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

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Report of the Global Oral Health Inequalities Task Group on Periodontal Disease: Implications for Dental Hygienists

I read a fascinating paper published this month in *Advances in Dental Research*. It was a report from the Global Oral Health Inequalities Task Group on Periodontal Disease.¹ The full report describes the oral health inequities in several areas of oral disease and the priorities for research in the future. Following is a brief summary of the report pertaining to periodontal disease and the impact and implications for dental hygienists.

Did you know that 90% of the global population has experienced oral or dental problems?² These figures are staggering when one considers that most oral disease is completely preventable. Several risk factors for periodontal disease were listed including poor oral hygiene, tobacco smoking, drug use, poor dental restorations and others linked to hyper-inflammatory polymorphisms, such as uncontrolled diabetes mellitus, obesity, untreated HIV infection and genetic variables.¹ We know that tobacco smoking is one of the risk factors that is the most important to reduce because its impact on periodontal disease risk is so great. We have made great strides over the years in educating our patients about the role of tobacco and diabetes mellitus, and how it can impact poor oral health and overall health. Yet many people around the world do not have the benefit of this education because they lack access to an oral care provider who can help them learn the benefits of good preventive care. We also lack understanding about the benefits of integrating oral health education into programs designed to promote general health and prevent chronic diseases.¹ While we think it would be beneficial and contribute to better oral health, it is a research priority to learn the most effective and efficient ways to conduct these programs. Dental hygienists have always been about prevention and education. They could play a huge role in the future in implementing these proposed strategies to alleviate periodontal disease.

The report further discussed the importance of oral health services, as well as patient compliance. Dental hygienists have known that professional oral care is key to prevention of disease and to the treatment and maintenance of periodontal disease. Just as important is the

patient's commitment to regular, supportive periodontal care and adherence to instructions from an oral health care professional. Yet we still know little about what it takes to modify behavior. More research is needed to learn how to motivate patients towards better compliance and adherence. Perhaps dental hygiene investigators could take the lead in investigating strategies to modify behavior.

The report provides several reasons for the failure to implement effective strategies that have evidence from clinical and laboratory studies. The first is a lack of awareness that leads to delayed treatment. The public and even some oral health care professionals lack awareness of the importance of periodontal health and the consequences of not treating the disease. This has a huge impact on the health, or lack thereof, of the public. The second is one that really "hits home" - the lack of appropriate oral health care systems and the availability of qualified oral health care professionals, such as dental hygienists in developing countries. Many countries do not have any oral care, much less a dental hygienist. Much more needs to be done to expand the availability of dental hygiene programs throughout the world so that everyone on this planet has access to care. Third, much more needs to be done to reimburse providers for preventive services, including health maintenance. Finally, more needs to be accomplished in collaborative care between medical and dental professionals. Although progress has been made, such as the joint recommendations by the Academy of Periodontology and the Journal of Cardiology, medical and dental professionals should be encouraged to work together to control common risk factors for oral and overall health.

Dental hygienists can make a difference in global health. I strongly recommend that each of you read this timely report and think about how you can make a contribution to periodontal health!

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

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Linking Research to Clinical Practice

Prevention of Root 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.

Tan HP, Lo EC, Dyson JE, Luo Y, Corbet EF. A randomized trial on root caries prevention in elders. J Dent Res. 2010;89(10):1086–1090.

Objective: Root caries is common in institutionalized elders, and effective prevention methods are needed. This clinical trial compared the effectiveness of 4 methods in preventing new root caries.

Methods: Twenty-one residential homes were surveyed. Three hundred and six healthy elders having at least 5 teeth with exposed sound root surfaces were randomly allocated into 1 of 4 groups: individualized oral hygiene instruction (OHI), OHI and applications of 1% chlorhexidine varnish every 3 months, OHI and applications of 5% sodium fluoride varnish every 3 months and OHI and annual applications of 38% silver diamine fluoride (SDF) solution.

Results: Two-thirds (203/306) of the elders were followed for 3 years. Mean numbers of new root caries surfaces in the 4 groups were 2.5, 1.1, 0.9 and 0.7, respectively (ANOVA, $p < 0.001$).

Conclusion: SDF solution, sodium fluoride varnish and chlorhexidine varnish were more effective in preventing new root caries than giving OHI alone.

Commentary

Root caries is prevalent in elderly populations worldwide. In the U.S., estimates for root caries prevalence in individuals over age 75 have exceeded 50%, and 25% for people over age 65. Dental hygienists are seeing more elderly patients in practice, and are also working or volunteering in senior

centers, assisted living complexes and long-term care facilities. The U.S. Department of Health and Human Services indicates that, because U.S. adults are keeping their teeth longer, more are at risk for root caries. Gingival recession caused by normal aging, vigorous tooth brushing and periodontitis puts root surfaces especially at risk. It is interesting to note, however, that root caries prevention differs from coronal caries prevention. If practitioners make the same recommendations for patients at risk for root caries, the interventions might not be as effective. Dentin is more susceptible than enamel because it has less mineral content and is more soluble. Elderly individuals also have higher rates of risk factors, such as medication-induced xerostomia.

This study tested 4 different interventions for prevention of root caries in institutionalized elders. Subjects ($n=306$) were living in 21 residential and nursing homes in Hong Kong and had at least 5 teeth, no serious medical problems and the ability to perform basic oral hygiene procedures after instruction. They were examined at baseline and randomly assigned to 1 of 4 groups: water (control), chlorhexidine varnish, sodium fluoride varnish or silver diamine fluoride solution (SDF). The random assignment of subjects to groups decreased the potential for researcher bias, and the large sample size drawn from many facilities increased power of the results. All subjects in all groups received oral hygiene instruction (OHI) for tooth brushing and use of fluoride toothpaste and dental treatment as indicated (scaling, restorative, extractions and prosthetic work) after initial examination. These elements of the research design were included to control extraneous variables, like poor oral hygiene

or existing active carious lesions, which might have influenced the impact of the interventions and, thus, the outcomes. The primary outcome of the study used to measure effectiveness of the preventive agents was new caries on exposed root surfaces. Clinical outcomes were monitored over 3 years for 203 subjects. Long-term results are valued in research because dental professionals and patients need to have confidence that the intervention (in this case caries prevention) will be effective over time. All measurements of new root caries surfaces were made by an independent examiner, someone other than the person who made group assignments and applied preventive agents. This blinded design is intended to eliminate researcher bias in measurement of the outcomes. Additionally, subjects did not know to their group assignment, so this study was actually double blinded. All of these study elements increase the quality of evidence that this study is able to contribute to our knowledge about prevention of root caries.

