contacted through snowball sampling. Each of the 20 respondents had at least 1 child under the age of 18 and was coping with what they considered to be "financial hardship." Because mid-level dental providers typically treat the underserved, a sample of low-income parents was particularly appropriate for this study. Detailed demographic information was provided for the study sample. In reporting results below, all respondents were assigned pseudonyms to protect confidentiality.

Data Collection and Analysis

The interviews for this study were conducted as part of a larger interpretive project focused on the help-seeking decisions of low-income families. This study was reviewed and approved by the University of Michigan Institutional Review Board. The larger project included 2 semi-structured, in-depth interviews with each of the 75 respondents, each of

whom fit the sample criteria described above (at least one child under age 18 and considering oneself to be going through "financial hardship").³⁸ The researchers used Holstein et al's active interview approach,³⁹ which is grounded in a constructionist ontology and an interpretive epistemology,⁴⁰ and accounts for the broader context of respondents' lives as well as that of the interview itself. Each interview lasted 1 to 2 hours.

In 20 of the 75 interviews, the interviewer included a discussion of oral health and dental care. This came toward the end of the first interview, after discussing respondents' financial circumstances, use of various public anti-poverty programs and broader life experiences. The portion of the interviews focused on dental care was guided by a series of questions developed by the research team. Members of this team have expertise in public health, mid-level dental providers, services for low-income families and interpretive research methods. In keeping with interpretive methodology, not all of the questions in the interview guide were asked (or asked in the same order) in every interview, since, as Atkinson points out, "if you come with pat questions and follow them precisely in the interview, the answers will very likely be pat and only skim the surface. You should know when to depart from what you had planned and enter into a free-flowing conversation that will capture even more of what the person wants to tell you."⁴¹

All interview respondents were asked about their previous and current use of dental care - for themselves and for their children - as well as experiences with, and reasons for, not seeking care when it was needed. After an open-ended discussion of these topics, the interviewer provided respondents with a brief oral description of a dually-trained mid-level dental provider. A typical description given was:

"In some other countries, they have a position called a mid-level dental provider [or dental therapist] who has all the training of a dental hygienist to do cleanings and stuff like that, plus more training so that they are also able to do things like fillings, crowns and pull teeth. They don't have all the training of a dentist though, so they are sort of between a dental hygienist and a dentist."

Respondents were also told that mid-level providers work under the supervision of dentists and that 2 states in the U.S. are currently trying out mid-level dental provider models.

The interviewer then asked respondents to share their thoughts about receiving care from such a provider, for themselves and for their children. The interviewer allowed respondents to articulate their perceptions in their own words, capturing the re-

spondents’ initial perceptions of mid-level dental providers based on a very limited understanding. Only after hearing respondents’ initial impressions did the interviewer correct any misperceptions. This approach enabled the researchers to assess how public education concerning their training and expertise might be shaped, were such providers to be introduced more widely.

Depending on the flow of the discussion, respondents were sometimes asked whether they thought they might be more inclined to obtain treatment from a mid-level dental provider if it cost less than seeing a dentist. In fact, in this country it is unlikely that the cost of treatment to a patient would vary by provider type, but prior literature does suggest that cost can be a mitigating factor in people’s comfort with new mid-level providers.^{27,29,31}

Interviews were audio-recorded and transcribed by a professional transcriber. The preliminary round of coding, which involved all members of the research team, consisted of reading through the transcribed interviews and discussing and extracting general themes. Transcripts were then uploaded into NVIVO 10 software (QSR International Pty Ltd., Melbourne, Australia), a qualitative data analysis program that assists with pattern-based coding and theme tracking. The software was used for secondary coding, revealing sub-themes as well as previously undiscovered themes. After reaching a theoretical saturation point in coding, one member of the team returned to individual transcripts to develop a better understanding of how the various themes related to one another within each individual’s narrative.

RESULTS

The comments of the 20 low-income parents in this study can be categorized into 3 broad themes: perceptions of their (and their children’s) oral health, experience with dental care and initial reactions to the idea of mid-level dental providers. Sub-themes to emerge included access to care (where dental care had been obtained and barriers to receiving care), anxiety about dental care, and, in addition to initial reactions about the idea of a mid-level dental provider, thoughts about the quality, training, and cost of such providers. Sample demographics can be found in Table I.

Perceptions of Oral Health

The vast majority of respondents indicated that they considered oral health to be very important. Many commented on the social importance of “good teeth,” and a number acknowledged feeling embarrassed about the appearance of their own mouths (Figure 1). When the subject of oral health and dental

Table I: Sample Demographics (n=20)

Characteristic	Category	Number of Respondents
Gender	Male	1
	Female	19
Race/ethnicity	Hispanic	1
	African American	6
	White	9
	Two or more races/ethnicities	4
Age	21 to 30	6
	31 to 40	6
	41 to 50	7
	51+	1
Number of children	1 to 2	10
	3 to 4	9
	5+	1
Marital status	Single (never married)	14
	Married	2
	Separated/divorced	4
Educational status	< High school	6
	High school diploma/GED	5
	Some college	6
	Associates degree	3
Monthly income	< \$500	4
	\$500 to 999	4
	\$1,000 to 1,999	8
	\$2,000 to 2,500	4

Figure 1: Representative Comments: Importance of Oral Health

When people look at your face, they’re attracted to your mouth, because you’re talking to them. Your smile is the first impression....It’s very important to take care of your teeth. (Tiffany)
Like, certain people I talk to, I just be like [mimes covering mouth so people can’t see teeth]. (Allen)
My teeth are really messed up, [but] you can’t tell, because I won’t open my mouth all the way. (Janet)

care was first raised, Amanda, a mother of 2, said that she made sure she and her children saw the dentist on a regular basis.

“No one in my family has teeth. My mom, her teeth are like falling out, and they’re like rotten and black, and my brother has the same issue...I never talk, we don’t talk about it.”

It is to this family history – and her desire to not

perpetuate it – that Amanda attributed her own focus on oral health: “I’m gonna have my teeth. It’s so important to me.”

Although 2 respondents expressed a lack of concern about oral health (because they did not consider themselves or their children to have any dental problems), most demonstrated a strong interest in maintaining their oral health and a desire to pass good dental habits on to their children. The oral health problems experienced by these parents could thus not be blamed on a failure to take oral health seriously or a lack of desire to receive treatment.

Experience with Dental Care

Although nearly half of the respondents described a time when they needed dental care but did not receive it, and only 8 reported having visited the dentist in the past year, all had previous experiences with dental care that shaped their perceptions of what such care ought to entail. These experiences included both care received and care that was needed or wanted but not obtained for one reason or another.

Access to Care

Every one of the respondents who had children living at home reported that their children saw a dentist regularly (Figure 2). Almost all of the children were covered by Medicaid (with the exception of one covered by private insurance and 2 by Michigan’s State Children’s Health Insurance Program), and their parents had been able to find dentists who accepted publicly insured children.

Though most respondents did not have trouble accessing dental care for their children, many described their own access to care very differently. For some, this meant not receiving care at all, and for others it meant receiving some, but not all, of the care they needed or wanted. Casey, for example, said:

“I went [to the dentist] two months ago. I went... to see what the Medicaid would cover, and basically... they would cover none of the things that I need done. So I just got a teeth cleaning, and that was it.”

Caroline reported similarly: “When I go to the dentist, I need stuff done that Medicaid won’t pay for.”

Some respondents, who either had no dental insurance, or were in need of care their insurance did not cover, were able to access dental care through free clinics (Figure 3). Others ended up at emergency rooms (one quarter of respondents said that they, or someone in their household, had visited an emergency room for a dental problem). Still others could not remember the last time they had seen a dentist. For one respondent in particular (Allen), this was not be-

Figure 2: Representative Comments: Children’s Dental Care

Since [my son] got older, I’ve been taking him right here [to a local dentist], and they’ve been cleaning his teeth and stuff like that. [My daughters] got a dentist that go to their school [Head Start], so that’s how they be getting their dental care. (Elsa)
My kids go to the dentist every six months . . . without fail, I make sure that they go. (Keandra)
Well my son, he has the Medicaid, so he’s covered and he’s been going to the same dentist for a while, so he’s good. (Casey)

Figure 3: Representative Comments: Use of Free Clinics

We went to [a local public clinic]. . . . That’s how we went to the dentist for a couple of years. It’s like you can go there, and if you have five bucks, you donate; if not, then you don’t pay anything. So that’s how I got my teeth cleaned for like the longest time. (Hannah)
I wouldn’t go to the dentist for years and years and years, and then somebody told me about [a local public clinic], and they offer free dental to uninsured adults within, if you meet the income guidelines. . . . So I have been a patient there for years and years now. (Liz)
I was going to the free dentist, which is at the [university] dentist school. (Jackie)

cause he thought his oral health was unimportant but, rather, because lacking any form of dental insurance, he perceived himself as having no access to care. Describing his situation, he said:

“I ate a piece of candy one year and lost my front tooth, and, I mean, I wish I could get it fixed, but I don’t have no dental care or nothing....I brush my teeth, but it’s like, when I brush them, my gums all bleed and stuff, you know? I wish I could see a dentist.”

Having recently suffered a heart attack and moved in with his sister and her 7 children while he recovered, Allen was likely to be at risk for further health problems, particularly considering the known link between oral infections and heart disease.⁵

In fact, although most respondents have found ways to access some form of oral health care, all described facing significant barriers to accessing what they perceive as adequate care. Of the 20 respondents, 12 had dental coverage through Medicaid and mentioned the limitations they faced when trying to access and afford care. As Priscilla explained: “The last dentist I did go see, I think he told me I needed a root canal or something. \$1,200. All I heard was \$1,200. I said, ‘Pull it out.’”

Even those with private insurance perceived the required out-of-pocket expenses as unaffordable. Amanda, who had dental coverage through her husband's employer, described a situation very similar to Priscilla's:

"[The dentist] wanted to do a root canal and a crown and all this stuff, and they're like, 'Even with your insurance coverage, it's gonna be \$1,000.' I'm like, 'Whoa, wait a minute. It's my very back tooth. Can we pull it?' They're like, 'Do you really want to pull it? It's still a good tooth.' 'Pull it. I can't afford \$1,000 on my mouth.'"

For some respondents, like Tiffany, matters of oral health often come down to a choice between receiving needed care or covering basic expenses:

"My filling fell out...and now there's like a hole in my tooth, and it hurts because the nerve is exposed. And I can't go to the dentist. Right now we're still trying to pay February's rent, and it's March."

Anxiety

For at least 7 respondents, the inability to pay for needed dental care was exacerbated by fear and anxiety about visiting the dentist. Georgia stated: "I'm afraid of the dentist. I'm afraid 'cause it done got so bad, it's going to be really painful." To avoid visiting the dentist, she takes over-the-counter pain medication to manage her failing oral health.

Others described visiting the dentist for some care, but still avoiding more extensive dental procedures because of fear or anxiety. Leslie reported:

"The dentist will come in and tell me I need fillings, like every single time, because I don't ever actually come back and get them. I've needed the same ones for a long time. I'm just scared to do it."

Finally, Elsa, who gets regular cleanings despite her admission that she cries every time, decided not to proceed with a necessary tooth extraction: "I'm really scared of getting some teeth pulled."

Reactions to the Idea of a Mid-level Dental Provider

The respondents in this study made it clear that they wanted dental care for themselves and their children. They wanted to maintain good oral health. In addition, the quality of the care they and their children received was also important to them. These parents expressed their strong desire to have care that was not only accessible and affordable but also professional and, for those with dental anxiety, even compassionate.

When told about the concept of a mid-level dental provider, the majority of the parents in the study were positively inclined toward them. Nearly all respondents (18 of 20) indicated that they would be likely to seek care from a mid-level provider should they be added to the dental team. A number drew comparisons between mid-level dental providers and nurse practitioners, with whom they were already familiar (and comfortable). Others, who had experienced difficulties accessing dental care in the past, were simply excited about the opportunity to be seen by any dental professional.

The 2 respondents who said they would not be comfortable being treated by a mid-level provider explained that this was, at least in part, due to their serious oral health issues, which they (accurately) perceived to be beyond the scope of a mid-level provider's training. Thus it was not necessarily a lack of trust in the quality of care mid-level professionals would provide but knowledge of their own dental needs that led to their decisions.

Among those who said they would seek care from a mid-level provider for themselves, a few did have hesitations about taking their children to one. Casey, for example, said she would be willing to receive care from a mid-level provider for herself but not for her son, saying: "I will make the sacrifice...but [for my son], I want him to get the best."

Quality of Care

Statements like Casey's, implying that it would be a sacrifice to be treated by a mid-level provider rather than a dentist, indicated an uncertainty about the quality of care mid-level providers might offer. In fact, assumptions about the quality of care, rather than the status or title of the provider, seemed to be the determining factor for many respondents. Several initially questioned the adequacy of mid-level providers' training, likening mid-level dental providers to dental students or, in the case of Leslie, "street dentists": "You're not really a dentist, but you're kind of a dentist. No. I don't like that." Once it was explained to her that a mid-level provider would be a fully trained professional (albeit with more limited training than a dentist) and would be working under a collaborative agreement with a dentist who could be reached if necessary, Leslie said that she would feel "fine" about receiving care from such a provider. Elsa, whose severe fear of the dentist resulted in her crying at every visit, went beyond this to say that what mattered most to her was "not really the person that does [the dental work]" but the patience and compassion that person was able to demonstrate.

Cost of Care

Because the primary concern of many respondents

was being able to afford the dental care they needed, they expressed even more interest in being treated by mid-level providers if these providers were to cost less than dentists. Under current U.S. policy, it is unlikely that out-of-pocket costs to patients would vary by treatment provider, but respondents' repeated reference to this issue deserves mention. Shelly, who originally stated that she would accept care from a mid-level dental provider for herself but not her children, quickly changed her mind when asked whether it would make a difference if the cost of seeing a mid-level provider was less than going to a dentist. Similarly, when Erin, who had immediately expressed comfort with the idea of mid-level providers, was asked if she would be even more likely to visit such providers if the cost were less, the reply was: "Oh hell yeah!"

DISCUSSION

The addition of mid-level providers to the dental workforce has the potential to improve access to care by both adding to the total number of practitioners and improving efficiency in the delivery of oral health care. The lower salary of a mid-level dental provider (roughly half that of a dentist) could allow safety-net clinics and dental offices to hire additional providers to perform routine procedures, leaving the more complex, but less common, procedures for the dentist.⁴² In addition, since the rate of reimbursement would be more in line with costs, these offices would be able to treat more Medicaid patients. Indeed, evidence from Minnesota suggests that the addition of mid-level providers leads to both of these results.⁴² Because mid-level dental providers are still relatively unknown, however, it is important to understand how potential patients might react to their care. The willingness of these individuals to be treated, or have their children treated, by a new provider has implications for the success of the strategy as a means of improving access to care.

It is clear that the low-income parents interviewed in this study cared about their oral health, but they also described many frustrating experiences trying to access or afford dental care. When the idea of a mid-level dental provider was proposed, they were positively inclined toward such a possibility. In fact, the rate of acceptance among respondents was at least as high, if not higher, than has been reported in previous studies regarding the early social acceptability of nurse practitioners, physician assistants and dental therapists in the United Kingdom. This might be because of their familiarity with mid-level medical providers and/or a reflection of the high perceived need for dental care among this particular sample.

Among the minority of parents who indicated reticence toward the idea of a mid-level dental provider,

most were comfortable with the idea of seeing one themselves but not with taking their children to one. This could be due to the fact that most seemed to have little problem accessing care for their children, while obtaining needed care for themselves was much more difficult. This finding is in line with the prior literature,³⁰ though also ironic, since in many countries where dental therapists are employed, their primary focus is on treating children, whose oral health needs typically fall squarely within the scope of practice of mid-level providers.

Although respondents expressed mainly positive views about mid-level dental providers, their interest in obtaining high quality care caused some to hesitate. As noted above, research has found that mid-level dental providers offer safe care and that their clinical competence (within their scope of training) is comparable to that of dentists, indicating that the actual quality of care offered by such providers is less of an issue for their future success than the perceived quality of care.^{14,24} None of the respondents in this study explicitly mentioned concerns about the type of two-tiered dental care that dentists often describe in their objections to the introduction of mid-level providers. Many did, however, express confusion about the training and professionalism of such providers, leaving open the possibility that they perceived mid-level providers as second-tier. This came across most clearly in Leslie's reference to "street dentists," but it was also a concern raised by others who compared mid-level providers to dental students. Keandra, for example, who was one of only 2 respondents who said that they would absolutely not accept dental care from a mid-level provider, based her opinion, in part, on previous negative experiences receiving care at a dental school:

"It was a bad experience, so, no, I don't want to do that. I'd rather just go to the dentist where I know it's going to be taken care of the first time."

Part of the confusion may have arisen from the interviewer's use of the term "supervision" to describe the relationship between mid-level dental providers and the dentists with whom they have collaborative agreements. Perhaps because many respondents had experience receiving care from dental school clinics, they associated the word "supervision" with practitioners who were still in the process of being trained. When told that a mid-level dental provider would always work "under the supervision" of a dentist, Jackie, for example, immediately responded: "I wonder if that's what the students are? I don't know if that's the name that they used." In fact, mid-level dental providers are professional practitioners who have completed their training and are licensed, unlike dental students who are still being educated. That several respondents did not recognize this distinction – and that their opinions about receiving care

from mid-level providers appeared to be impacted by this misperception – demonstrates the need for conscious public education, particularly among low-income adults and other likely patients, if mid-level providers are to be successfully integrated into the U.S. dental workforce.

As has been noted above, cost was mentioned by many respondents as a barrier to receiving needed dental care. Since the prior literature had identified cost as a potential mitigating factor for individuals who were apprehensive about new mid-level providers,^{29,31} the interviewer sometimes queried along these lines to better understand how the feelings of respondents in this study compared to those reported in the literature, and to understand what might make these parents more or less hesitant about receiving treatment from a new mid-level provider. In practice, it is unlikely that patients would face a different cost of care based solely on what type of provider delivered that care. The fact that several respondents indicated that their willingness to utilize a mid-level dental provider might be impacted by the perceived lower cost of doing so, serves to highlight the importance placed on receiving needed dental care.

Conversations with the low-income parents in this study suggest other possible benefits associated with the introduction of mid-level dental providers. Dental anxiety was mentioned by several respondents as an additional barrier to obtaining dental care. Existing literature supports this, as those with dental anxiety have been found to go to the dentist less often than those without such fear and too often delay or avoid needed care and have poor oral health outcomes.⁴³⁻⁴⁷ It is possible that the reverse may also be true: those who are unable to access timely care may develop more serious dental problems, which may lead to more fear and anxiety about treatment. Research also suggests that patients tend to experience higher levels of dental anxiety for treatment by dentists than for treatment by dental hygienists, in part because they find dental hygienists easier to talk to and more patient.^{48,49} This suggests that mid-level dental providers, whose training tends to emphasize skills that lead to rapport-building, might also be better able to meet the needs of patients with dental anxiety. A hallmark of the Alaskan DHAT program, for example, is that the mid-level providers come from the communities in which they work, which has had positive results with respect to dental fear among Alaska Natives.⁵⁰

The fact that the emergency room was mentioned as a source of dental care by a number of respondents points to another potential benefit of the addition of mid-level dental providers. It is well recognized that non-traumatic oral health issues are an increasing reason for hospital emergency department visits.^{2,51,52} The emergency room is not a sat-

isfactory source of care, however, since it is often limited to treatment for pain and infection, leaving underlying problems unaddressed.⁵³ Improving access to routine dental care would allow earlier and better preventive treatment, which in turn should result in the need for fewer expensive procedures and extractions in the future.

It is known that patients who receive treatment from mid-level providers (medical or dental) are, for the most part, satisfied with the experience. What has not been known previously is how potential patients in the U.S., particularly low-income adults who currently face barriers to accessing dental care, perceive the idea of mid-level providers in dentistry. Prior studies on the attitudes of the public toward nurse practitioners, physician assistants and dental therapists in the United Kingdom suggest that, before new mid-level providers became well known, skepticism and misconceptions were common. Despite this lack of knowledge, however, the public has generally been positively inclined toward the introduction of such providers.

Drawing on their experiences receiving (and not receiving) dental care in the past, the respondents in this study shed light not only on the need for increased and expanded dental care options in the U.S., but also on the ways in which new options might best be introduced. In light of their experiences and perceptions, it seems unlikely that these respondents would view the introduction of mid-level dental providers as creating a second tier of care if adequate public education explained the training and professionalism of such providers. The comments offered by respondents highlight the aspects of mid-level dental care provision that are most appealing and most concerning to potential patients, giving public health officials and policy advocates critical information for designing campaigns to introduce these new dental providers at a time when increased access to dental care is desperately needed.

Limitations and Recommendations

Based on the size and characteristics of the sample, as well as the interpretive methodology employed, it is not possible to generalize the findings of this study to the broader population of low-income parents in the U.S. It is, however, recommended that researchers draw on the depth of knowledge provided by this sample in developing future studies related to the acceptability of mid-level dental providers. Because the findings reported here are based on a sample of 20 individuals in a single geographic region, it is specifically recommended that future studies expand on our results in two ways.

First, additional interpretive studies should be conducted in other parts of the country, with a particular

focus on dental health professional shortage areas. It is possible that the views and experiences of the 20 individuals in this sample are shaped, at least in part, by the resources present (and absent) in their particular location. Individuals and families living in rural areas of the country, for example, may have very different experiences of accessing dental care than those living in or near a major city, and these experiences may shape their willingness to accept care from mid-level providers. Conducting research similar to that described here in multiple locations has the potential to provide support for the current findings and/or to add new insights on the topics in question.

Second, larger scale quantitative research should be conducted in order to determine the level of acceptability of mid-level dental providers among a representative sample of low-income adults. Drawing on the findings presented here, such research should include survey questions that address not only respondents' likelihood of accepting care from mid-level providers but also their ideas about the qualifications of these providers. Surveys should also gather information about respondents' current access to and experiences with dental care, as our findings suggest that these factors play a role in how low-income parents think about mid-level providers.

CONCLUSION

Based on their responses to the questions asked in this interpretive research study, the low-income parents in this sample would likely seek care from mid-level dental providers if such providers were introduced in the U.S. The success of mid-level providers in meeting the needs of this population would potentially be even greater if public education clearly explained their training and professionalism.

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DISCLOSURE

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Interventions for the Reduction of Dental Anxiety and Corresponding Behavioral Deficits in Children with Autism Spectrum Disorder

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Abstract

Purpose: Autism Spectrum Disorder (ASD) can greatly inhibit a child's communication and social interaction skills, impacting their comfort during dental hygiene treatment and services. Children with ASD may exhibit sensory sensitivities, fear of the unfamiliar and lack of socio-cognitive understanding, leading to anxiety and corresponding behavioral deficits. Since the prevalence rates for ASD have risen significantly in the past decade, increased emphasis has been placed on educational and behavior guidance techniques, which can be helpful for children with ASD because of their increased capabilities in visual-processing. The purpose of this literature review is to summarize the interventions available to reduce dental anxiety in children with ASD, and to determine which strategies are best suited for implementation by the dental hygienist. Advancements in technology and socio-behavioral interventions were assessed for appropriate use, efficacy and engagement in the target population. Interventions were categorized into the following groups: picture cards, video technologies and mobile applications.

Keywords: children, autism spectrum disorder, interventions, oral health, dental hygiene, anxiety, behavioral deficits

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

INTRODUCTION

Autism spectrum disorder (ASD) is the diagnostic term for a complex, heterogeneous, neurodevelopmental disorder, which manifests most commonly as difficulty with social communication and in the occurrence of behaviors that are atypical in appearance, frequency and/or magnitude.¹ A diagnosis of ASD is typically made before age 3, when caregivers begin to notice unusual behaviors or delayed development in the areas of social communication and social interaction. For example, the child may not respond to the caregivers' presence, voice or touch, seem disinterested in social interactions with peer groups, exhibit delays in speech and communication, and engage in repetitive body movements or avoidance behavior.^{2,3}

According to the Autism and Developmental Disabilities Monitoring Network, the prevalence of ASD in 8 year old children has risen from approximately 1 in 150 in the year 2000, to 1 in 68 in the year 2010.^{2,4} A prevalence rate of 2.00% (1 in 50) was calculated for children ages 6 to 17 in the years 2011 to 2012, as compared to 1.16% (1 in 86) from the year 2007.⁵ For unknown reasons, the disorder is almost 5 times more likely to occur in males than females; however, no link can be found between prevalence rates and factors such as race, ethnicity or socioeconomic status.⁵

Symptoms of the disorder vary considerably in each individual. Although a child diagnosed with ASD will have deficits in social communication and behaviors, those with mild ASD may have strong cognitive abilities that foster the learning of appropriate replacement skills in these deficit areas. As a result, children with mild ASD may only demonstrate impairments in social skills and interpersonal relationships. Conversely, a child with a more severe form of ASD may demonstrate significant speech impediment, unusual or repetitive behaviors, perceived indifference toward others, emotional outbursts, and hypersensitivity to new stimuli.⁶ The range in symptoms makes it difficult to predict how each child will be affected; therefore, individualized educational and/or behavioral interventions are often necessary to help the child function effectively and comfortably with others, especially in novel settings.⁷

A dental hygiene appointment can be especially difficult for children with ASD since the child is in an unfamiliar environment, surrounded by new people and things. Approximately 40% of children diagnosed with ASD receive a comorbid diagnosis of anxiety disorders, which can exacerbate deficits in communication and socialization while increasing inappropriate behaviors such as self-stimulation, self-

Table I: Adverse Effects and Complications Associated with Sedative Drugs and General Anesthesia for the General Population, and Complications of Physical Restraint for People with Intellectual Disabilities¹³⁻¹⁶

Adverse Effects of Drugs and Drug Interactions	Complications of General Anesthesia	Complications of Medical Restraint
<ul style="list-style-type: none"> • Xerostomia (Dry Mouth) • Sialorrhea (Drooling) • Dysphagia (Difficulty Swallowing) • Stomatitis (Mouth Inflammation) • Glossitis (Swollen Tongue) • Bruxism (Clenching or Grinding of Teeth) • Pain • Headache • Sinusitis 	<ul style="list-style-type: none"> • Heart Attack • Stroke • Allergic Reaction • Temporary Mental Confusion • Lung Infection • Damaged Vocal Cords • Waking During Anesthesia (Rare) • Death (Rare) 	<ul style="list-style-type: none"> • Psychological Trauma • Physical Trauma • Scratches • Abrasions • Bruises • Strangulation (Rare) • Asphyxiation (Rare) • Nerve Damage (Rare)

injury and tantruming.⁸ Furthermore, anxiety may be increased by the inability of the child to effectively communicate fears and/or reservations experienced at the thought of undergoing dental treatment. There are foreign sights, smells and sounds that a child must absorb and process during a short period of time, such as hand pieces, suction, bright lights and personal touch, all of which are stimuli that can exaggerate sensitivities and make the child feel uncomfortable. During this process, a child with ASD can easily become overwhelmed on all sensory levels: visual, auditory, tactile, olfactory and gustatory.^{9,10} Sensory overload is associated with negative reactions in children with ASD and can lead to aggression, self-injurious behavior, emotional outbursts, attempts to block the stimuli, or physical and social withdrawal.^{7,9,11,12} This behavior makes conducting dental hygiene treatment extremely difficult, prompting some dental professionals to consider sedation, physical restraint or referral to a pediatric specialist who may also employ these techniques. Though sometimes necessary, neither sedation nor restraint are absolutely safe and effective. Pharmacological sedation is considered highly controversial due to high cost and associated health risks, while medical restraint can cause psychological and physical trauma in people with intellectual disabilities (Table I).¹²⁻¹⁷

There are options for reducing dental anxiety, such as social and communication training, which do not carry the same medical risks as sedation and restraint. Advancements in special education and behavioral guidance have allowed children with ASD to achieve comfort and relaxation, resulting in more cooperative behaviors during situations known to induce anxiety or stress.^{7,18} A thorough understanding of associated symptoms, hypersensitivity reactions, behavioral response, treatment options and intervention strategies could allow dental hygienists to interact more effectively with children with ASD.

The primary focus question for this literature review was: what interventions are available to reduce dental anxiety in children with ASD? A secondary focus question was: which are the best interventions for use by the dental hygienist to help children with ASD receiving dental hygiene services? There were 38 scholarly journal articles collected that were applicable for this review. The inclusion criteria consisted of the following: published between January 2000 and April 2014, published in peer-reviewed journals, primary sources (including intervention studies, case reports, randomized controlled trials and surveys), publications of a medical or government organization (such as Centers for Disease Control and Prevention (CDC) or National Institutes of Health (NIH)), written in English, full text available, related to topic, and applicable to focus questions.

Picture Cards

By far, the most studied intervention for children with ASD is use of the Picture Exchange Communication System (PECS). PECS uses cards featuring a simple picture paired with its associated word, phrase or sentence and includes 6 phases of training: how to communicate, distance and persistence, picture discrimination, sentence structure, answering questions, and commenting.¹⁹ Children are taught to choose the appropriate card to express their wants, needs or feelings and present the card to a “communicative partner” as an alternative form of expression. The ASD population is ideal for training with PECS due to the disorder’s characteristic developmental delays in language and social skills, including lack of eye gaze. Children with ASD may begin speaking much later than their typically-developing peers, may use a vocabulary of fewer or more simple words, or may be completely nonverbal. Not only does PECS allow the child to learn a larger and more complex vocabulary while associating those words with pictures and ideas, it requires the child to physically present the card to others, thereby initiating

Figure 1: Example of a Social Cue Card Series for a Student Who Frequently Throws Tantrums When Asked To Get Off the Computer¹⁸



social interaction between the child and the communicative partner.¹⁹

Studies using picture cards, such as PECS, as the sole intervention demonstrated increases in verbal speech, spontaneous communication and social-communicative behaviors, and a decrease in problem behaviors.²⁰⁻²³ The study by Gordon et al is of particular importance because it utilized 84 participants from 15 schools in a randomized controlled trial of PECS, which is rare when conducting research on children with ASD.²³ Due to varying degrees of symptom severity, diverse presentation of deficits, difficulty matching controls and the heterogeneous nature of the population, limited sample sizes are common. Similarly, 2 studies utilized social cue cards to resolve unfavorable conduct, practice acceptable verbal and physical communication, and maintain targeted social skills in children with ASD.^{20,24} The social cue cards show a simple picture paired with an age-appropriate social story, which are attached together in sequence and read to the child in a step-by-step fashion (Figure 1). The use of social stories in general is a popular behavioral intervention for children with ASD.²⁵ Social stories are read prior to a specific social situation, and are not used to elicit a specific change in behavior, but to facilitate the understanding of social situations and the perspectives of other individuals in the setting.²⁶ When utilized together, social stories and social cue cards help to mediate problem behavior by ensuring the student is aware of appropriate responses expected during a given situation.