Findings indicated all of the active ingredient interventions were more effective at preventing root caries than OHI alone (with the water control). Average numbers of new root caries after 3 years in each group were:

- OHI and placebo (water), 2.5 new lesions
- OHI and applications of 1% chlorhexidine (CHD) varnish every 3 months, 1.1 new lesions
- OHI and 5% sodium fluoride varnish every 3 months, 0.9 new lesions
- OHI and 38% SDF solution every 12 months, 0.7 new lesions

The clinical significance of just over 1 new lesion (1.1 in CHX varnish) versus almost 1 new lesion (0.9 in sodium fluoride varnish and 0.7 in SDF solution) over 3 years may not be significant, but the comparison of 1 new lesion to 2.5 new lesions every 3 years would be clinically significant in terms of oral health and costs of dental care.

Fluoride in any form is estimated to prevent coronal caries by 35% and root caries by 22%. However, the evidence for fluoride varnishes in adults is incomplete. Several authors and speakers recommend fluoride varnish treatments every 3 months for adults with high caries risk, but evidence to support effectiveness of fluoride varnish has been generated from studies conducted primarily with children and adolescents for prevention of coronal caries. The results of this study indicate 5% sodium fluoride varnish also can be effective for root caries prevention in institutionalized elders. Additionally, findings support use of 1% chlorhexidine varnish applied professionally every 3 months. Studies on

the effect of chlorhexidine in caries prevention are limited, and studies of chlorhexidine varnish, once again, have been primarily conducted in populations of children and adolescents. Chlorhexidine varnish has limited effectiveness on pit and fissure caries, where sealants have been shown to be effective, but may have promise in prevention of root caries in adults. More studies are needed. The 5% sodium fluoride varnish and a 1% chlorhexidine/thymol varnish are available in the U.S., however, the SDF solution is not available.

Application of fluoride varnish 4 times a year for elderly patients seen in practice settings aligns well with 3 month periodontal maintenance intervals recommended for many elders with high caries risk or periodontitis. The other interesting point generated by this research project relates to the use of fluoride varnish in public health or institutional settings where adults are treated. Results support the use of varnishes in clinical and community settings where many dental hygienists are delivering preventive oral hygiene instruction and oral health services to older adults. Prevention of root caries will continue to be an important aspect of dental hygiene care, and its importance is likely to increase as the elderly population grows in the U.S.

Vale GC, Tabchoruryl CPM, Del Bel Cury AA, Tenuta LMA, ten Cate JM, Cury, JA. APF and dentifrice effect on root dentin demineralization and biofilm. J Dent Res. 2011;90(1):77–81.

Because dentin is more caries-susceptible than enamel, its demineralization may be more influenced by additional fluoride. We hypothesized that a combination of professional fluoride, applied as acidulated phosphate fluoride (APF), and use of 1,100 ppm fluoride dentifrice would provide additional protection for dentin compared with 1,100 ppm fluoride alone. Twelve adult volunteers wore palatal appliances containing root dentin slabs, which were subjected, to biofilm accumulation and sucrose exposure 8 times per day during 4 experimental phases of 7 days each. The volunteers were randomly assigned to the following treatments: placebo dentifrice (PD), 1,100 ppm fluoride dentifrice (FD), APF+PD and APF+FD. APF gel (1.23% fluoride) was applied to the slabs once at the beginning of the experimental phase, and the dentifrices were used 3 times per day. APF and FD increased fluoride concentration in biofilm fluid and reduced root dentin demineralization, presenting an additive effect. Analysis of the data suggests that the combination of APF gel application and daily regular use of 1,100 ppm fluoride dentifrice may provide additional protection against root caries compared with the dentifrice alone.

Commentary

Evidence indicates fluoridated toothpaste has preventive effects in children and adults for both coronal and root caries. For root caries, fluoride has been shown to promote remineralization and inhibit demineralization. Higher concentrations of fluoride appear to be required for prevention of root caries than coronal caries. Thus, daily home use of 5,000 ppm fluoride gels, polishes and dentifrices are recommended for adult and elderly patients with root exposure rather than, or in addition to, over-the-counter dentifrices with 1,000 or 1,100 ppm fluoride. For coronal caries prevention, the combination of fluoride dentifrice with other topical fluoride treatments (gels, rinses or varnishes) has been shown to have modest additive effects in children and adolescents, according to systematic reviews conducted by the Cochrane Collaboration. Additional research is needed to determine cumulative benefits of combining other forms of fluoride treatments with daily toothpaste use in adults. This study was conducted to test whether a combination of professional fluoride, specifically APF and the use of an 1,100 ppm fluoride dentifrice, would provide additional protection for dentin which, as mentioned earlier in this column, is more caries-susceptible than enamel, in comparison to the 1,100 ppm fluoride dentifrice alone.

Despite mechanical removal of plaque from tooth surfaces, biofilms remain. These biofilms may significantly influence tooth remineralization and demineralization because fluoride ions from toothpastes and dentifrices accumulate in dental plaque where the concentration remains effective for hours after tooth brushing. It is believed that this fluoride retention in biofilm might be one of the main mechanisms for the preventive effect of fluoride toothpastes. The same rationale might reasonably be applied to mouth rinses, although to date, studies regarding fluoride retention in plaque biofilm have focused on dentifrices. It is known, however, that regular use of a fluoride mouth rinse is associated with a reduction in caries in children. It also has been shown that fluoride from either highly concentrated fluoride dentifrices or fluoride mouthrinses has a preventive effect on root caries.

Fluoride gels, including APF, applied twice a year have also been shown to reduce caries in children. The theory behind the cariostatic effect of APF professional fluoride differs from formulations used at home, in that it is applied to a clean tooth surface after professional scaling and/or polishing. The acidic pH is intended to etch the tooth surface to allow for optimal uptake of fluoride, however, evi-

dence does not support APF as more effective than other forms of professionally applied fluoride gels. A concern has been asserted by several authors, speakers and clinicians about the effect of etching by APF on composite and porcelain dental restorations.

Results of this study were based on in situ testing, meaning a situation was created to simulate the effects in the oral cavity of humans over a period of time. It differs from in vitro studies, which are conducted in laboratory settings. These investigators used acrylic palatal appliances with 4 root dentin slabs, comprised of bovine dentin (from cows), inserted into the mouths of adult volunteers. Two of the dentin slabs were treated with APF and removed immediately after its application to assess fluoride concentration. Twelve volunteers were randomly assigned to groups to reduce researcher bias as follows: PD (placebo dentifrice), FD (1,100 ppm fluoride dentifrice), APF+PD or APF+FD. Although the sample size was small, the authors indicated a strong statistical power of 90%.