Another method for decreasing inappropriate behaviors in children with ASD is to teach the child to appropriately express anxiety. The use of functional communication training, where a child is taught a communication skill to replace a behavior (e.g. raise hand to ask for a break instead of hitting), is one of the most effective methods for decreasing inappropriate behaviors.²⁷ Studies which implemented functional communication training with picture cards demonstrated that the presence of the cards during social situations improved the subject's ability to interact effectively with others, and the use of functional communication training facilitated the learning of picture card systems.^{28,29} In Danov et al, the pri-

mary targeted behavior was self-injury, and results revealed a significant decrease in self-injurious behavior (SIB) after intervention with functional communication training and picture cards.²⁸ The child began utilizing the cards to communicate a want or need for desired objects instead of SIB. Similarly, in Hines et al, the subject displayed more of the desirable "appropriately engaged" behaviors and less disruptive behaviors after intervention with functional communication training and picture cards.²⁹ When the picture cards were unavailable, the child reverted to problematic behaviors such as disruptive vocalizations, refusal to participate and lying on the floor, which demonstrates the importance of having the cards present and accessible once they are learned (Table II).²⁹

Video Technology

The literature suggests electronic screen media is an ideal educational tool for children with ASD because this population tends to favor visual stimulation.^{30,31} A survey of caregivers indicated children with ASD show more interest in watching television and video than using the computer, and a predilection for animated programming versus non-animated.³¹ Additionally, children with ASD most often engaged in verbal and physical imitation while viewing electronic screen media.³¹ Given the preference for animation, children with ASD may be more attentive to video modeling techniques featuring an animated character whose actions can be easily followed and imitated.³¹

Studies incorporating a component for both picture cards and video technology support the use of video technology for children with ASD.^{18,32} In one such study, instructional video clips were created and implemented to teach the selection and retrieval of picture cards to express requests.³² Video technology was utilized in this case because children with ASD often do not attend to their surroundings, including people, and therefore do not readily obtain new skills through observation of their environment or behavioral models.³³ Video technology is known to attract the attention of children with ASD and can be easily adapted to present the desired content. However, the study found the ability to pay attention to

Table II: Summary of the Current Literature on Picture Card Interventions for Children with ASD

Author(s)	Study Design	Participant Diagnoses	Number of Participants	Age (years)	Intervention(s)	Outcome
Gordon, McElduff, Wade, Pasco, Howlin, Charman (2011)	Randomized controlled trial, group	ASD	84	4 to 10	PECS	Enhanced spontaneous communication for instrumental requesting using pictures and/or speech
Quirnbach, Lincoln, Feinberg-Gizzo, Ingersoll, Andrews (2008)	Randomized controlled trial, group	ASD	45	7 to 14	Social stories	Effective in eliciting, generalizing, and maintaining targeted social skills
Caballero, Connell (2010)	Multiple baseline across participants	Autistic Disorder or PDD-NOS	3	4 to 5	Social cue cards	Increased specific social communication skills; Improved rates of target behaviors; Appropriate defending-self behaviors
Charlop, Malmberg, Berquist (2008)	Multiple baseline	ASD	3	5 to 9	PECS	Ancillary decreases in problem behaviors; higher percentages of responding
Charlop-Christy, Carpenter, Le, LeBlanc, Kellet (2002)	Multiple baseline across participants	ASD	3	3 to 12	PECS	Increased speech and social-communicative behaviors; decreased problem behaviors
Son, Sigafoos, O'Reilly, Lancioni (2006)	Case series	ASD	3	3 to 5	Picture exchange (PE) system vs. voice output communication aid (VOCA)	No significant difference in acquisition rates between picture cards and VOCA; both are viable augmentative and alternative communication (AAC) interventions
Boesch, Wendt, Subramanian, Hsu (2013)	Multiple baseline across participants, alternating treatments	Severe ASD	3	6 to 10	PECS vs. SGD	No significant differences between PECS and SGD; Phase II (PECS) encourages most social-communicative behavior
van der Meer, Kagohara, Roche, et al. (2013)	Case series, alternating treatments	ASD	2	10 to 11	Manual signing, PE, and speech-generating device (SGD)	All interventions effective at teaching target behaviors; child's preference for AAC option not conducive to proficiency in using it
Hines, Simonson (2008)	Single subject, alternating treatments	ASD	1	3	Functional communication training and PECS	Presence of PECS associated with more desirable, less disruptive, and more appropriately engaged behaviors
Danov, Hartman, McComas, Symons (2010)	Case report	ASD	1	3	Functional Communication Training and PECS	Use of PECS with Functional Communication Training eliminated self-injurious behavior during requesting
Vaz (2013)	Survey	ASD and Learning Disabled (LD)	50 (health professionals)	N/A	N/A	Health professionals agree: using symbols in clinics and sending visual symbols home before appointments improves children's understanding and cooperation

Table III: Summary of the Current Literature on Video Technology Interventions for Children with ASD

Author(s)	Study Design	Participant Diagnoses	Number of Participants	Age (years)	Intervention(s)	Outcome
Isong, Rao, Holifield, et al. (2014)	Randomized controlled trial	ASD	80	7 to 17	Video peer modeling (DVD) vs. video goggles with favorite movie vs. both	Electronic screen media technology effective for reducing dental fear and uncooperative behaviors
Mineo, Ziegler, Gill, Salkin (2008)	Randomized controlled trial	ASD	42	6 to 17	Animated video vs. video of self vs. video of familiar person engaged in virtual reality vs. self-immersion in virtual reality	All stimuli held student attention reasonably well; portrayal of self on-screen generates greater gaze duration; virtual reality conditions garner more vocalizations than traditional video
Strickland, McAllister, Coles, Osborne (2007)	Case series; single subject changing criterion	ASD and fetal alcohol spectrum disorders (FASD)	16 (ASD); 32 (FASD)	3 to 9	Headset-based virtual reality hardware system, personal computer (PC)-based program	virtual reality programs proved effective for teaching new skills in the virtual space; most children able to generalize learned actions to real-world
Orellana, Martinez-Sanchis, Silvestre (2013)	Prospective quasi-experimental	ASD	38 (children); 34 (adults)	4 to 9 (children); 19 to 41 (adults)	Multiple behavioral techniques including audio-visual modeling	Effective in facilitating a full dental assessment by increasing compliance; Majority of sample able to complete intra-oral exam with mirror and probe
Odluyurt (2013)	Adaptive alternating treatments	ASD	21	7 to 13	Direct modeling vs. video modeling	No significant differences between interventions in terms of efficiency variable
Self, Scudder, Weheba, Crumrine (2007)	Randomized controlled trial	ASD	8	6 to 12	Virtual reality vs. integrated/visual treatment model	Both groups learned targeted safety skills; virtual reality group learned skills in considerably less time

the screen for approximately 10 to 26 seconds (full length of the video clips) was a necessary prerequisite to successful intervention.³² If the child lacked the ability to fully attend to the presented message, he or she was unlikely to learn content through video modeling.³² Orellana et al used both pictures and videos in a training program to achieve a complete dental examination in children with ASD.¹⁸ The video showed a model patient executing the “10 steps” of an oral assessment, which included entering the room, lying back in the chair and pressing the teeth together in occlusion. The majority of children (81.6%) participating in the program successfully accomplished cooperative behavior (e.g. remain sitting still, legs stretched out, mouth open) during an intraoral examination with mirror and probe, showing great potential for similar exercises conducted by dental hygienists.¹⁸

Advancements in virtual reality technology over the past decade have contributed to exploration of educational virtual reality interventions for children with ASD. Two separate studies using virtual reality simulations to teach safety skills found students learned the material more quickly when immersed in virtual reality.^{34,35} Students aged 6 to 12 learned proper fire drill behavior during a simulated building tour, and were able to generalize this training in a real-life fire drill in the school setting.³⁴ The research noted that children with ASD were able to effectively implement their virtual reality safety training in similar real-life scenarios at a rate of over 50%.³⁵ While these results appear promising, it is unclear if virtual reality could be effective for use by the dental hygienist due to the slower-paced and less physically involved nature of dental hygiene treatment. More research on virtual reality training in the dental hy-

Table III: Summary of the Current Literature on Video Technology Interventions for Children with ASD (continued)

Author(s)	Study Design	Participant Diagnoses	Number of Participants	Age (years)	Intervention(s)	Outcome
Keen, Branigan, Cuskelly (2007)	Multiple baseline across participants	ASD	5	4 to 6	Animated video modeling, operant conditioning strategies	Acquisition of urinary control facilitated by animated toileting video in conjunction with operant conditioning strategies
Bereznak, Ayres, Mechling, Alexander (2012)	Multiple probe across behaviors	ASD	3	15 to 18	Video self-prompting	Increased performance of target behaviors, increased percent of steps performed independently; Students able to teach themselves new skills
Plavnick (2012)	Multiphase changing criterion	ASD	1	4	Video modeling	The ability to attend to a video screen is an important prerequisite to learning through video modeling interventions
Jowett, Moore, Anderson (2012)	Single subject, multiple baseline across numerals	ASD	1	5	Treatment package including video modeling	Video modeling, when used in a package, is effective for teaching numeracy skills
Shane, Albert (2008)	Survey	ASD	89 (caregivers surveyed)	N/A	N/A	More time spent engaged with electronic screen media than any other leisure activity; preference for TV, movies, animation; Imitation likely after engagement with electronic screen media

giene setting is needed to confirm efficacy for children with ASD.

When considering the overall engagement of virtual reality technologies, there may be a potential for anxiety reduction through mere distraction. A study comparing video technology (animated versus self-immersed) and virtual reality simulations (familiar person versus self-immersed) found all 4 strategies were able to hold the attention of 6 to 18-year-olds with ASD.³⁶ While the self-immersed video and self-immersed virtual reality conditions achieved the longest gaze durations, virtual reality simulations in general garnered more vocalizations than traditional video viewing.³⁶ Thus virtual reality programs, which can be utilized for distraction and relaxation during dental hygiene services, are a suitable intervention for children with ASD (Table III).

Mobile Applications

The popularity of mobile devices with high-speed internet connectivity has contributed to increased

use of standard and downloadable applications. One advantage of mobile devices is convenience of use - the portability of handheld technology allows the user access to his or her applications almost anywhere and anytime. This is particularly valuable when educating children with ASD, who benefit from repetition of content when learning new skills and information. For example, if socio-communicative interventions learned in the classroom are encouraged outside of the school setting, they are more likely to be retained for later use in social situations.^{37,38}

Mintz et al developed an application for smartphones to support social skills and life skills via a flexible software design.³⁷ Key benefits of the software include using the teacher's or caregiver's picture and voice with instructions, use of a rewarding video with the appropriate action or response, and the ability to track logged time and achievements.³⁷ The program is designed to enhance social skills by encouraging calm, rational behavior in situations likely to induce high levels of anxiety, and by prompting consideration of others' perspectives during everyday discus-

sion and interaction. Mixed reviews prompted critical evaluation of the application's components. Consequently, a second prototype was created using the same foundations of the original application with a redesigned graphical user interface.³⁸ The technical adjustments allowed the program to have a more stable internet connection and user-friendly interface, providing further support for case-specific intervention via smartphone application (Figures 2, 3).³⁸

Picaa is a mobile learning platform created for elementary school children with ASD, and is based on the iPad and iPod touch devices.³⁹ The program provides flexibility of content, exchange of content between professionals, mobility between multiple devices, and a built-in accelerometer that responds to rotations or movements of the device.³⁹ The capability for personalization and adaptation of the educational content is necessary to focus the intervention for a specific learning deficit. The Picaa application provides templates that educators can use to create individualized lesson plans and learning exercises for each student.³⁹ The researchers observed a significant increase in scores for all 5 skill categories: language, math, environmental awareness, autonomy and social skills.³⁹ The significant difference in scores confirms Picaa platform's potential as a tool for developing educational skills in children with special needs.

Additionally, studies utilizing computer and smartphone applications demonstrated improvement in literacy skills, engagement, on-task behavior and the ability to maintain a set schedule in children with ASD.^{40,41} For example, a case study describing the use of Microsoft PowerPoint as an educational intervention was used to train a child with ASD how to research favorite topics and create non-fiction texts. The project helped the child enhance his literacy skills by increasing interest, engagement and attitude regarding reading.⁴¹ Overall, the customizable and multifaceted nature of mobile applications makes them appropriate and convenient for use in most situations and settings; therefore, they are a viable option for helping children with ASD cope with receiving dental hygiene care (Table IV).

DISCUSSION

Research testing the effects of picture cards, video technology and mobile applications has shown great potential for helping children with ASD access dental hygiene treatment.^{18,37,38} However, due to the heterogeneous nature of this community, it is very difficult to find a "one-size-fits all" intervention to decrease stress and anxiety, and increase comfort, cooperation and learning. Dental hygienists treating children with ASD should be knowledgeable in the above mentioned interventions and work with care-

Figure 2: The HANDS Server Based Teacher Set Up Function Showing Creation of Step-By-Step Sequence^{34,35}

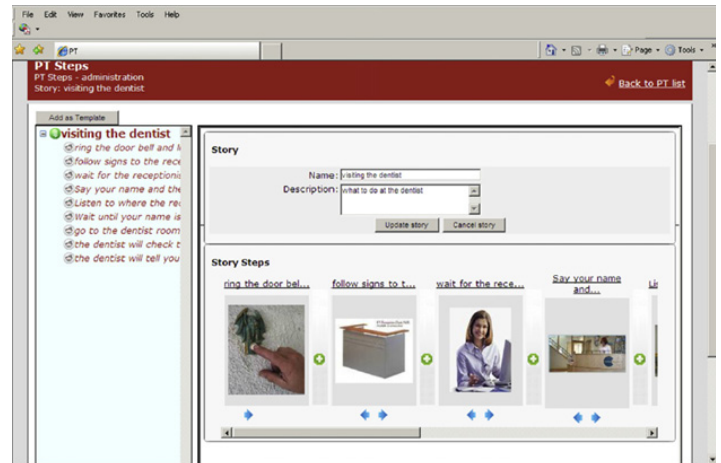
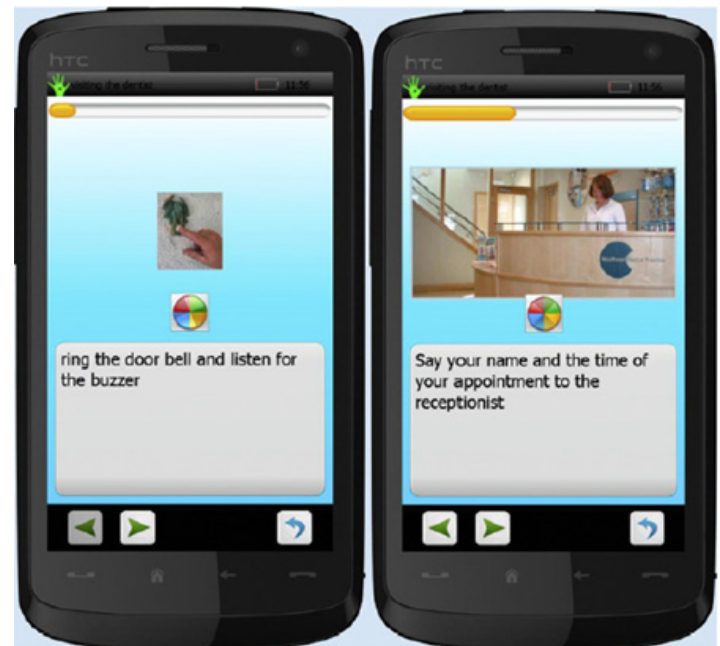


Figure 3: The HANDS Smartphone Client Application^{34,35}



givers well in advance of the first physical visit to become acclimated with the child's behaviors, sensitivities and symptom severity. Many resources are available to prepare for children with ASD undergoing dental hygiene treatment to include continuing education courses, online resources and local autism support groups or special education professionals.

It is helpful to inquire which learning tools are already used at the child's home or school to coincide with the child's learning preferences. For example, mobile applications can provide an appropriate and fun tool for children with a mild form of ASD, who may be high-functioning with an exceptional ability to navigate various forms of technology.³⁷⁻⁴¹ Mobile applications are convenient for use in the waiting

Table IV: Summary of the Current Literature on Mobile Application Interventions for Children with ASD

Author(s)	Study Design	Participant Diagnoses	Number of Participants	Age (years)	Intervention(s)	Outcome
Fernandez-Lopez, Rodriguez-Fortiz, Rodriguez-Almendros, Martinez-Segura (2013)	Pre-experimental	Students with special education needs (46% ASD)	39	4 to 20	Mobile learning platform on iPod and iPad devices	Increased scores in language, math, environmental awareness, autonomy and social skills
Mintz, Branch, March, Lerman (2012)	Direct observation, interviewing, questionnaire	ASD	27	11 to 16	Cognitive support application for smartphones, 1st prototype	Potential to make a difference in social and life skills development
Mintz (2013)	Direct observation, interviewing, questionnaire	ASD	16	11 to 16	Cognitive support application for smartphones, 2nd prototype	Increased potential to make a difference in social and life skills development
Carlile, Reeve, Reeve, DeBar (2013)	Multiple probe across participants	ASD	4	8 to 12	Individualized picture activity schedules for iPod touch	All participants learned to independently follow leisure activity schedules, increased on-task behavior
Oakley, Howitt, Garwood, Durack (2013)	Case series	ASD	2	5 to 8	Multiple iPad applications: digital flashcards, introduction and practice with letters, Microsoft PowerPoint, digital comic books	Effective in improving the participating child's literacy achievement and engagement

area or treatment rooms, especially for children who already use a tablet or mobile phone.

To increase verbal or non-verbal communication, the dental hygienist can incorporate a picture card or video prompting system.^{20-24,28,29,32,33} Picture cards and video prompting are often the best option for children with a more severe form of ASD, who may be dependent on caregivers for activities requiring fine motor skills. Additionally, video and virtual reality technology can be used to familiarize children with the dental hygiene process and as a distraction technique during the appointment.³⁰⁻³⁶

Video modeling can be beneficial prior to and during dental hygiene treatment if the child watches a video and imitates the on-screen actions, such as an animated character that demonstrates how to "lay back in the chair," "put your feet out straight and hands on your stomach," and "open your mouth to show your teeth," thereby teaching the child ideal

patient positioning. Both picture cards and video technology offer a do-it-yourself option, as the cards, social stories and short video clips can be made at home or in office. Other interventions, such as mobile applications and virtual reality systems, may be more costly with fewer options available on the consumer market. More interventions utilizing electronic screen media technology need to be developed and made available to help dental professionals provide treatment for children with ASD.

CONCLUSION

A lack of social awareness, fear of the unknown, and sensory sensitivities can make dental hygiene treatment very difficult for children with ASD. While sedation and restraint techniques have been used in the past, socio-communicative and behavioral training are the preferred methods for reducing dental anxiety. Incorporating educational and behavior guidance techniques prior to and during the dental

hygiene appointment can help providers achieve a more successful outcome of care. Early familiarization may prevent the child from feeling so overwhelmed in an environment with multiple forms of new stimuli. When children with ASD have gained initial trust in the dental hygiene environment, subsequent appointments will most likely be less traumatic. Improving oral care experiences and opportunities for this unique population directly translates into increased access to care and oral health-related quality of life.

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Oral Care for Pregnant Patients: A Survey of Dental Hygienists' Knowledge, Attitudes and Practice

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Abstract

Purpose: The purpose of this study was to examine the knowledge, attitude and practice behaviors of dental hygienists' providing oral health care to pregnant women.

Methods: Data was collected from an anonymous electronic survey administered to all Michigan Dental Hygiene Association (MDHA) members (n=1,047). The survey asked questions which assessed dental hygienists knowledge, behaviors and attitudes when providing oral care to pregnant patients. Statistical analysis was conducted correlating years in practice and years since dental hygiene degree with survey questions to identify any correlations.

Results: The response rate was 14.4% (n=150). Results indicated that regardless of years of experience, or level of degree, the majority of the respondents surveyed (64%) desired more education about caring for a pregnant patient. Ninety percent of respondents reported willingness to provide care for pregnant women, and 85% indicated they or their employers agreed to accept referrals to treat pregnant women. Respondents' knowledge indicated the following treatments could be provided throughout pregnancy: Prophylaxis (95.8%), emergency care (92.7%), periodontal treatment (76.3%) and restorative care (61.5%). One question, "dental hygiene services should only be provided during the second trimester," was written in the negative, with a disagree rate of 85.6% indicated a high level of knowledge about this topic.

Conclusion: Dental hygienists are in a position to use current findings, protocols and practice guidelines to provide preventive oral health care and advocate for the pregnant patient. This study found continuing education regarding oral health care and pregnancy was desired by many dental hygienists.

Keywords: dental hygienist, guidelines, infant mortality, knowledge, low birth weight, oral health, periodontitis, pregnancy, prenatal care, preterm birth

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

The high rate of infant mortality in the U.S. is a public health crisis.¹ Infant mortality, defined as the number of infant deaths before age 1 per 1,000 live births, is an indicator of national health due to its association with maternal health, quality and access to medical care, socioeconomic status, and public health practices.^{1,2} The U.S. ranks 26th in infant mortality among other developed countries.^{1,2} The chief causes of infant mortality in this country are low-birth-weight (weight below 2,500 g or 5 lbs. 8 oz.) and pre-term births (birth before 37 weeks gestational age), which account for over 39% of infant mortality.^{1,2} In recent years, research placed emphasis on the link between poor oral health of pregnant women and premature or low birth weight babies.³⁻⁵ Studies concerning adverse pregnancy outcomes associated with periodontal disease found that dental treatment during pregnancy is safe.^{4,6-11}

There have been many efforts during the past decade to move pregnant patients and health care providers toward a better understanding of the importance

and safety of oral health care prior to, during and after pregnancy.¹²⁻¹⁵ Dental hygienists are well-positioned to provide oral care and offer pregnancy oral health information, as well as facilitate referrals to other health care providers. Many states, including Michigan, are currently developing perinatal oral health care guidelines with specific goals in mind. Goals include reducing the infant mortality rate, ensuring a healthy start for babies at the outset of their life and providing access to care, through improving the oral health of the mother.^{13,15} In addition, a panel of multidisciplinary experts with the New York State Department of Health developed the 2006 Oral Health Care During Pregnancy and Early Childhood: Evidence-Based Guidelines for Health Professionals to improve oral health care during pregnancy.¹² The oral health guidelines were intended to educate health care providers and patients on the effectiveness and safety of dental care during pregnancy. The guidelines suggest dental exams and periodontal care are encouraged at any time during pregnancy.¹²

Background

In 2009, Cruz et al reported periodontal disease was recognized as the second most prevalent oral disease worldwide.⁸ A significant association found in the study linked maternal periodontal disease and low birth weight babies.⁸ In 2008, a meta-analysis was published on the topic of maternal periodontal disease, poor pregnancy and neonatal outcomes. This report reviewed several clinical trials and compared birth outcomes of pregnant women who received periodontal disease treatment during pregnancy with a control group of pregnant women whose periodontal disease was treated post-partum. The report concluded treating periodontitis with standard therapies (scaling and root planing) during pregnancy was safe.⁹ Even though dental care during pregnancy has been shown to be safe and can prevent long-term health problems for both mother and child, an overwhelming number of women do not seek dental care during pregnancy.^{9,16,17} Several studies have demonstrated a need for pregnant women to receive preventive dental care and oral health education during pregnancy to enhance early health of their child.^{4,7,9,18} In addition, studies have demonstrated a major hurdle for pregnant patients to receive oral care lies in the health care provider's basic understanding of how essential oral health contributes to the overall health of the mother, and the developing fetus.^{7,9}

During pregnancy, health care providers of various disciplines work concurrently to support the health care needs and well-being of the woman and her developing fetus. Among those health care providers are: general medical doctors/physicians, obstetricians, midwives, advanced practical nurses, nurse practitioners, dentists and dental hygienists. Over the last decade many health care professionals shared their knowledge and attitudes regarding the importance of oral health during pregnancy. A 2012 study explored the current knowledge, attitudes and behaviors of dental and prenatal care practitioners about oral health care during pregnancy.¹⁹ Noteworthy, only 50% of general practitioners (medical doctors and physicians) advised their pregnant patients to seek a periodontal checkup as part of their prenatal care, even though 81% were aware of the increased risk associated with gingival inflammation during pregnancy.¹⁹ Fifty-four percent of the general practitioners indicated they were aware that poor oral health could affect pregnancy outcomes.¹⁹ Many (68%) believed that dental procedures such as scaling and root planing were unsafe treatments during pregnancy and advised patients to delay dental treatment until after the birth.^{19,20} Bell found health care providers received little oral health education and therefore reported low confidence levels in knowledge of oral health during pregnancy.⁶ These attitudes, knowledge and practices are in contrast to current recommendations and highlight a lack of awareness on this topic.^{12,14}

Obstetricians' knowledge of oral health and birth out-

comes were reported in a random sample survey of U.S. obstetricians. Sixty-four percent reported the need for dental care during pregnancy, yet 49% included an oral health evaluation in their plan of care.¹¹ The majority of the obstetricians surveyed agreed that it was safe for pregnant patients to complete preventive care treatments such as prophylaxis, restorative treatments for active carious lesions and treatment for abscess drainage. Conversely, obstetricians debated the safety regarding radiographs, periodontal surgery, amalgam placement and narcotic use.¹¹

Occasionally, pregnant women received care though an office midwife or nurse practitioner versus the physician. Both professions are positioned to educate women on the need for oral care during pregnancy. A 2012 report stated midwives had limited knowledge of oral health care during pregnancy, were not informed of poor oral health impact on birth outcomes, and only discussed oral health when initiated by the pregnant patient.¹⁹ Similarly, advanced practical nurses and nurse practitioners responded with little knowledge of oral health effects on pregnancy and birth outcomes when surveyed.¹⁷ Research indicated that the traditional education of advanced practical nurses and nurse practitioners did not include providing an oral health examination during routine visits, and they needed more information about periodontal disease and its impact on adverse pregnancy outcomes.¹⁷ Twenty percent of the surveyed NPs indicated that oral examinations are the responsibility of the dental professional.¹⁷

In 2009, a study reported most dentists have favorable attitudes toward pregnancy specific counseling and agreed preventive dental treatment should be a part of prenatal care.^{3,11} Of those surveyed, 91% agreed dental treatment was an important aspect of prenatal care. However, the study also reported dentists were still reluctant or uncomfortable treating pregnant patients even though it has been shown safe. Several studies have reported that dentists are uncertain about the safety of dental procedures and stress their hesitancy to treat women during pregnancy.^{3,11,19} Dentists and dental hygienists were asked the same questions regarding knowledge, attitudes and practice of oral health and birth outcomes in a 2012 study. Misinformation was found among dental personnel regarding the safety and efficacy of dental care during pregnancy.²¹

George et al reported dentists have a high level of knowledge regarding adverse effects of poor oral health on pregnancy; however, many reported treatment practices taught in dental school included delay of treatment until after delivery.^{19,22} Several studies reported lack of time for proper counseling, legal risks associated with negative birth outcomes and limited knowledge of dentists about the safety of procedures as reasons for lack of dental treatment by dental professionals during pregnancy.^{3,11,19,22}

The dental hygienist is an oral health care professional well versed in preventive measures and advocates for healthy lifestyles in addition to providing safe and effective dental hygiene services. A research study completed in 2012 surveyed the dental hygienist's knowledge and attitudes regarding oral-systemic connections.⁶ In a 2012 study that surveyed dental hygienists' knowledge over oral-systemic connections, less than half of the dental hygienists surveyed reported having a strong opinion regarding evidence that links periodontal disease to pregnancy outcomes.⁶

The dental hygienist is in a prime position to educate and advocate, therefore it is important to investigate the knowledge of dental hygienists when treating pregnant women. The purpose of this research was to survey dental hygienists' knowledge, attitude and practice behaviors providing oral health care to pregnant women.

METHODS AND MATERIALS

A convenient sample of Michigan dental hygienists was surveyed to explore their knowledge, attitudes and practice behaviors while providing care for pregnant patients. Data were collected through electronic surveys to answer the following questions:

1. What is the knowledge level reported by dental hygienists who provided care to pregnant patients?
2. What are the attitudes of dental hygienists who provided care for pregnant patients?
3. What are the practice behaviors of dental hygienists who provided care to pregnant patients?

The study utilized an anonymous electronic survey administered via Survey Monkey to all Michigan Dental Hygiene Association (MDHA) members (n=1,047). The MDHA email list provided electronic addresses to disseminate the invitation, survey and informed consent. This study received approval from the Institutional Review Board of the University of Texas Health Science Center San Antonio. Survey participants were given 2 weeks to complete the survey, with 2 follow-up emails to encourage participation.

Original survey questions were distributed to Michigan dentists for a study to evaluate dentists' knowledge of oral health care during pregnancy; the results were analyzed by the Michigan Department of Community Health. Subsequently, questions were modified for dental hygienists to gather similar data regarding knowledge, attitudes and practice behaviors when providing oral care to pregnant patients. The survey included participant demographics and Likert-scale questions which captured the dental hygienists knowledge, attitudes and practice behaviors. Likert rating scales were anchored as follows: 1=strongly disagree, 2=disagree, 3=agree, 4=strongly agree. Generally, items were worded such that higher ratings reflected more positive evaluations and lower ratings reflected more negative evaluations of instructional qualities and outcomes.

Data were collected online via Survey Monkey and imported into SAS 9.4 for Windows. Statistical analysis included: Descriptive statistics, Spearman's Rho correlations, analysis of variance and chi square contingency tables. When Spearman correlations were given, the ordered survey responses were coded numerically and the numbers were correlated. For some tables, strongly agree and agree were collapsed to agree, and strongly disagree and disagree were condensed to disagree. Significance was taken at $p < 0.05$ for all analyses.

RESULTS

Demographics

A 14.4% response rate (n=150) was attained. The majority of the respondents were white (98.7%) and female (98.0%). The most frequent age group was 55 to 64 (31%). Education levels reported were: entry-level associate degrees (41.6%), baccalaureate degree (39.6%) and graduate level degree (18.8%). The number of years practicing ranged from 0 to 48 and averaged 21.0 years.

Knowledge

Knowledge regarding oral care during pregnancy is represented in Table I. Respondents' knowledge indicated that the following treatments could be provided throughout pregnancy: prophylaxis (95.8%), emergency care (92.7%), periodontal treatment (76.3%) and restorative care (61.5%). One question, "dental hygiene services should only be provided during the second trimester," was written in the negative; a disagree rate of 85.6% indicated a high level of knowledge about this topic. Respondents agreed there was an association between poor dental care and adverse pregnancy outcomes (95.9%) and obstetric complications associated with poor oral health (91.6%).