Volunteers were instructed to wear the appliance all of the time except when eating. Low molecular carbohydrates in the diet (white flour and sugar) are known to be metabolized by oral bacteria and provide a cariogenic challenge to tooth surfaces. To simulate dietary exposure to sugar, the volunteers dripped 20% sucrose solution on the slab outside of the mouth. Participants brushed their teeth and the appliance with the assigned toothpaste after meals (3 times a day). Biofilm was collected on the seventh day of the experiment, 10 hours after the last sucrose exposure and without brushing. The research design attempted to simulate what might happen to human root surfaces in the oral cavity over time.

Results showed APF and 1,100 ppm FD increased fluoride concentration in biofilm fluid and reduced root dentin demineralization. The additive effect was shown to be more effective than either treatment alone. The increased fluoride concentration in biofilm was sustained for 7 days after a single APF application. The authors concluded that the anti-caries efficacy of this combination should be confirmed in real conditions of dentifrice use. Human dentin might respond differently to fluoride than bovine dentin. Actual dietary exposure to low molecular carbohydrates in the mouth might differ from the simulation used in this study. The authors did not discuss the safety of using APF on the root surface, however, surface hardness was improved, and no adverse events were reported. Additional research is needed.

The Bottom Line

Each of these studies addressed prevention of root caries in adults. This research is important because most evidence for caries preventive methods have been conducted in children and adolescents. In addition, most studies have been directed at coronal caries prevention, rather than root caries. Thus, strong evidence is lacking to support decision making regarding best practices for reduction of root caries in adults.

As the population ages and people keep their teeth longer, root caries prevalence is on the rise. Exposed root surfaces resulting from recession are at risk for caries because dentin is more susceptible to caries than enamel. Recession caused by aging, toothbrush trauma and periodontal disease is common in adults and older adults.

Fluoride is the most well-documented and widely used caries preventive agent. Home use of a fluoride toothpaste as an adjunct to mechanical biofilm removal has been shown to significantly reduce both coronal and root caries. Previous research also supports higher concentrations (5,000 ppm) of fluoride than concentrations (1,000 or 1,100 ppm) found in over-the-counter fluoride dentifrices. Additional evidence is needed to confirm the additive benefits of multiple sources of fluoride used at home.

Evidence supporting professional application of fluoride in adults is weak. Nonetheless, use of topical fluorides for adults in dental practices is common. Application of fluoride varnish 4 times a year, coinciding with 3 month re-care intervals, is recommended for patients with high caries risk. Studies assessing combinations and frequencies of home and professional agents effective in controlling root caries in adults also are needed.

These 2 studies addressed this important need. Results of the first study conducted with residents of long-term care facilities indicate that professional application of 5% fluoride varnish can be recommended for older adults. Fluoride varnish combined with oral hygiene instruction (OHI) is more effective than OHI recommending daily tooth brushing with fluoridated toothpaste for reduction of new root caries lesions over a 3 year period. Results also provided support for the use of 1.1% chlorhexidine and 38% silver diamine fluoride solution (SDF) for prevention of new root caries lesions. The second study, using an in situ approach, provided initial data suggesting the combination of APF gel and daily use of 1,100 fluoride dentifrice increased fluoride concentration in biofilm fluid and reduced root dentin demineralization. Both of these studies provide support for an additive effect of multiple delivery mechanisms

of fluoride. Long-term clinical trials are needed to strengthen this evidence. In the meantime, the following conclusions can be drawn:

- There is some evidence to support that sodium fluoride varnish, chlorhexidine varnish and SDF solution are more effective in preventing new root caries than giving OHI for daily tooth brushing with a fluoride dentifrice alone
- Preliminary data suggests that the combination of APF gel application and daily regular use of 1,100 ppm fluoride dentifrice may provide additional protection against root caries compared with the dentifrice alone. However, other agents in professional fluoride gels and safety issues related to use of APF on root surfaces need further study before these results can be adopted confidently in practice

Summary

Dental hygienists are treating more elderly patients in private practices, community clinics and assisted-living or long-term care facilities. Effective and safe measures for prevention of root caries are needed to address the needs of this population. Well designed, long-term clinical trials that assess the additive effects of combinations of fluoride, alongside the caries-inhibiting effects of other preventive agents (chlorhexidine, casein phosphopeptide-amorphous calcium phosphate (CPP-ACP) and xylitol) are needed.

Dental hygienists evaluating forthcoming studies can use this comparison of study methodologies to evaluate the strength of the evidence. Findings from in vivo studies with human subjects are more valid than in vitro (lab) or in situ (simulated in a natural environment) studies given appropriate research designs and controls, however, the latter might be more appropriate for early testing needed to establish safety or generate preliminary results supporting efficacy. Trials with larger sample sizes have more statistical power than those employing small sample sizes. Clinical studies conducted in real world settings with randomization, controls, double blind or blind scoring, and over a long time period, are desirable.

Studies evaluating caries risk assessment and protocols also are needed. Despite the low level of evidence for prevention of root caries in adults, some recommendations for clinical practice can be made. Frequency of appointments for preventive dental hygiene services can be adjusted based on caries risk assessment with shorter intervals for patients with high risk. Professional application of 5%

fluoride varnish and recommendations for higher concentration (5,000 ppm) fluoride dentifrice used daily at home may be used to reduce development of new root caries lesions. These measures are easily and safely delivered in the various settings in which dental hygienists treat older adults. Dental hygienists are providing oral health care to elders in long-term care facilities, assisted-living facilities, senior centers, community clinics and private dental offices. The numbers of people in the U.S. over the age of 65 is projected to continue to increase over the next 2 decades, and some predict 1 in 5 elders will live in long-term care facilities. Practical, evidence-based approaches for prevention of root caries are needed. These studies add information to the body of knowledge to strengthen our confidence

in use of some measures while indicating a need for further research in others. No single preventive method will be ideal for all patients in all settings. Effective prevention will depend on more evidence to document effectiveness of various agents and protocols for individuals at low, moderate and high caries risk.

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

Critical Issues in Dental Hygiene

Development and Status of the Advanced Dental Hygiene Practitioner

Rebecca L Stolberg, RDH, MS; Colleen M. Brickle, RDH, RF, EdD;
Michele M. Darby, BSDH, MS

Introduction

In March 2009, President Barack Obama initiated his first step to reform the United States health care system by hosting a task force representing many stakeholders in health care. Unfortunately, dentistry and dental hygiene were not involved.¹ While dental spending topped \$100 billion in 2008,² there are "profound and consequential oral health disparities within racial and ethnic minorities, rural populations, individuals with disabilities, the homeless, immigrants, migrant workers, the very young and the frail elderly."³ As we continue to educate our nation's leaders on the importance of oral health as part of the health care reform agenda, it is dentistry and dental hygiene's ongoing responsibility to work collaboratively to eliminate access to care deficiencies. The purpose of this paper is to explain the need for the advanced dental hygiene practitioner (ADHP) as proposed by the American Dental Hygienists' Association (ADHA), and to report on the status of its implementation.