Higher Degree

Knowledge about providing dental hygiene services outside of the second trimester was positively associated with dental hygienists who had a higher degree completed ($r=0.25$, $p=0.0354$), as was the knowledge about restorative care being provided throughout pregnancy ($r=0.27$, $p=0.0117$). Also associated with higher degree completed was the knowledge that periodontal treatment (scaling and root planing) could be safely provided throughout pregnancy ($r=0.22$, $p=0.0371$).

Years Since Degree

There was a statistical difference between knowledge dental hygienists demonstrated regarding restorative care being provided during pregnancy related to years since degree completion. In the group of respondents who were less than 5 years post degree completion, 18% believed that restorative care

Table I: Dental Hygienists' Knowledge, Attitudes and Behaviors Toward Treating Pregnant Patients

Knowledge (presented in order of Dental Hygiene importance)	Agree	Disagree
^Pregnant women can safely receive routine prophylaxis care throughout pregnancy (n=96)	95.8%	4.2%
^Pregnant women can safely receive periodontal care (scaling/root planing) throughout all stages of pregnancy (n=97)	76.3%	23.7%
^Pregnant women can safely receive dental radiographs throughout pregnancy all stages of pregnancy (n=97)	49.5%	50.5%
*^Dental hygiene services should only be provided to pregnant women during the second trimester (n=97)	14.4%	85.6%
^Emergency care can be provided to pregnant women throughout all stages of pregnancy (n=97)	92.8%	7.2%
^Restorative dental care can be provided to pregnant women throughout all stages of pregnancy (n=96)	61.4%	38.6%
^There is an association between poor dental care and adverse pregnancy outcomes (n=96)	95.8%	4.2%
^The presence of active periodontitis has been associated with low birth weight and premature births (n=96)	95.9%	4.1%
^The presence of active periodontitis during pregnancy may increase the risk of developing preeclampsia (n=96)	90.2%	9.8%
^Obstetric complications are associated with poor oral health (n=95)	91.6%	8.4%
Attitudes and behaviors	Agree	Disagree
I consider oral health care to be an important part of prenatal care (n=96)	100%	0%
Prenatal care should include a dental screening (n=97)	100%	0%
I am trained to treat pregnant women throughout pregnancy (n=97)	93.8%	6.2%
*I have liability concerns when treating pregnant women (n=95)	14.7%	85.3%
*I do not feel comfortable treating pregnant women (n=97)	6.2%	93.8%
*I prefer not to treat women during pregnancy (n=97)	3.1%	96.9%

*Negatively worded item

^Supported by New York State Guidelines 2006 and 2012 Oral Healthcare during pregnancy consensus statement

could be completed throughout pregnancy. Similarly, 48% of respondents in the group who were more than 21 years since their degree completion believed the same ($p=0.0480$). Those who knew restorative dental care could be provided throughout pregnancy averaged 24.4 years in practice while others averaged 18.9 years ($p=0.0175$). Respondents were evenly split on whether pregnant women could safely receive dental radiographs, although the knowledge about the safety of dental radiographs was also positively associated with years since degree ($r=0.26$, $p=0.0215$).

Attitudes

New education and inter-professional collaboration regarding oral health and pregnancy was favored by 64% and 74% of respondents, respectively (Table II). Regardless of years in practice ($p=0.7124$), level of degree ($p=0.6365$) or years since degree ($p=0.6933$), the majority of respondents (64%) desired more education about caring for a pregnant patient. Table II displays attitudes toward obtaining and receiving the most current education. Delivery responses varied from continuing education to 1-day workshops.

Table I displays dental hygienists' attitudes and practice behaviors about treating pregnant patients. All respondents agreed oral health care was an important part of prenatal care and prenatal care should include a dental screening. The majority of respondents were trained, comfortable and had no aversion to treating pregnant women. Most items in Table I show significant ($p<0.01$) evidence that the respondents responses were consistent with the 2006 New York State Perinatal Guidelines and the 2012 Oral Health Care National Consensus Statement.^{12,14}

However, respondents differed from the above guidelines, regarding the safety of radiographs - only 50.5% of the respondents agreed radiographs throughout pregnancy were safe.

Behaviors

Ninety percent of respondents reported willingness to provide care for pregnant women, and 85% indicated they or their employers agreed to accept referrals to treat pregnant women. Table III shows the differences between the percentages of respondents provid-

Table II: Dental Hygienists Attitudes Towards Obtaining and Receiving New Education

	Yes	No	Not at this time, maybe in the future	Other
Obtaining new education:				
Are you interested in receiving additional information to enhance your knowledge of treating pregnant patients? (n=132)	63.6%	11.4%	20.5%	4.6%
Are you interested in attending intra professional collaboration activities such as professional networking, CE course, meetings etc. with women's healthcare providers in your community? (n=132)	74.2%	3.0%	20.5%	2.3%
Receiving new education:				
I would attend a CE course focused on current best practices regarding prenatal oral health care (n=116)	83.6%	16.4%	-	-
I would attend a one day workshop or seminar focused on current best practices regarding prenatal oral healthcare (n=116)	37.9%	62.1%	-	-
I would prefer to read information/research articles on current best practices regarding prenatal oral health care (n=116)	53.5%	46.5%	-	-
Other (Email/Web articles/Hands on experience) (n=116)	8.6%	91.4%	-	-

Table III: Dental Hygienists Behaviors Regarding Care and Referral From Prenatal Health Care Providers

	Yes	No	Unsure
Are you willing to provide care to pregnant women? (n=136)	90.4%	2.9%	6.7%
Are you or your employer willing to accept referrals from a prenatal health care provider to treat pregnant women? (n=133)	85.0%	2.3%	12.8%
Do you or your primary employer accept pregnant women with Medicaid insurance that are referred from a prenatal health care provider? (n=127)	30.0%	70.0%	0%
Do you or your employer collaborate or engage in professional discussions with referring prenatal care providers regarding care for pregnant patients? (n=133)	27.1%	45.1%	27.8%
Do you or your employer have professional referral arrangements established with prenatal care providers to provide dental care for their pregnant patients? (n=132)	11.4%	69.7%	18.9%

ing care and accepting referrals for pregnant women. Although dental hygienists and employers were willing to treat pregnant patients (90.4%), those who accepted Medicaid patients were much lower (30%). When asked about established referral arrangements with prenatal care providers, the majority of dental hygienists (69.7%) reported no arrangement was in place, 11.4 % responded yes and 18.4% were unaware of an arrangement.

Respondents who had more years in practice reported having established referral arrangements for pregnant patients between prenatal care providers and oral care providers ($p=0.0027$). There was a significant difference ($p=0.0027$) in years of practice between respondents reporting established referral arrangements (28.2 years), those reporting no arrangements (21.9 years) and those unsure (13.3 years). It was also reported that as a dental hygienist's degree level increases, so does the referral acceptance rate ($p=0.0111$).

DISCUSSION

Michigan dental hygienists demonstrated positive knowledge, attitudes and behaviors regarding oral care provided throughout pregnancy. All respondents regarded oral health care an important part of prenatal care and believed oral exams should be included with prenatal preventive care. In general, higher degree level and greater years of experience resulted in higher agreement with guidelines developed in the 2006 New York Perinatal Oral Care Guidelines and the 2012 Oral Health Care National Consensus Statement.^{12,14}

The majority of respondents agreed upon the association between poor oral health care and adverse pregnancy outcomes. They were also knowledgeable about the links between active periodontitis, low birth weight and pre-mature birth. These findings, although more positive than previous studies, are consistent with the earlier reports found in the literature.¹¹ When

compared to low birth weight and pre-mature birth, the current study revealed some skepticism regarding the correlation of the presence of active periodontitis during pregnancy and its association for an increased risk of developing preeclampsia. Again, the findings of the current study are more positive than earlier reports, yet consistent with trends found in the literature.¹¹ Respondents were less knowledgeable about obstetric complications and the association to poor oral health, which is consistent with the literature.¹¹ An unexpected finding revealed that a small percentage of respondents reported feeling uncomfortable and/or preferred not to treat pregnant women. Some felt as though they were not trained to treat women during pregnancy, while others had liability concerns. Although these findings were unexpected to come from the respondent group, dentists surveyed in an earlier study declared having the same fears as the respondents from this survey.¹¹

Inconsistencies existed within the profession regarding when and what procedures can be safely performed during pregnancy. The majority of the respondents identified emergency care and prophylaxis could be safely provided throughout pregnancy. By contrast, some were less knowledgeable about when and if periodontal therapy (scaling and root planing), restorative care and radiographs could be completed. Knowledge regarding what procedures could be safely provided throughout pregnancy, such as restorative care and periodontal therapy, was positively associated with a more advanced degree. Similarly, knowledge about administering radiographs throughout pregnancy was positively associated with the number of years since degree.

The results concluded continuing education regarding oral health care and pregnancy was preferred. These results were consistent with findings throughout the literature that dental hygienists required continuing education to increase their knowledge about new oral-systemic connections.^{6,23} Implementing additional peri and prenatal education could be accomplished through continuing education courses and inter-professional collaboration. Comprehensive care for pregnant patients can improve when dental hygienists participate in inter-professional collaboration. Dental hygienists indicated an interest in participating in professional collaboration activities, however, lacked time and knowledge to develop professional referral relationships with prenatal care providers.

This study adds to the body of literature regarding dental hygienists' knowledge, attitudes and behaviors about oral health and pregnancy, however, limitations were noted. Limitations included a 14.4% response

rate, no item identified if dental hygienists were actively practicing and respondents were allowed to skip items. This lack of full participation with each question could have resulted in fewer answers about key knowledge, attitudes and practice behaviors. The survey questions for this study were modified from a research study that evaluated dentists' knowledge of oral health care during pregnancy and were not tested for validity which could be a limitation

Future research goals should focus on how dental hygienists can increase their knowledge about perinatal oral care through continuing education and inter-professional collaboration. Research should place emphasis on developing a universal standard of care surrounding perinatal oral health guidelines for all health care providers. Michigan can benefit from these survey results as they forge a strategic plan to develop and implement Michigan-specific guidelines. As guidelines are implemented and assessed, pregnant patients will be provided the opportunity to seek counsel, diagnosis and treatment of oral health problems creating an overall higher standard of care.¹⁵

CONCLUSION

Surveyed Michigan dental hygienists demonstrated positive knowledge, attitudes and behaviors about providing oral health care during pregnancy. Additionally, results indicated regardless of years of experience or level of degree, most desired more education about caring for pregnant patients. Dental hygienists are in a position to use current findings, protocols and practice guidelines to provide preventive oral care and advocate for pregnant patients. Improving oral health practices and preventive behaviors of pregnant women through education and referrals could reduce the risk of premature births and low birth weight babies. It is imperative that prenatal health care providers collaborate with oral health care providers to help improve the chances for a full term infant.

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RESEARCH

Oral Health Status of Older Adults Attending Senior Centers and Congregate Meal Sites in New Hampshire

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Abstract

Purpose: This study assessed the oral health status of older adults in randomly selected New Hampshire senior centers and congregate meal sites for the purpose of future planning, implementation and evaluation of targeted public health programs.

Methods: A cross-sectional surveillance project was developed. Registered dental hygienists visually assessed denture use, number of natural teeth, teeth mobility, untreated caries, root fragments, gingivitis, need for care and treatment urgency among randomly selected active older adults living within New Hampshire communities.

Results: Altogether, 610 adults 60 years old and older attending 25 senior centers and congregate meal sites participated. Sixteen percent were edentulous and 42% reported having a removable upper or lower denture. Among edentulous adults, 5% had no dentures at all. Among 513 dentate participants, 22% had untreated caries, 14% had root fragments, 9% had gingivitis and 7% presented with obviously mobile teeth. Overall, 19% required early or urgent dental care. Differences were detected by sex, age group, urban versus rural location of the site and by the participation in a federal nutritional program for older adults.

Conclusion: Baseline information about oral health needs of older adults in New Hampshire was gathered. Overall needs as well as existing oral health disparities will be addressed through the collaboration of public and private partners.

Keywords: oral health, surveillance, older adults

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

According to the United States Census Bureau, the number of Americans age 65 and older will reach 71 million in 2030, comprising 20% of the U.S. population.¹ Similarly, within the next 15 years, the number of older adults in New Hampshire will surpass 350,000, or 21% of the state's population.¹

With this demographic transition predicted to continue beyond the year 2030 the oral health of older adults is gaining attention.^{2,3} Due to the cumulative effect, oral diseases disproportionately affect older adults more than any other age group, and impact their nutritional status, social functioning and overall well-being.^{4,5} Oral inflammatory diseases have been linked to cardiovascular diseases, type 2 diabetes, respiratory diseases and cancer.⁶ Selected drug therapies, prescribed to control chronic diseases that are highly prevalent among older adults, reduce salivary flow and lead to oral dryness, and problems with speech and swallowing.^{7,8} Declining mental and physical abilities of older adults interfere with oral hygiene and self-care, adding to the complexity of this issue.

Simultaneously, older adults face barriers to regular dental care due to a lack of dental insurance, financial constraints, absence of perceived need and transportation issues.⁹ In New Hampshire, data on the oral health of older adults are limited to estimates from the Behavioral Risk Factor Surveillance Survey, which is an ongoing population-based telephone survey of New Hampshire adult residents. In 2012, the New Hampshire Behavioral Risk Factor Surveillance Survey indicated that approximately 11.1% of adults aged 60 or older were edentulous, 70.5% had any permanent teeth extracted, and 74.7% had visited a dentist or dental clinic within the past year (New Hampshire unpublished observations). To gather evidence for targeted interventions, in 2010, the New Hampshire Oral Health Program (OHP) surveyed the self-reported oral health status, access to dental care and attitudes related to oral health among older adults in 6 senior centers and congregate meal sites.¹⁰ In 2012, the OHP followed up with a pilot project that utilized the Basic Screening Survey (BSS) – Older Adults tool, created by the Association of State and Territorial Dental Directors

(ASTDD), to assess several oral health indicators and need for dental care among older adults attending the same 6 sites.^{11,12} In 2014, building upon the 2012 pilot, the OHP used the BSS to assess the oral health of older adults and investigate possible disparities in randomly selected senior centers and congregate meal sites statewide for the purpose of future planning, program implementation and evaluation of targeted public health programs.

METHODS AND MATERIALS

The assessment utilized the ASTDD BSS – Older Adults tool.¹¹ The ASTDD is a non-profit organization that promotes sound national oral health policy and assists states and territories with initiatives for the prevention and control of oral diseases. One of the ASTDD initiatives is to support surveillance activities that gather reliable and nationally comparable data on the oral health of selected populations. The BSS – Older Adults tool provides guidance on planning and implementation of the oral health survey among older adults.¹²

The list of all New Hampshire senior centers and congregate meal sites was obtained from the New Hampshire Bureau of Elderly and Adult Service and 25 out of 32 sites that provide services to at least 35 older adults were selected. The desired sample size of 625 older adults (25 sites, each with approximately 25 older adults screened) was determined based on the clustered study design, preferred precision and expected participation known from the previous work.¹³ All older adults active at the selected sites were eligible for the oral health assessment that was advertised in advance to increase participation. Ten public health dental hygienist screeners, trained by the OHP to uniformly evaluate the oral health status of older adults, assessed the following indicators: dentures and denture use, functional posterior occlusal contact, number of natural teeth, suspicious soft tissue lesions, severe dry mouth, and need for dental care. Among dentate adults, additional indicators included: untreated caries, root fragments, obvious tooth mobility (visibly mobile tooth, or tooth that moves when a gloved finger is placed on the occlusal or incisal surface and gently wiggled), severe gingival inflammation and need for periodontal care. The need for dental care was categorized as urgent (needing treatment as soon as possible) when pain, swelling or infection was present, or as early (care needed within the next several weeks) when dental treatment was needed prior to the next routine dental visit. Brief visual examinations employed disposable dental mirrors and gauze to ease the evaluation of the oral cavity.