Oral diseases have social, psychological, physical and economic costs, both to individuals and society as a whole. When oral diseases are left untreated, a person's overall health can be seriously affected and may even cause death, as illustrated by the case of young Deamonte Driver.⁴ Without the ability to pay for dental care, few providers willing to serve public program enrollees, and the ever present cultural barriers that exist in diverse societies like the United States, many people do not receive needed preventive or restorative dental care. Some postpone treatment until they have nowhere else to go, other than a hospital emergency room (ER). A recent study of patient visits to 7 Twin Cities'

Abstract

Purpose: Advanced dental hygiene practitioners (ADHPs), members of the oral health care team, bring care to persons disenfranchised from adequate dental services. ADHPs are licensed and provide the traditional educational, preventive and therapeutic dental hygiene services, plus diagnostic, prescriptive and minimally invasive restorative services. ADHPs work in collaboration with all members of the dental team, referring patients in need of services outside of their scope directly to dentists or other health care providers.

Keywords: Advanced Dental Hygiene Practitioner (ADHP), mid-level provider, Dental Therapist, Advanced Dental Therapist

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

ERs found over 10,000 ER visits for oral problems at a cost of more than \$4.7 million.⁵ In Spokane, Washington, an average of \$2.9 million was spent for dental care in local hospitals per year.⁶ California emergency departments log more than 80,000 visits a year for preventable dental conditions, especially those living in rural areas and ages 18 to 34.⁷ Unfortunately, the extent of care rendered for dental needs in an ER is likely to be pain medication and/or antibiotics, with advice to follow-up with a dentist. The patient does not receive a complete oral examination, treatment to eliminate the problem and follow-up. Often, patients will make repeated visits to an ER because there is no other dental home for affordable care (over 20% of the Twin Cities patients returned at least twice for their dental problems).⁵

In the 2003 National Oral Health Call to Action, the Surgeon General stated:

"The burden of oral infections and conditions that affect the mouth, face and jaws is so broad and

extensive that the dentists can't do it alone; the hygienists can't do it alone; surgeons can't do it alone; government agencies can't do it alone; and the average person can't do it alone. It will take all of us working together to continue to make progress in advancing the oral health of this country."⁸

Poor oral health can adversely affect all aspects of life. Annually, children miss 51 million hours of school due to dental problems, and they can't learn in school if they are in pain. Similarly, adults lose 164 million work hours annually due to visits to the dentist to treat periodontal illnesses or to repair teeth.¹ Regardless of age, persons with dental problems may also experience challenges with eating, nutrition, speaking and self image.

Health care policy, practice and education must evolve concomitantly to meet societal needs and expanding demands. The United States population is expected to grow by 20% by 2020, with most of that growth in minority populations.⁹ Because of community water fluoridation, fluoride dentifrices and preventive dental care, people age 65 or older have retained more of their teeth. However, for some, their need to maintain optimal oral health is often complicated by multiple chronic conditions such as cardiovascular diseases, diabetes, stroke, respiratory illness, obesity and cancer. Creation of integrated health care systems that identify and remove barriers to quality, cost effective care and efficient use of existing manpower resources are necessary. For example, the ADHA Master File Survey of Dental Hygienists' in the United States in 2007 found over 150,000 licensed dental hygienists in the United States, with 130,000 actively practicing. Twenty-five percent hold licenses in more than 1 state.¹⁰ By 2016, a 30% increase in licensed dental hygienists is anticipated.¹¹ This increase significantly exceeds the expected 9% increase of licensed dentists.¹² The December 2009 Washington State's Oral Health Workforce document shows an expected general population growth of 24% between now and 2025, with an 80% growth for seniors during this time frame. It also estimated that 50% of current dentists may retire within 15 years.¹³

Background for the ADHP

In 2004, the ADHA recognized the need to develop a mid-level practitioner, following the Surgeon General's Call to Action Report. The ADHA termed this practitioner an "advanced dental hygiene practitioner," similar in concept to the advanced nurse practitioner, and the ADHA House of Delegates recommended a task force to develop the model. After several years of work by a task force, advisory committee and public commentary, the ADHP

Competency Document was published by ADHA in 2008.¹⁴ This document builds on the strong foundation and accreditation standards of existing dental hygiene education, established clinical practice standards, and the dental hygienists' unique orientation toward primary care and collaboration with dentistry. With specially designed master's level education, an ADHP, as a licensed provider of primary care within a defined scope of practice, will be able to serve the public directly and safely and is well-placed to help dentistry fill the void in care that currently exists. ADHPs will focus on providing preventive, therapeutic and referral services within community clinic settings, school clinics, long-term care facilities, hospitals and primary care clinics.¹⁵ In the collaborative role, the ADHP would consult with dentists when necessary and guide the patient into treatment that requires the expertise of a licensed dentist.¹⁶ While dental hygienists are considered the preventive and nonsurgical periodontal care experts, many states have also incorporated basic restorative services into their legal scopes of practice. Twenty-nine states allow for direct access to dental hygienists, 15 states directly reimburse registered dental hygienists under Medicaid and 20 states allow dental hygienists to perform some type of restorative dentistry, indicating that many states are well positioned to move towards the ADHP.¹⁷ Given that the 2007 National Health and Nutrition Examination Survey reports that the highest prevalence of untreated decay is in adults ages 20 to 64,¹⁵ basic restorative as well as preventive and periodontal therapy by an ADHP will be necessary to help dentistry expand access to care.

The ADHP at the Master's Degree Level

Because Americans define the baccalaureate degree as a college education, it is important to move dental hygiene closer to the norm of other health professionals with comparable responsibility. To earn respect, societal trust and professional accountability within the multidisciplinary health care system, the ADHP must present educational credentials similar to other mid-level providers, i.e. the nurse practitioner, physical therapist and occupational therapist.^{14,16} Dentally underserved and unserved populations are likely to have the most complex health histories and suffer chronic medical and dental conditions. The formal education necessary to effectively and safely provide care to persons with advanced medical and dental conditions is beyond that currently in the already crowded curricula of associates or baccalaureate dental hygiene degree programs. In addition, these accredited programs do not prepare graduates for

Table I: Resources on the Minnesota Advanced Dental Hygiene Practitioner Effort

Full text of Senate File 2083
https://www.revisor.mn.gov/bin/bldbill.php?bill=ccrsf2083.html&session=ls86
Metropolitan State/Normandale Advanced Dental Therapy Program
http://www.metrostate.edu/msweb/explore/cnhs/index.html
ADHP Competencies
http://www.adha.org/downloads/competencies.pdf
OHP Workgroup Report/Recommendations
http://www.health.state.mn.us/healthreform/oralhealth/
Minnesota Public Radio Story
http://minnesota.publicradio.org/display/web/2009/05/12/dental_practitioner_compromise

mid-level provider competencies, such as the ability to triage dental patients, manage cases and reimbursement mechanisms, work independently but collaboratively in isolated settings, measure outcomes of their care in relation to quality, safety and productivity using qualitative and quantitative research skills.¹⁸ A graduate degree is necessary to develop advanced practitioner competencies, which also carry the burden of additional legal liabilities.¹⁶

Implementation Status of the ADHP in Minnesota

Minnesota faces a serious health care crisis because many Minnesotans are unable to obtain treatment for dental disease, especially those who are low-income, disabled, elderly, disadvantaged or living in isolated rural areas. Over half of Minnesota's counties are designated dentist shortage areas, and most counties have seen a steady decline in dental care access for low-income people on state public programs.¹⁹ Although the problem of access is multifaceted, an estimated 60% of Minnesota's dentists may retire in the next 15 to 20 years.²⁰ The dental workforce in rural areas has a larger percentage of dentists over the age of 55, magnifying the loss of dentists expected to retire in the near future. The geographic distribution of Minnesota dental hygienists more closely matches the distribution of population than does the distribution of dentists, both of which are more concentrated in urban areas.²¹

Since 2001, with the passage of statutory language known as "Limited Authorization for Dental Hygienists,"²² Minnesota's collaborative practice dental hygienists are uniquely qualified and positioned to meet the oral health needs of the underserved. Minnesota has demonstrated success and easy matriculation of dental hygienists in providing dental hygiene services by establishing collabora-

Table II: Minnesota's Dental Hygiene Advanced Practitioner Timeline

- 2000–2003 – Heightened awareness to enhance the oral health workforce capacity
- 2004 – First Draft of the ADHP Competencies by the American Dental Hygienists' Association
- 2005 – Normandale Community College and Metropolitan State's partnership
- 2006 – MnSCU New Programs' application
- 2007 – Master's program advisory committee formed
- 2008 – ADHP competencies approved
- 2009 – Advance dental therapist master's program begins

tive practices and becoming certified in performing basic restorative services. Therefore, it was a natural progression for Minnesota dental hygienists and institutions of higher education to lead the nation in development and implementation of an ADHP program at the master's degree level.

In 2005, a partnership formed between Metropolitan State University and Normandale Community College that allowed these institutions to take a pivotal leadership role in advancing the concept of a new mid-level dental hygiene practitioner model. The new programs proposed were a baccalaureate degree completion program, a post-baccalaureate certificate program and an oral health care practitioner master's of science program based on the ADHP Competencies Document. The Minnesota State Colleges and Universities new programs received final approval in November 2006. During the application process, letters of support documented the need for the development of these new programs. Alliances made with community partners paved the way for building valuable, sustainable relationships with influential community leaders and organizations that also saw the value in an ADHP. Community partners voiced a common theme that

Table III: Minnesota's Dental Therapist and Advanced Dental Therapist Legal Scopes of Practice

Dental Therapist		Advanced Dental Therapist
Under general supervision:	Under indirect supervision:	Under general supervision as defined in the written collaborative management agreement:
<ul style="list-style-type: none"> • Oral health instruction • Nutritional counseling and dietary analysis • Preliminary charting of the oral cavity • Taking radiographs • Mechanical polishing • Application of topical preventive or prophylactic agents • Pulp vitality testing • Application of desensitizing medication • Resin fabrication of athletic mouthguards • Placement of temporary restorations • Fabrication of soft occlusal guards • Tissue conditioning and soft reline • Atraumatic restorative therapy • Dressing changes • Avulsed tooth reimplantation • Administration of local anesthetic • Administration of nitrous oxide 	<ul style="list-style-type: none"> • Emergency palliative treatment of dental pain • Placement and removal of space maintainers • Cavity preparation • Restoration of primary and permanent teeth • Placement of temporary crowns • Preparation and placement of preformed crowns • Pulpotomies on primary teeth • Indirect and direct pulp capping on primary and permanent teeth • Stabilization of reimplanted teeth • Extractions of primary teeth • Suture removal • Brush biopsies • Repair of defective prosthetic devices • Recementing of permanent crowns 	<ul style="list-style-type: none"> • All services and procedures described for the Dental Therapist • Oral evaluation and assessment of dental disease • Formulation of an individualized treatment plan authorized by the collaborating dentist • Nonsurgical extractions of permanent teeth (limitations) • Refer patients to receive any needed services that exceed the scope of practice • Provide, dispense, and administer analgesic, anti-inflammatory, and antibiotic medications

the current dental workforce simply cannot meet the oral health needs of Minnesotans, especially for vulnerable people (Table I).

The formation of a strong strategic partnership between the Minnesota Health Care Safety Net Coalition, the Minnesota Dental Hygienists' Association and the Minnesota State Colleges and Universities resulted in significant legislation moving forward in 2008 and 2009 that would legitimize the ADHP (Table II). Through the efforts of these 3 organizations, nearly 60 other organizations signed on to advocate for legislation that would establish the ADHP in Minnesota. Countless hours were invested keeping lines of communication open, formulating testimony, delegating responsibilities and sharing negotiation tactics during mounting opposition from the opponents of this legislation that sought to improve access to dental care for thousands of Minnesotans.

In a last minute compromise, the Minnesota legislature established 2 levels of dental therapists, a basic level that requires at least a bachelor's degree and an advanced level that requires at least a master's degree (Table III).²³ The law established

the requirements for licensure of dental therapists and certification of advanced dental therapists, but did not dictate to educational institutions what their admission requirements should be or how to structure their programs. Different educational institutions may establish different types of programs, as long as the programs appropriately educate students to the necessary level of competency. Flexibility in accommodating a range of educational backgrounds will add to the diversity, opportunities and innovation in the dental workforce.

Metropolitan State University established a master's program that combines both the basic level of dental therapist training and the additional education needed to be an advanced dental therapist. Students in this program will become licensed as a basic dental therapist as part of a longer curriculum that will lead to advanced practice certification. Metropolitan State University has also chosen to limit program admission to existing, experienced, baccalaureate-prepared licensed dental hygienists. Increasing the likelihood of employability, graduates will be eligible for licensure and certified as advanced dental therapists after completing clinical hours being specified by the Board of Dentistry,

so that they can practice both dental therapy and dental hygiene and expand dental services where needed.