Dental hygienists wore appropriate personal protection equipment and adhered to all applicable infection control recommendations.¹¹ In addition

to taking part in visual screenings, participants filled out a short self-administered questionnaire on tobacco use, dental insurance, past oral cancer screening, if they had a particular dentist or a dental clinic for usual dental care (a dental home), and whether they were receiving commodity supplemental foods. The Commodity Supplemental Food Program (CSFP) is a federally funded program for income eligible elderly people at least 60 years of age. The eligibility was set at 130% of federal poverty guidelines during 2014.¹⁴ Utilizing the Rural Urban Commuting Area (RUCA) codes, each selected site was classified as urban or rural on the basis of its zip code.¹⁵ Sites within metropolitan areas (RUCA 1-3) were categorized as urban; those within micropolitan areas, small towns and rural areas (RUCA 4-10) were categorized as rural. Questions on dental insurance, dental home and cancer screening were adapted from the BSS manual.¹¹ Data were gathered on standardized forms, entered into an EpiInfoTM database, analyzed using SAS® software (version 9.3, SAS Institute, Inc., Cary, North Carolina) and the PROC SURVEYFREQ procedure. Population proportions for variables of interest, and 95% confidence intervals adjusted for a clustered design and finite population, were calculated with additional subgroup analyses by sex, age group (60 to 74 year olds, 75 year olds and older), site location, and the CSFP participation which approximated income. Those with missing or “I do not know” responses were excluded from the analyses for the particular question. The Rao-Scott chi-square test was used to test associations and p-values <0.05 were considered statistically significant. Anyone with a need for urgent care and/or a suspicious soft tissue lesion was linked with a provider in the community for free follow-up care paid for by the New Hampshire Bureau of Elderly and Adult Service using Title III funds. The New Hampshire Department of Health and Human Services (DHHS), the Division of Public Health Services determined that this surveillance activity is a public health practice, therefore not requiring the institutional review board approval.¹¹

RESULTS

Twenty-five senior centers and congregate meal sites participated in the assessments that took place between December 2013 and June 2014. The number of older adult participants per center ranged from 10 to 46 (median 24). Overall, 610 adults aged 60 years and older were screened (age range 60 to 97 years, median 75 years). In the aggregate, 70.9% were females (sex was missing for 11 participants) and 96.4% reported white race.

Approximately 65.7% of participants were screened at the sites categorized as rural, and 9.3% participated in the CSFP. Overall, 18.4% of older adults reported having some type of dental insur-

ance, 66.2% had a dental home, 13.0% of older adults had a severely dry mouth, 42.3% had either an upper or lower denture, 28.0% had no functional posterior contact assessed with dentures in place and 15.9% were edentulous. Among edentulous adults, 5.2% had neither an upper nor lower denture. Among dentate adults, 25.4% had untreated caries and/or root fragments, 8.8% had gingivitis, 7.2% had obviously mobile teeth, and 6.8% had a need for periodontal care. Number of all teeth ranged between 2 and 32, with a median of 22 teeth. Overall, 18.9% of participants required either urgent or early dental care. Detailed results are reported in Table I. Subgroup analyses indicated significant differences by sex, age, rural versus urban location of the site and substantial disparities by the CSFP participation. When comparing males with females, males were less likely to report receiving a cancer screening within the last 5 years (34.4% males compared with 47.5% females, $p<0.0001$), and were significantly more likely to be in need of dental care (23.6% of males compared with 16.7% of females, $p=0.0138$). Among dentate males, 34.7% had untreated caries and/or root fragments compared with 21.8% of females ($p=0.0001$). Males were also more likely ($p=0.0399$) to have mobile teeth (10.3%) when compared with females (6.1%). Comparisons of those 60 to 74 years old with 75 years old and older revealed that those from the older age group were significantly less likely to have dental insurance, more likely to have dentures and more likely to be edentulous (data not reported). Older adults attending rural sites were significantly less likely ($p=0.0002$) to have some type of dental insurance, and among dentate adults more likely to have gingivitis ($p=0.0008$), obviously mobile teeth ($p=0.0011$) and need for periodontal care ($p<0.0001$).

Though not always statistically significantly dif-

Table I: Prevalence Estimates of Oral Health Indicators among New Hampshire Older Adults

	Number of Respondents	Number; Percent (95% CI*) of Respondents with the Characteristic
Having some type of dental insurance	593	109; 18.4 (16.5 to 20.3)
Having a particular dentist/dental clinic	607	402; 66.2 (63.7 to 68.7)
Having an oral cancer check	565	246; 43.5 (40.9 to 46.2)
Having removable upper denture	610	237; 38.9 (36.2 to 41.5)
Wears upper denture while eating	236	222; 94.1 (92.4 to 95.7)
Having removable lower denture	610	150; 24.6 (22.8 to 26.4)
Wears lower denture while eating	150	134; 89.3 (86.7 to 92.0)
Has upper or lower denture	610	258; 42.3 (39.9 to 44.7)
No functional contact#	607	170; 28.0 (24.9 to 31.1)
Edentulous adults	610	97; 15.9 (13.8 to 18.0)
Edentulous - not having dentures	97	5; 5.2 (3.0 to 7.3)
Dry mouth	610	79; 13.0 (8.6 to 17.3)
Suspicious lesions	608	28; 4.6 (3.4 to 5.8)
Need for early dental care	610	95; 15.6 (13.5 to 17.6)
Need for urgent dental care	610	20; 3.3 (2.5 to 4.1)
Need for urgent or early care	610	115; 18.9 (16.7 to 21.0)
Following indicators were assessed only among those with remaining natural teeth (n=513)		
Substantial oral debris	512	74; 14.5 (11.3 to 17.6)
Gingivitis	512	45; 8.8 (6.8 to 10.8)
Untreated caries	512	113; 22.1 (18.7 to 25.4)
Root fragments	513	73; 14.2 (12.6 to 15.8)
Untreated caries or root fragments	512	130; 25.4 (22.1 to 28.6)
Obvious mobility of teeth	513	37; 7.2 (6.1 to 8.4)
Need for periodontal care	513	35; 6.8 (4.8 to 8.9)
Number of upper natural teeth (median, range)		11 (1 to 16)
Number of lower natural teeth (median, range)		11 (1 to 16)

*Confidence Interval

#Functional contact assessed with dentures in place

ferent, those attending rural sites tended to have a greater need for dental care and less favorable oral health (Table II). Adults participating in the CSFP were significantly less likely to have a particular dentist or dental clinic to provide them with usual dental care (47.3% CSFP participants compared with 68.0% nonparticipants, $p=0.0043$), and were more likely to be edentulous (29.1% CSFP participants compared with 14.6% nonparticipants, $p=0.0008$). They were also significantly more likely to be in need of dental care (32.7% CSFP participants compared with 17.6% nonparticipants, $p=0.0007$). Among dentate adults, those participating in the CSFP were more likely to have substantial oral debris (23.1% CSFP participants compared with 13.2% nonparticipants,

Table II: Prevalence Estimates of Oral Health Indicators among New Hampshire Older Adults, by the Urban or Rural Site Location

	Urban Percent (95%CI*)	Rural Percent (95%CI)	p-value
Having some type of dental insurance	25.0 (22.7 to 27.3)	14.9 (12.7 to 17.1)	0.0002
Having a particular dentist/dental clinic	69.2 (64.5 to 74.0)	64.7 (61.9 to 67.4)	0.4169
Has upper or lower denture	43.1 (38.9 to 47.2)	41.9 (38.9 to 44.9)	0.8254
No functional contact#	28.7 (23.3 to 34.2)	27.6 (23.9 to 31.3)	0.8745
Edentulous adults (no teeth)	15.8 (11.6 to 20.0)	16.0 (13.6 to 18.3)	0.9725
Dry mouth	8.1 (3.9 to 12.4)	15.5 (9.4 to 21.5)	0.3267
Suspicious lesions	5.7 (3.9 to 7.6)	4.0 (2.4 to 5.6)	0.4842
Need for dental care (urgent or early)	18.2 (13.9 to 22.5)	19.2 (16.9 to 21.5)	0.8425
Following indicators were assessed only among those with remaining natural teeth (n=513)			
Substantial oral debris	12.6 (8.1 to 17.0)	15.4 (11.2 to 19.7)	0.6605
Gingivitis	2.9 (1.5 to 4.3)	11.9 (9.2 to 14.5)	0.0008
Untreated caries	16.6 (11.5 to 21.6)	24.9 (20.8 to 29.1)	0.2245
Root fragments	12.5 (9.9 to 15.1)	15.1 (13.1 to 17.1)	0.4541
Untreated caries or root fragments	20.6 (16.3 to 24.8)	27.9 (23.6 to 32.2)	0.2367
Obvious mobility of teeth	3.4 (2.4 to 4.5)	9.2 (7.7 to 10.7)	0.0011
Need for periodontal care	0.6 (0.0 to 1.1)	10.1 (7.2 to 13.0)	<0.0001

*Confidence Interval

#Functional contact assessed with dentures in place

p=0.0325), gingivitis (15.4% CSFP participants compared with 7.7% nonparticipants, p=0.0470), and untreated caries and/or root fragments (56.4% CSFP participants compared with 23.0% nonparticipants, p<0.0001) (Table III).

DISCUSSION

This statewide survey of New Hampshire older adults was conducted to obtain baseline data to utilize the findings in a needs assessment and targeted program planning. To put the data into perspective, 2 publicly available data sources have been chosen for comparison. Estimates available from the United States Census Bureau reveal that 94.2% of New Hampshire residents are Caucasian, 55.7% of those older than 65 years of age are females, and 8.8% of those 55 years and older live below 1.25 Federal Poverty Level.¹⁶ The older adult population that was screened during this assessment is similar to Census Bureau reports with regard to race and income (approximated by the CSFP participation) while it slightly underrepresents older adult males. Gathered New Hampshire data were also compared to a similar survey conducted among seniors attending Massachusetts subsidized meal sites in 2009. Though many estimates from the Massachusetts survey are not directly comparable to the results of this assessment, those that are comparable yield similar findings. The

Massachusetts statewide survey assessed 212 older adults from 20 meal sites and found that 66.5% of meal site participants had a dentist, 18.9% had dental insurance, 19.3% were edentulous, 34.5% had untreated caries and 3.5% were in need of urgent care.¹⁷

The New Hampshire assessment identified oral health disparities related to rural site locations and disparities by income approximated by participation in the CSFP. Inequalities related to oral health in rural areas of New Hampshire, although mainly among children, have been described previously.¹⁸ The findings of this study established the oral health needs among older adults. The New Hampshire DHHS has already begun to address geographic disparities with various initiatives including strategic workforce development, deployment of public health hygienists into rural areas, support of community water fluoridation and integration of dental facilities to rural Federally Qualified Health Centers.

Disparities related to income, approximated by the participation in the CSFP, will require novel approaches. As stated above, the CSFP is a federally funded program with a goal to improve the health of low-income older adults by supplementing their diets with nutritious foods.¹³ CSFP recipients pick up their monthly food packages at a variety of participating sites including the CSFP warehouses, senior centers,

Table III: Prevalence Estimates of Oral Health Indicators among New Hampshire Older Adults, by the CSFP Participation

	Participates in CSFP Percent (95%CI*)	Does not participate Percent (95%CI)	p-value
Having some type of dental insurance	11.3 (5.9 to 16.8)	18.4 (16.5 to 20.3)	0.3077
Having a particular dentist/dental clinic	47.3 (40.2 to 54.4)	68.0 (65.5 to 70.6)	0.0043
Has upper or lower denture	52.7 (46.0 to 59.4)	41.3 (38.8 to 43.8)	0.0873
No functional contact#	40.0 (33.1 to 46.9)	27.1 (23.7 to 30.5)	0.0733
Edentulous adults (no teeth)	29.1 (23.3 to 34.9)	14.6 (12.5 to 16.6)	0.0008
Dry mouth	12.7 (7.4 to 18.1)	13.1 (8.7 to 17.4)	0.9336
Suspicious lesions	5.6 (2.9 to 8.2)	4.7 (3.3 to 6.1)	0.7859
Need for dental care (urgent or early)	32.7 (26.9 to 38.5)	17.6 (15.5 to 19.6)	0.0007
Following indicators were assessed only among those with remaining natural teeth (n=513)			
Substantial oral debris	23.1 (16.3 to 29.9)	13.2 (10.2 to 16.2)	0.0325
Gingivitis	15.4 (10.3 to 20.5)	7.7 (5.9 to 9.5)	0.0470
Untreated caries	51.3 (43.8 to 58.7)	19.7 (16.5 to 23.0)	<0.0001
Root fragments	38.5 (32.7 to 44.2)	12.0 (10.7 to 13.4)	<0.0001
Untreated caries or root fragments	56.4 (48.9 to 63.9)	23.0 (19.9 to 26.1)	<0.0001
Obvious mobility of teeth	7.7 (3.7 to 11.7)	7.2 (6.0 to 8.5)	0.9091
Need for periodontal care	12.8 (7.5 to 18.1)	6.1 (4.2 to 8.0)	0.0840

*Confidence Interval

#Functional contact assessed with dentures in place

churches, senior housing and community buildings. In New Hampshire, CSFP distribution sites are located in every county and are also affiliated with the Women, Infants and Children (WIC) Program.¹⁹ Community-based oral health programs have been integrated into several New Hampshire WIC sites where pregnant women and young children receive oral health education and preventive services. The sustainability of oral health care delivered at the New Hampshire WIC sites is currently being evaluated and the findings will be instrumental for any future planning and program implementation.

A similar model of service delivery could be developed for New Hampshire older adults. Older adults collecting the CSFP packages could receive selected preventive and early intervention therapeutic services including prophylaxis, fluoride varnish application, interim therapeutic restorations and oral health education that could be scheduled on days when the CSFP pick-up occurs. Nationally, there are demonstration projects under way that will provide insight into sustainability and effectiveness of oral health service delivery outside of dental offices. For example, "virtual dental homes," community-based oral health delivery systems, operate in a variety of sites in California. These sites range from Head Start sites to residential care settings and nursing homes.²⁰ In summary, licensed dental hygienist providers can work in non-traditional community settings using

collaborative agreements with dentists. Dental hygienists can deliver on-site preventive oral health services to high-risk patients at a low cost, and can refer patients with urgent or early care needs to participating dental practices. Restorative treatment can be funded through collaborations with partners like the Bureau of Elderly and Adult Service that receive federal funds suitable to cover dental services for clients 60 years and older. Selected services could be delivered outside of dental offices within environments where older adults live, seek their social interactions or receive general health care.

Findings of the study are generalizable to New Hampshire older adult residents that are active and living independently within their communities. It is not known whether those that chose to participate in the screenings have better or worse oral health than non-participating older adults. Though all screeners underwent standardized training to uniformly assess and record the oral health status, the possibility of the observation bias cannot be excluded.