Implementation Status of the ADHP in Washington State

Eastern Washington University (EWU) expects to pilot an ADHP program for those who live on and near tribal lands. EWU's close proximity and relationships with multiple tribes places it strategically and affords the ability to perform portions of the training in rural tribal clinics. EWU Department of Dental Hygiene offers a master's degree in dental hygiene as an entirely web-based program reaching students within their own communities and promoting their acceptance into local health care networks. An additional ADHP emphasis area has been approved and is ready for implementation, should funding occur. The curriculum reflects that of the ADHA's, and is a 2 year curriculum with the entire first year web-based, making it more accessible for working or rural dental hygienists via distance education technology.

The 1999 Oral Health Survey of American Indian and Alaska Native Dental Patients found that American Indians have inadequate access to preventive and restorative dental care. It also found a tremendous backlog of dental treatment needs among American Indian patients.²⁴ One third of American Indian children report missing school because of dental pain. Moreover, 25% of American Indian children avoid laughing or smiling, while 20% report difficulty sleeping because of dental problems.²⁴ In general, American Indians have twice as much untreated dental caries as white people, and have diabetes at a rate 190% higher than the general United States population.²⁴ Washington dental clinics serving primarily American Indians are overwhelmed with demands for restorative dental care and thus have fewer resources for preventive care.²⁵ A dentist hired by a regional tribal wellness center's dental clinic conducted oral examinations on 3 high school students during the fall of 2008. In these 3 American Indian students alone, the dentist found \$15,000 worth of untreated dental problems. In addition, the center searched for over 10 months before finding a part-time dental director for its dental clinic (Pokotas, personal communication, March 2009). While the clinic needs a full-time dentist, this goal has not yet been achieved. Although not documented in the literature, other tribal dental clinic directors in Eastern Washington have experienced similar problems with untreated needs as well as a shortage of dental care providers.

Licensed Washington dental hygienists are already well prepared to provide quality basic restorative services, as this has been legal for decades. With additional education, ADHPs will also be educated in case management, health care policy and working with diverse populations and collaboratively with other health care professionals. The limited professional workforce available to staff community health centers remains a critical concern in Washington. Statistics document that only 2% of the nation's dentists work in health centers, with rural health centers particularly vulnerable.²⁶ Health centers are ideal settings for ADHPs to practice, and ADHPs should be cost effective for the health centers.

Washington ADHPs will receive training in rural areas and treat diverse populations close to where they live and work. ADHPs will develop research and scientific backgrounds to allow them to make evidence-based decisions and provide oral health care within their defined scope of practice. While tribal partnerships will be vital, the ADHP will also collaborate with the entire health care team, oral health coalitions, public health districts and various community-based safety-net organizations. EWU faculty and dentists do not view this program as re-defining the scope of dental hygiene practice. Rather, it builds on the already successful role of traditional and expanded function dental hygienists. The choice to pursue the ADHP master's degree would be up to the dental hygienist, much as a dentist chooses to specialize.

Documented Effectiveness of Practitioners Similar to the ADHP

Globally, the idea of a mid-level practitioner is not a new concept. New Zealand led the world in 1921 with the preparation and implementation of dental nurses (now known as dental therapists).²⁸ While many countries have termed their practitioners "dental therapists," the roles and responsibilities assigned to them are similar to those proposed by ADHA for the ADHP. In addition, while most dental therapists began by treating only children, their value soon expanded to include adult care as well. These 52 countries' dental therapists share goals with the ADHPs, i.e., improved dental care access, cost reduction and oral health for all.²⁷ Similarly, the effectiveness and safety of dental therapists have been documented in other countries by the extent to which they perform quality care and satisfy patients.²⁷ Furthermore, New Zealand dental therapists have been highly valued by the public for over 80 years.²⁷ Care must be taken to avoid preparing new dental workforce personnel that are not employable or that would be poorly un-

derstood by the public and other health professionals. Recognition and employability are clear advantages favoring the ADHP over other models that have been proposed.

Working collaboratively with a dentist does not mean substituting the ADHP for a dentist – both have defined and different scopes of practice. Like any mid-level practitioner, the intent of the ADHP is to increase efficiency in the oral care delivery system and availability of primary care and referral for persons not served in the existing system. Collaboration with other health care and dental providers is key for providing access to quality care, with improved health indicators, cost containment and patient satisfaction as additional desirable outcomes.

In multiple settings, quality of care provided by mid-level practitioners has been more than satisfactory. For example, in Australia, more restorations placed by dentists were defective than those placed by dental therapists. Also, diagnosis and treatment planning decisions were comparable between the 2 provider entities.²⁷ A study of Canadian dental therapists revealed that the quality of their restorations was better, on average, than those by dentists, and stainless steel crowns were comparable in quality. Canada has also documented that the use of dental therapists is cost-effective.²⁷

In the United States, dental health aide therapists (DHATs) in Alaska have been performing preventive and restorative therapies on inhabitants of rural Alaskan villages since 2005. DHATs work using a tele-medicine cart connected via secured internet to the hub clinics and their supervising dentists.²⁸ A quality assessment of DHATs and chart audits found DHATs to be performing safely, performing functioning within the scope of training and meeting the standard of care of the dental profession.²⁹ Currently, DHATs are only allowed to practice in clinics of the Native Alaska Tribal Health consortium in Alaska. In both California and Iowa, the quality of care rendered and the safety of care provided by expanded function dental hygienists in nontraditional settings has been documented.^{30,31}

Conclusion

Oral health is essential for whole body health. Limitations to professional dental hygiene services and other primary dental services compromise the health of people who have been disenfranchised by the current system of dental care delivery. The 2009 U.S. Oral Health Workforce Summary states

more than one third of the United States population lacks dental coverage. In the early 2000s, there were less than 2,000 dental health professional shortage areas. In 2008, there were over 4,000 dental health professional shortage areas.³² If the evidence and mechanism for implementation are known, society cannot ignore the people who look to dental professionals for leadership, expertise and humanity.

As learned in Minnesota, a strong professional organization and support of other stakeholders can be a powerful influence on public policy, increasing interest of third party stakeholders in oral health policy issues. Dictated by codes of ethics, advocacy requires active involvement and ongoing commitment to the health of all people. Through ADHA and its partners, a collaborative network will continue a unified voice on behalf of the uninsured and underinsured individuals until access to oral health care and other health care policy changes occur. The end point of advocacy is the health and welfare of the public.³³

Any new model of care will create anxiety and opposition from those who are satisfied with, and benefit from, the existing model. ADHPs supplement rather than compete with dentists, as they will be treating patients unlikely to seek care in a private dental practice.²⁸ As learned in medicine, no single program or oral health provider can do it all. To resolve the access to care crises, a team must include dentists, dental hygienists, educators, nutritionists, nurses, physicians and other health care professionals who work together to identify and meet the needs of populations. As leaders, rather than continuing to promote the status quo, we must design and test new ways to improve oral health outcomes in a manner that does not discriminate. The ADHP, building upon the already established roles of licensed dental hygienists, can collaborate with dentists and other health professionals to reduce existing health disparities. Moving beyond traditional modes of practice will enable improved quality of life for all.