CONCLUSION

The first statewide survey of older adults' oral health in New Hampshire was conducted and its findings advanced the understanding of oral health needs in the state. The study documented an unmet need for dental care among older adults living inde-

pendently in their communities, particularly among those residing in rural areas, and those with limited incomes.

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Ultrasonic Instrumentation Instruction in Dental Hygiene Programs in the United States

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Abstract

Purpose: The purpose of this study was to determine the extent of ultrasonic scaling instrumentation instruction in dental hygiene programs in the U.S. Currently, there is no publication available defining a consensus of instruction for ultrasonic instrumentation.

Methods: Exempt status was received from the West Virginia University Institutional Review Board. A survey was developed with dental hygiene administrators and faculty, based on assumptions and a list of questions to be answered. The survey was tested for validity and revised after feedback from additional faculty. The instrument was 64 questions divided into demographics, curriculum and equipment. Most questions included a text box for additional comments. An email survey was sent to all directors of accredited dental hygiene programs in the U.S. (n=323). The final possible number of respondents was n=301. Results were collected in aggregate through the Secure Online Environment (SOLE). Results were transferred to an Excel spreadsheet for statistical analysis.

Results: After 3 emails, the response rate was 45% (n=136). No significant differences in methods of instruction were found between associate and baccalaureate degree granting programs. Eighty-nine percent of programs introduce hand scaling prior to ultrasonic scaling instruction. Students in 96% of the programs were required to administer pre-procedural mouth rinse intended to reduce the amount of bacteria. The magnetostrictive ultrasonic scaler is widely used in dental hygiene instruction. A variety of inserts/ tips were available although a universal or straight insert/tip was most common. Calculus, not inflammation, was the primary criterion for ultrasonic scaler use.

Conclusion: The results of this study demonstrate that ultrasonic instrumentation is an integral component of the clinical curriculum and the majority of the dental hygiene programs prescribe to similar teaching methods. Programs could benefit from incorporating current scientific research findings of using site specific inserts to perform periodontal debridement based on thorough biofilm removal measured by resolution of inflammation.

Keywords: acoustic turbulence, cavitation, lavage, debridement

This study supports the NDHRA priority area, **Professional Education and Development:** Evaluate the extent to which current dental hygiene curricula prepare dental hygienists to meet the increasingly complex oral health needs of the public.

INTRODUCTION

Ongoing research of periodontal disease has provided the professional community with a comprehensive foundation of information, leading to significant improvements in effective treatment options. Management of periodontal disease includes understanding the association between systemic health and oral health along with understanding available therapeutic treatment. Historically, periodontal scaling and root planing were accomplished using hand instruments because ultrasonic scalers were originally designed for gross scaling and removal of supragingival calculus.¹⁻⁴ Originally, the tips of ultrasonic scalers were too large to fit into the sulcus around the tooth.¹⁻⁴ Now there is a body of evidence that supports the efficacy of modern ultrasonic instrumentation with longer and thinner tips, offering a valuable component of periodontal therapy.³⁻⁵

Based on the Commission on Dental Accreditation (CODA) Dental Hygiene Standards, dental hygiene programs would be expected to teach content on the theory for periodontal therapy that is current and evidence-based which would include ultrasonic instrumentation. Instruction would include the therapeutic mechanism of the ultrasonic action, ultrasonic instrumentation technique including the adaptation of various inserts in relation to tooth morphology, the rationale and criteria for use of inserts, infection control, and the application of these principles through actual clinical experience. Development of a clinical competency measure of student proficiency using an ultrasonic scaler throughout the clinical experience would be expected.⁶ The information provided by this study could assist in reevaluating portions of ultrasonic curriculum while validating other segments

of instruction, thereby establishing consistency of theory and practice.

The past 50 years saw a change in the methods, rationale and theory for periodontal debridement. In the 1960s and 1970s, practitioners advocated aggressive hand scaling and root planing with the purpose of achieving a glassy smooth finish which resulted in removing pathogens along with excessive amounts of tooth structure, often resulting in dentinal hypersensitivity.^{3-5,7,8} Gracey curets designed in the 1970s were effective in achieving the glassy smooth root surface that was thought to inhibit new calculus accumulation.^{2,5} Ultrasonic scaling was viewed as an adjunct used prior to fine hand scaling.³ The role of bacteria was still unclear during this period.²

Study results revealed a paradigm shift in the mid-1980s and 1990s. Dental biofilm and free-flowing planktonic bacteria were established as the cause of periodontal infection; the infection could be treated effectively with the ultrasonic unit set on low power to remove bacteria and calculus.^{2,4} Calculus was recognized as a niche for bacterial growth and a retainer of bacterial toxins and other byproducts.^{2,4,9-16} Tooth structure was preserved while calculus was burnished due to the low power setting and pathogens remained. The result was soft tissue ulcerations over burnished calculus deposits resulting in chronic inflammation.²

In March 1990, Smart et al published the results of an in vitro study of conservative therapy with ultrasonic scaling of the root surface alone. The study found that the ability of the ultrasonic scaler to detoxify root surfaces was significant. This finding suggested that conventional root planing was unnecessary.⁸

In 1993, the term "debridement" was introduced to dental hygiene students by Irene Woodall. Debridement advocated the treatment of the root surface, the pocket space and the pocket wall to promote healing.^{5,8,9,11,17-20} This recognized and addressed the need for elimination of pathogens and tissue response instead of only calculus removal for the treatment of periodontal inflammation. In contrast, the focus of root planing was on deposit removal and a glassy smooth root surface, not the reduction of pathogens.

Today, ultrasonic scaling is recommended for the treatment of periodontal disease using a variety of inserts designed for reaching deeper into the sulcus and to adapt to root concavities. The suggested process starts with the ultrasonic scaler used on medium to high power to remove the bulk of calculus, then progressing to a medium-low power setting using a thin tip insert and removing the residual deposits, biofilm and endotoxins. Ultrasonic inserts were

redesigned with smaller tip diameters and longer shanks to access deep subgingival pockets for disruption of the biofilm, which is necessary for control of periodontal disease. Micro-ultrasonic thin tip inserts were shown to be superior to manual instrumentation when accessing deep, narrow defects and class II and III furcations.^{10,16,18,21} Numerous studies were performed comparing ultrasonic scaling and hand scaling with varying results. At minimum, the two were equal in effectiveness with respect to probing depth reduction, gain of clinical attachment and decreased clinical inflammation.^{3,5,9-10,21-29} Periodontal debridement continues to be the gold standard for periodontal disease treatment.^{15,17} In addition, ultrasonic scalers may require less time to complete subgingival debridement with decreased clinician fatigue.^{3,5,9,21,22} Alterations of the tooth surface are directly related to the amount of pressure applied by an instrument - less pressure, less cementum removed.^{4,5,7} Ultrasonic scaling required less pressure to accomplish removal of calculus, endotoxins and biofilm without removal of cementum.^{8,9} The 1990s produced research which recognized that cementum removal was not necessary for treatment of periodontal disease.^{8,9}

Ultrasonic scalers provide a mechanical disruption of the plaque biofilm by the movement of the insert tip and the subsequent lavage flushed debris from the sulcus. Cavitation produced by the ultrasonic vibration of the tips helps to break up the subgingival bacterial plaque.^{3,5,9,11,12} The areas reached by the cavitation are detoxified which reduces the periodontal-disease-causing pathogen load.^{10,13,14}

More than 50 ultrasonic inserts have been designed to work in specific areas, for specific needs. A heavy tip would provide enough vibration on medium-high to high power to fracture heavy supra gingival calculus. A standard diameter tip insert would be used for general debridement or moderate to heavy supragingival and subgingival calculus. Slim diameter inserts were introduced in the late 1980s. An insert designed for subgingival periodontal debridement has a tip that is 40 to 47% thinner than the standard diameter tip with a longer shank that can reach 1 mm deeper than hand instruments, into subgingival areas, furcations, root concavities and interproximal areas.^{2,5,18} As the insert tip diameter becomes smaller, less power is required to accomplish debridement.⁵ The thin tip inserts should be used only on low to medium power. If not used properly, an ultrasonic insert tip used on low power can burnish rather than remove the calculus.^{2,7,24,29} One study found more cavitation occurred with broader tips at the same power setting than the slimmer insert tips.^{3,18}

Specialized insert tips are available. A beaver-tail tip has a wide working end, ideal for removing

thick tobacco stains, orthodontic cement and tenacious calculus. Site-specific inserts can have a right or left curved shank or a shank with a number of backbends, all designed to enhance adaptability to the root anatomy of the teeth.

Tips wear as a result of use, resulting in loss of effectiveness. One millimeter of tip wear will result in approximately 25% loss of efficiency.^{4,5} Two millimeters of wear will result in approximately 50% loss of efficiency, and replacement would be required.^{4,5} Wear guides can be obtained from the manufacturer.

Ultrasonic scaling instruments can be very effective with deliberate, multidirectional strokes, keeping the tip constantly moving. The entire surface of the tooth or root must be contacted by the side of the tip using short and overlapping vertical, horizontal and oblique strokes, in a cross-hatching pattern and working circumferentially for effective removal of biofilm pathogens.^{2,4,5,8,30-32} Fracturing of calculus can be accomplished by working from the coronal or lateral boundary of the deposit, gently tapping the deposit using the active sides of the insert tip, unlike curets, which require the clinician to place the instrument under the apical aspect of the deposit. Increased pressure decreases the effectiveness of the tip by restricting or stopping the movement of the insert tip.^{4,5,9}

Investigators have reported that ultrasonic scalers release bacteria-laden aerosol into the environment creating a biohazard.^{3-5,7,16,32-37} Microorganisms can remain suspended for at least 30 minutes and up to 24 hours.^{4,7,33} The area of exposure can be up to 20 feet from the treatment center. Having the patient rinse with an antimicrobial mouth rinse prior to treatment decreased the amount of bacteria in the mouth to be released into the air.^{4,32-36,38} High-speed evacuation captured the excess water which significantly decreased the amount of bacteria-laden aerosol released into the air.³²⁻³⁷ Studies showed that blood is present in the aerosols produced by ultrasonic scalers even though it is not visible.^{10,35-37} The standard saliva ejector cannot capture aerosols adequately.^{10,37} Adaptors added to the high-speed evacuation are available and would make it easier for the clinician to use the high-speed evacuation without assistance.^{32,33} Proper cleaning of the operatory surfaces would be necessary due to the contamination by the aerosols produced by ultrasonic scalers.

Historically, cardiac pacemakers were considered a contraindication for the use of ultrasonic scalers. Pacemakers are shielded; therefore, the magnetostriuctive ultrasonic electromagnetic field will pose no risk to a patient with a modern cardiac pacemaker.³⁹⁻⁴¹ The piezoelectric ultrasonic scaler did not produce an electromagnetic field.

The purpose of this study was to assess the level of ultrasonic instrumentation instruction employed in dental hygiene educational programs in the U.S. Currently, there is no publication available defining the current consensus of teaching methods for ultrasonic instrumentation in dental hygiene programs in the U.S.

METHODS AND MATERIALS

Exempt status was received from the West Virginia University Institutional Review Board. A survey was developed with dental hygiene administrators and faculty of West Virginia University. The survey was tested for validity, using additional faculty to review the survey and revised after feedback. The instrument consisted of 64 questions asking about demographics, curriculum and equipment. Most questions included a text box for additional comments. An email survey was sent to all directors of accredited dental hygiene programs in the U.S. (n=323). The West Virginia University Secure Online Environment (SOLE) system was utilized for the email survey. A total of 3 emails were sent. Email addresses were obtained from The American Dental Education Association Directory of Institutional Members.

RESULTS

Most questions allowed for more than one answer to be selected, therefore totals did not equal 100% for every question. After the first email, 22 subjects were eliminated for various reasons, including 3 programs without onsite student clinics, 2 program directors who stated they did not answer surveys, 1 director who responded that the program was too new, no email could be found for 1 program, 11 emails bounced back, and 4 automatic responses stated out of the office until fall (n=301). After 3 emails, the response rate was 45% (n=136). Results were collected in aggregate through SOLE and transferred to an Excel spreadsheet for statistical analysis.

Demographically, the programs were divided into 4 regions: Northeast, South, Midwest and West, using a regional designation employed by the U.S. Census. The response rate was the least from the northeast states (8.1%) and the greatest response rate was from the Midwest states (38.2%). There was no significant difference in the response rate between programs conferring associate degrees or bachelor degrees.

Pre-clinical instrumentation was introduced by 86% of the dental hygiene programs in the first term, with 26% including ultrasonic scaling instruction during the pre-clinical instrumentation course. No difference was noted between programs con-

ferring an associate degree and programs conferring a bachelors degree. The majority of programs (89.2%) introduced hand scaling instrumentation instruction prior to the introduction of ultrasonic scaling instrumentation instruction (Figure 1). Sixty nine percent of respondents reported that equal emphasis was placed on hand scaling instrumentation and ultrasonic scaling instrumentation (Figure 2).

Use of teaching strategies was explored (Figure 3). The most common strategy for teaching was the use of typodonts. Other teaching strategies included student partners (89%) and onsite clinical patients (83%).

Ultrasonic insert tip adaptation techniques taught in the program were also assessed. Five choices were provided (oblique, modified oblique, vertical, furcation adaptation and other). The 2 most common techniques were the oblique using the lateral insert surface (91%) and vertical strokes working parallel to the tooth similar to a probe (91%). Also taught was the modified oblique using the face and back of the insert (84%), followed by furcation adaptation (41%).

When asked about criterion for use of the ultrasonic scaler, 77% used the amount of calculus as a criterion. Stain was a criterion by 50% and degree of inflammation was reported by 31%.

The study asked about the prevalence of the 2 most common types of ultrasonic scalers. Magnetostrictive ultrasonic scalers were much more prevalent than piezoelectric ultrasonic scalers in dental hygiene programs and were reported to be used in 93% of the dental hygiene programs who responded. The majority of programs (80%) indicated that the ratio of magnetostrictive ultrasonic units to students was predominantly 1:1. Six programs (5%) required students to purchase their own magnetostrictive ultrasonic scaler unit.

Most programs (72%) required students to purchase ultrasonic scaler inserts while enrolled in the dental hygiene program. Figure 4 notes the magnetostrictive inserts students were required to purchase and which inserts were provided by the program. The slim diameter straight tip was the most common choice of tip.

Sixty nine percent of programs (n=94) reported having piezoelectric ultrasonic scalers. Only 10 programs had a higher than a 1:5 ratio of piezoelectric ultrasonic scalers to students. Most reported using them for demonstration purposes. Most programs (69%) utilizing piezoelectric ultrasonic scalers provided the tips for students to use. The diamond coated tip was used with supervision (Figure 5).