It is likely that the ADHP provider will save critical health care dollars by making care accessible for those who currently receive no care or, when in pain, seek costly emergency room care. Further cost savings are obvious when considering the preventive, educational and primary care procedures provided by ADHPs that could lead to fewer complex dental problems, reductions in the use of sick days and increased workforce productivity. More importantly, preventive oral health care for children can lead to improved nutrition, positive self image and greater success in school.

In the age of health reform, the dental hygiene profession, in conjunction with dentistry, is well poised to deliver cost-effective, quality, primary care that will aid the United States taxpayer now and in the future. In addition to Minnesota and Washington, other states and higher educational institutions are planning ADHP graduate programs, e.g., Connecticut, New Hampshire, Idaho and New Mexico.

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Methadone and Oral Health – A Brief Review

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Introduction

The University of British Columbia Professionalism and Community Service (PACS) module¹ lists community service learning as its main pedagogy, and is taught at the Doctor of Medical Dentistry undergraduate program. Community service learning is also offered at the University of British Columbia Dental Hygiene undergraduate program separately from the PACS module. In both cases, however, the community service learning initiatives are supported by didactic lectures and cases discussions. In one of these community activities, students reach underserved communities, including methadone maintenance therapy patients, at the Portland Dental Clinic.^{2,3} The clinic is located in the Vancouver Downtown East Side, the poorest postal code in Canada, and employs dental hygienists and dentists who focus on a population of individuals with special needs and a variety of medical challenges, including those enrolled on a methadone maintenance therapy.⁴ The clinic also offers opportunities for senior dental and dental hygiene students to engage on clinical rotations and on health promotion activities. In the academic year of 2008/2009, a PACS group of 8 second year junior dental students and a dentist tutor from the University of British Columbia Faculty of Dentistry were assigned to the Portland Dental Clinic as a community site to develop a collaborative, non-clinical community class project about the side effects of methadone. This manuscript incorporates parts of that class project as it reviews the literature on the oral side effects of methadone, and offers some recommendations and considerations when providing dental and dental hygiene treatment to methadone users.

The authors believe that such a manuscript would be of benefit not only to community dental and dental hygiene clinics similar to the Port-

Abstract

Purpose: Methadone is a prescription drug used to help individuals overcome withdraws from highly addictive illicit substances, such as heroin, but it has detrimental oral health effects. This manuscript reviews the oral health manifestations of methadone maintenance therapy, and considers its implications to oral care. It hopes to raise awareness among health care professionals, regulating bodies and the population at large about the oral side effects of methadone, the implications for dental treatment and considerations to better enhance the oral health of methadone users. The role of professional teams, particularly dentists and dental hygienists, is illustrated.

Keywords: Methadone, Dentistry, Dental Hygiene, Community Services, Dental Education, Oral Health

This study supports the NDHRA priority area, **Health promotion and disease prevention:** Investigate how environmental factors (culture, socioeconomic status–SES, education) influence oral health behaviours

land Dental Clinic, but also to other health units, students, health professionals and the community at large. As discussed by Farnsworth (2004),⁵ this manuscript hopes to:

- Increase the knowledge of oral health care professionals and staff working with methadone users on appropriate health promotion strategies and practices to integrate oral health into health promotion strategies
- Raise awareness of the appropriate oral health promotion information and education for clients under methadone maintenance therapy programs

Review of the Literature

A brief literature review using OVID (MEDLINE), Google Scholar and STATRef was undertaken into the context of "methadone and dental considerations," and on "methadone and adverse effects on oral health."^{2,3,6–32} The review was not done systematically, but to synthesize relevant literature. We now discuss methadone and other opiates and oral manifestations of methadone therapy, and consider

the provision of dental and dental hygiene treatments and access to care for methadone users.

Understanding Methadone

It is estimated that between 60,000 to 90,000 Canadians are addicted to illicit opiates, such as heroin. Methadone is a prescription drug used to help individuals overcome withdraws from highly addictive illicit substances, such as heroin, and was first used as such in Vancouver in 1959.³³ According to the North American Opiate Medication Initiative, "chronic, untreated opiate addiction is associated with overdose, infection risks and epidemics, loss of regular social functioning, drug-related and drug acquisition crime, and extensive costs to the public health, welfare and criminal justice systems."³⁴ This report also states that the average cost of untreated heroin addiction exceeds \$45,000 USD per person annually. The use of methadone can then be seen as a harm-reduction approach, which decreases the financial burden of drug addiction to the health care system.

Opiates like heroin and morphine act on the μ -receptors in the brain to release dopamine. Methadone is a synthetic long-acting agonist opioid on this receptor, and can be administered as maintenance therapy for opioid dependence.³⁴ Methadone prevents cravings while blocking the euphoric effects of heroin to establish abstinence.³ Methadone has an onset of action of less than 30 minutes, and its effects last between 24 to 36 hours.^{34,35} The objective is to maintain a low dose to prevent tolerance, while controlling cravings.^{21,22} Although still addictive, methadone is typically administered orally via a highly concentrated sucrose-syrup preparation,^{2,34} a method believed to decrease the seroprevalence of infectious diseases as it eliminates intravenous use and potential for needle sharing. However, the current methadone preparation has detrimental effects, particularly when associated with poor oral hygiene, high sugary diet and other illicit drug use.