Figure 1: Hand Scaling Instrumentation Instruction Relative to Ultrasonic Instrumentation Instruction (n=129)

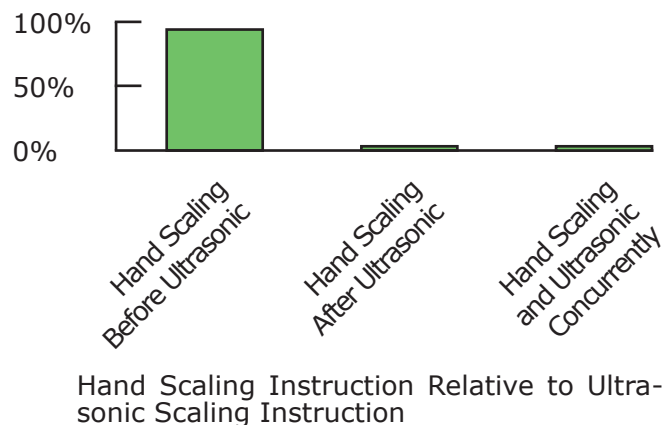


Figure 2: Program Emphasis (n=131)

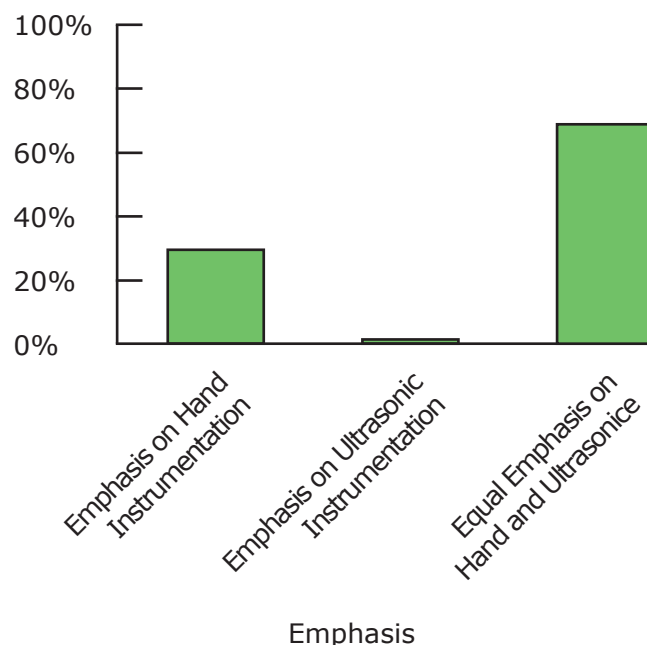


Figure 3: Teaching Strategies Used for Ultrasonic Instrumentation (n=131)

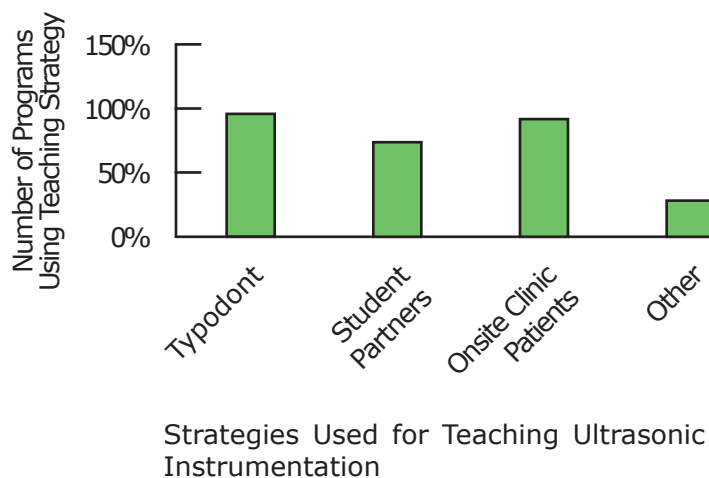
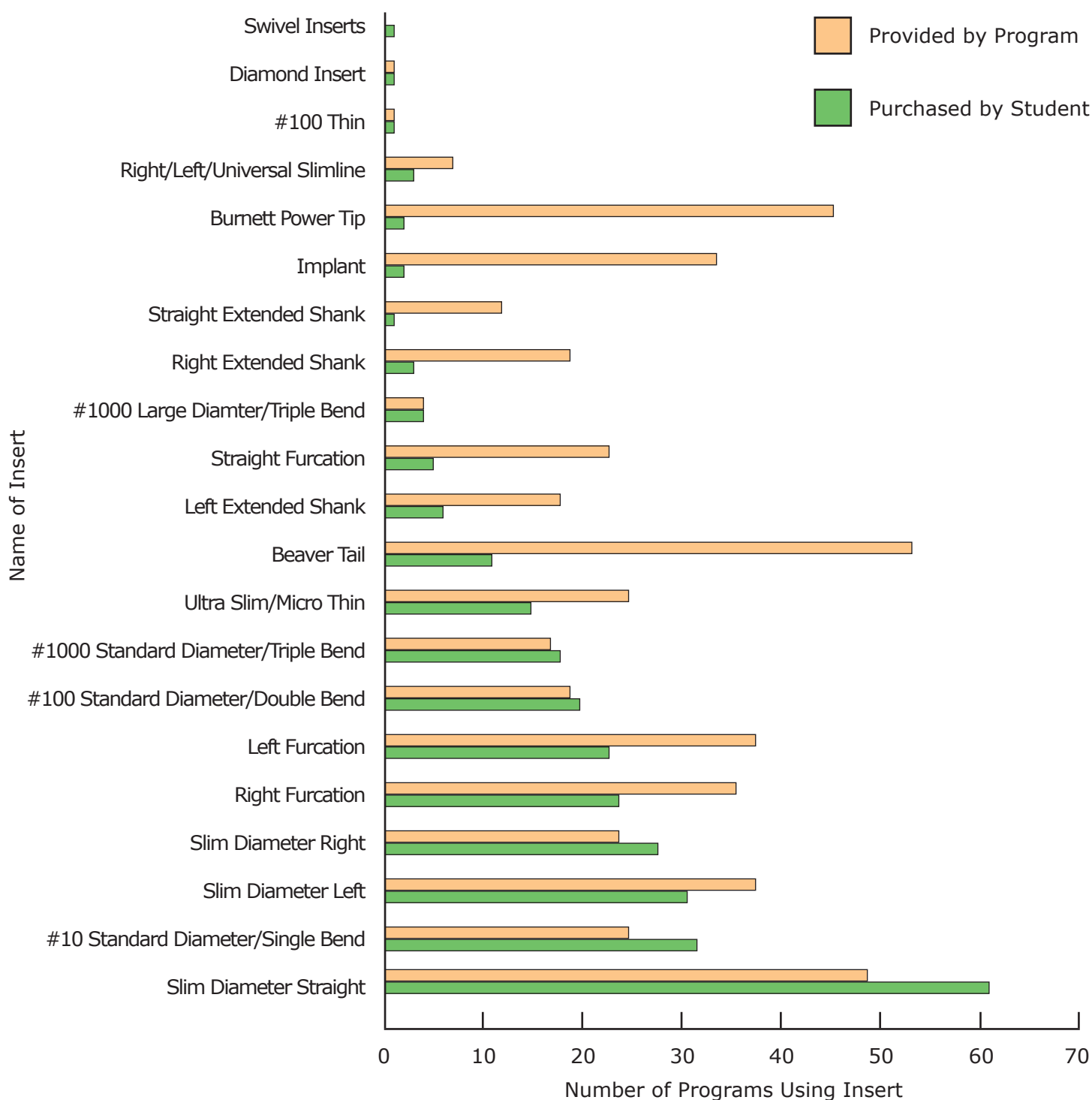


Figure 4: Magnetostrictive Inserts Used by Programs

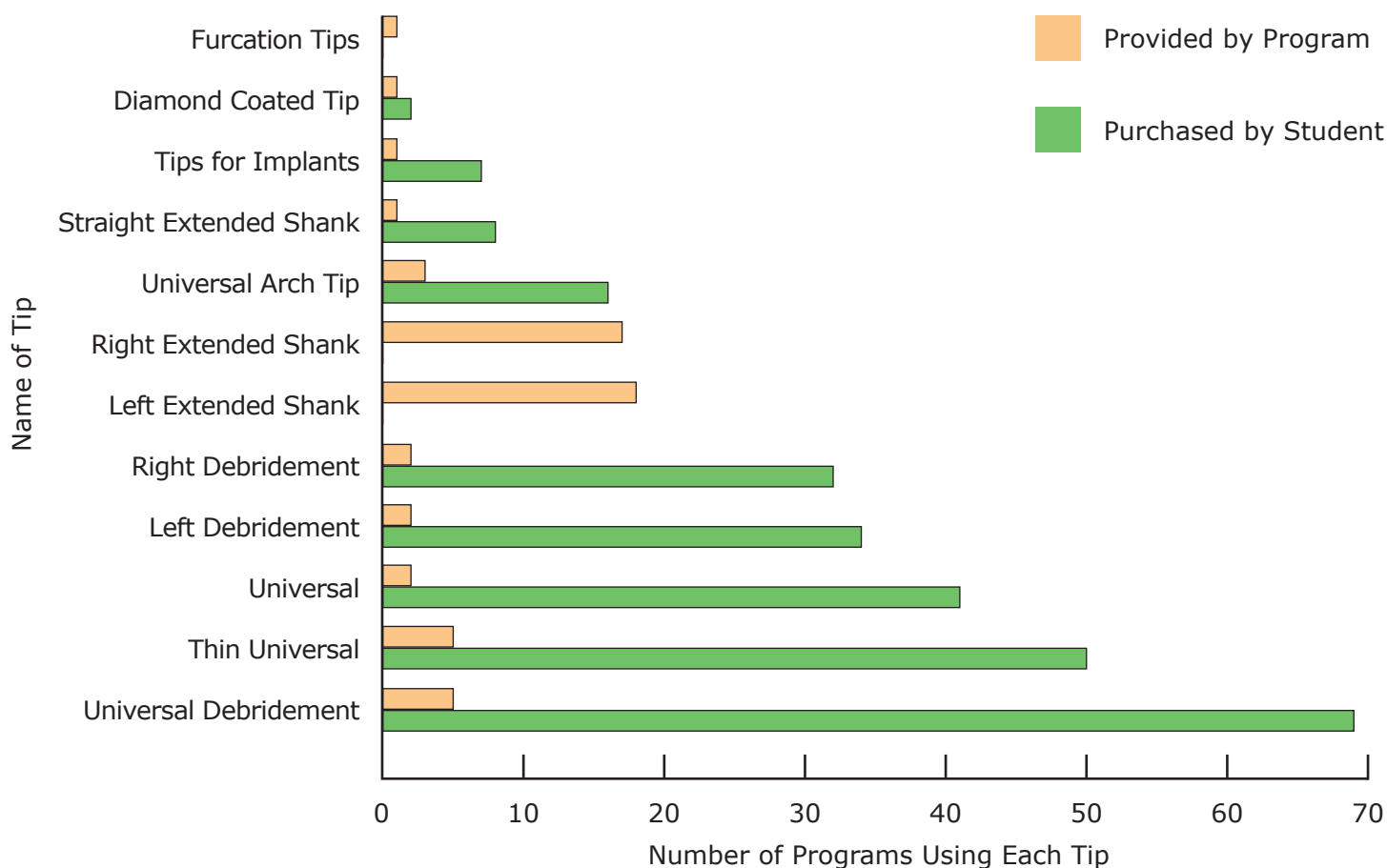


The majority (90%) incorporated more than one type of competency assessment for ultrasonic instrumentation (Figure 6). Methods included direct observation, pre- and post-exam by instructor and process examination by instructor. Six programs (5%) used additional methods including critical thinking narratives that included determination of instrument selection, techniques used and identification of correct treatment modalities for specific patients. Skill evaluation, self-evaluation and a written exam were utilized for competency assessment.

DISCUSSION

The results of the study indicate that a majority of schools surveyed approach ultrasonic instrumentation instruction in a similar way. Most use the same textbooks and the same teaching methods, such as requiring a pre-procedural rinse, use high volume evacuation, teach ultrasonic instrumentation theory across the curriculum and encourage the students to use the ultrasonic scaler freely on all patient types. No significant differences were found between associate and baccalaureate degree granting programs.

Figure 5: Piezoelectric Tips

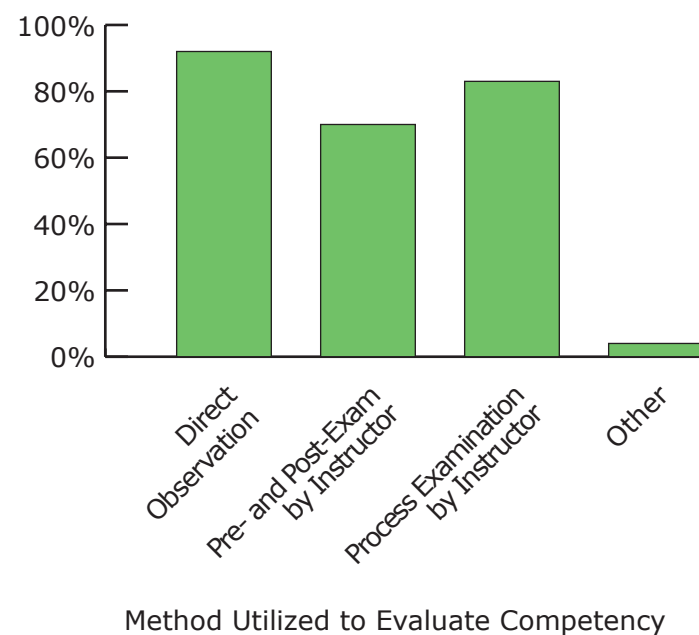


No research is available that addresses the consensus or extent of instruction of ultrasonic instrumentation in dental hygiene programs. Studies focus on the therapeutic effect of ultrasonic instrumentation versus hand instrumentation for the treatment of periodontal disease.^{3,5,7,9,10,15-18,23,24,27-31}

The magnetostrictive ultrasonic scaler is taught in 93% of programs. The piezoelectric is primarily used as enrichment. Most respondents (68.7%) indicated that equal emphasis is placed on ultrasonic scaling; however, the majority of programs (89.2%) present hand scaling instruction prior to ultrasonic scaling instruction. There are a variety of inserts available but the most common is a slim diameter straight tip insert. Scientific literature demonstrates that utilization of site specific inserts maximizes efficacy and efficiency of deposit removal, minimizes root surface damage, minimizing the chance of bur-nishing calculus.^{3,5,7,10,13,16,18,21,31}

Most programs (97.82%) cite calculus as a criterion for using the ultrasonic scaler, with 31% indicating inflammation as a criterion for ultrasonic debridement. This suggests that dental hygiene programs are still teaching a traditional approach to instrumentation. However, respondents agree that most patients benefit from the use of the ultrasonic scaler. Programs should reevaluate the criteria used

Figure 6: Evaluation Methods to Determine Competency (n=132)



to determine the need for ultrasonic instrumentation utilizing evidence-based and current philosophies of periodontal therapy that recognizes the key role of inflammation. Considering the vast amount of evidence implicating biofilm as the etiological

factor for periodontal disease rather than calculus, the current survey revealed that a traditional teaching approach is utilized by most dental hygiene programs.^{2,5,9,11,14,15,17} Traditionally, instrumentation has been approached based on the presence of clinically-detectable calculus deposits, with the end point of therapy measured by the absence of clinically-detectable deposits. An approach that aligns with the current treatment philosophy of periodontal debridement would be based on thorough removal of biofilm in addition to calculus, with the end point of therapy measured by resolution or absence of inflammation.^{2,5,9,11,14,15,17} The findings of this study indicate a disconnect between what is written in scientific literature and what is actually practiced in dental hygiene programs.

CONCLUSION

Dental hygiene programs in the U.S. universally embrace teaching ultrasonic instrumentation, and encourage ultrasonic use on all patient profiles. The

majority of programs recognize the need for a pre-procedural mouth rinse, and the use of high volume evacuation to reduce the bacteria laden aerosol produced. Almost all programs cited calculus removal as the criterion for using the ultrasonic scaler. The results of this survey suggests that the teaching of instrumentation is not fully aligned with current treatment philosophy of periodontal debridement based on the need for thorough removal of biofilm using site specific inserts, with the end point of therapy measured by resolution or absence of inflammation.

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