General Health and Methadone

According to world wide reports, methadone maintenance therapy (MMT) patients tend to be between 25 and 35 years old, undernourished, cachectic in appearance and with general health problems including asthma, diabetes and clinical depression.^{2,19,35} MMT patients are often vague or guarded with their replies to medical history or medication questions. A poor diet, homelessness and past heroin abuse further contribute to the decline in general health.²¹ Poor self-esteem, low income and depression may lower the standards of general and oral hygiene even though not all drug users are within

the lower socio-economic groups.² Methadone users with poor general health, lowered immune response and increased risky sexual behavior are also at risk for HIV, hepatitis B and C and bacterial infections, including endocarditis.^{20,27}

Oral Manifestations of Methadone Maintenance Therapy (MMT)

Xerostomia

Methadone and other opioids suppress salivary secretion,² which is mediated by disordered peripheral signalling at parasympathetic muscarinic receptors, or centrally at primary salivary centers.¹¹ Since MMT patients can be often medicated with anti-depressants that further inhibit salivary flow, xerostomia is a common finding. With low saliva flow, generalized bacterial plaque accumulation from poor oral health and buccal cervical highly stained caries of the lower canines and premolars teeth are often present and pathognomonic on MMT patients (Figure 1),⁶ even though the mechanism of this particular pattern of decay is not fully understood.³⁶

Immunosuppression

Although MMT patients might be susceptible to immunosuppression, secondary to chronic infection (such as HIV), as well as poor nutrition, conflicting evidence exists as to whether or not methadone treatment can lead to immunosuppression.^{30,37} Exogenous opioids have been linked to immunosuppression, whereas endogenous opioids have been related to physiological immune signalling.³⁰

With respect to innate immune response, in vitro studies demonstrated that the exogenous opioid morphine suppresses macrophage activity for the fungus *Candida albicans*.²⁰ Recent animal studies have suggested that a central mechanism appears to be involved in immunosuppression, as opioids crossing the blood brain barrier might suppress natural killer cells and T-cell proliferation.³⁰ A human study compared heroine users with MMT patients to conclude that the latter showed a significant increase in T-cell proliferation.³⁷ This suggests that methadone seems to restore immune function,³⁸ conflicting with other studies.³⁹

Cell cycle dysfunction

Opioids have been related to derangement in cell cycling (e.g., apoptosis), while methadone seems to act as an effective cancer chemotherapeutic drug.²² Animal studies have indicated that chronic methadone treatment and repeated withdrawal impair cognitive function further and increase expression

of apoptosis-related proteins.^{14,29} Increased apoptosis may have oral implications including the disruption of natural microbial defence.^{21,22}

Increased sugar craving

The activation of μ and κ -opioid receptors has been shown to enhance the reward pathways generated by food ingestion.⁸ Methadone users seem to favour a high intake of sugars and low intake of fibre, which might result in a high prevalence of plaque biofilm accumulation and dental decay as seen in any individual who favours a high sugary diet and carbonated beverages in the absence of proper oral hygiene.^{18,32}

Analgesic Effect

Although methadone does not act as a potent analgesic, it does cause some analgesia through activation of the μ -opioid receptors,⁶ making it a valuable option in the management of chronic pain.²⁸ This analgesic effect may also mask the pain caused by oral diseases which might contribute to the seriousness, severity and high incidence of oral problems.²¹ When dental treatment is performed, however, the reduced responsiveness to analgesia might require higher doses of local anaesthetics and the need for more potent painkillers after treatment.^{13,21}

Dental Anxiety

Studies worldwide have found that nearly half of MMT patients have co-occurring mood, personality and anxiety disorders.^{2,23} Such disorders may contribute to a higher incidence of dental anxiety and needle phobia, discouraging dental or dental hygiene visits for cleanings or treatments.²¹

Bruxism

A higher incidence of bruxism has been seen in opioid-dependent patients.³¹ The exact mechanism is unclear, but may be related to the increased neurosis experienced by this population.¹⁰ Bruxism may lead to a higher risk of enamel wearing, temporomandibular joint disorders and myofascial pain.

Dental and Dental Hygiene Considerations for MMT patients

MMT patients might present with behavioral and psychosocial challenges that create barriers to accessing oral health care. Such disparity makes this population further vulnerable to dental diseases and in need of special attention and proper treatment. Charnock et al showed that 68% of drug users reported oral health problems, compared to 51% of

non-drug users.⁹ Almost 60% of the non-drug users made use of dental services regularly, compared to only 29% of the drug users – drug users may give low priority to their oral health. Charnock et al also revealed that about half of drug users sought dental treatment only when in severe pain, whereas only 30% of non-drug users visited the dentist under the same circumstances.^{2,13}

Barriers that might prevent access to dental and dental hygiene services include homelessness, prolonged drug binges, being waitlisted for drug treatments and rehab, low self-esteem and poor acceptability of services.²⁶ MMT patients might perceive and experience great marginalization and avoidance behavior by service providers. Sheridan, Aggleton and Carson found that 20.8% of drug users reported having treatment refused by dentists compared with 1.6% of non users.²⁵ The reasons for refusal by the dentist/dental team's perspective include patients' snobbish behavior, the need for blood tests prior to the appointment, arriving late or under the influence of alcohol and not making payments in a timely fashion. From the patients' perspective, issues of fear, perceptions that dental professionals are unsympathetic, being negatively labelled as a drug user and the inability to afford dental treatment remain the main reasons for not receiving care. Some patients even feared that others in the waiting room would "look at [them] and know [they were] user[s]."⁹

Lewis highlighted that generalized cervical buccal heavily stained carious lesions can be pathognomonic in both methadone and heroin addicts, similar to those who have undergone radiotherapy of the head and neck and those who take multiple xerostomic medications.¹³ Sheedy compared the detrimental effect of methadone to the oral cavity and coined the term "Methadone Mouth" to characterize the extreme poor oral health conditions of most long-term MMT individuals, particularly with rapid tooth destruction due to aggressive carious activity (Figure 1).²⁴ Methadone Mouth should not be mistaken, however, with "Meth Mouth" (Figures 2 and 3).

Meth Mouth is a term associated with the use of the illicit drug methamphetamine.⁴⁰ Although some methadone and methamphetamine users can present with the same oral condition, the latter tend to be more often associated with higher gross decay to the extent that the "teeth are in such disrepair that they are unsalvageable and must be extracted."⁴¹

Although methadone users tend to have a higher prevalence and severity of oral disease, methadone is not the only contributing factor.²⁴ Clinical depres-

Figure 1: Methadone Mouth



Figure 2: Meth Mouth



sion, for example, may lead to significantly higher apathy towards dental treatment. In all, methadone users have a greater need for holistic dental and oral care and education, and dental rehabilitation has been shown to play an important role in the reconstruction of one's identity which contributes positively to recovery.²¹

Dental Hygiene and Dental Care

Robinson found that MMT patients respond best to dental hygiene and scaling and dental treatment when they are put at ease, are well informed about the procedures and are encouraged to maintain regular appointments.²¹

The provision of a less elaborate course of dental or dental hygiene procedures, while still maintaining an acceptable standard of quality and professionalism, has been suggested.^{6,7,12,13} A simple dental scaling is suggested for the first appointment, and thorough subgingival calculus and plaque removal could then follow at a subsequent visit. Removable partial dentures and fillings could be favoured over

crowns and fixed partial dentures. Tooth extractions should be avoided when restorations are possible. However, it is not uncommon for methadone users to require multiple tooth extractions and complete maxillary and mandibular lower and upper dentures, due to the severity of dental disease.²⁴

As per the length of the appointments, 20 minute visits and a minimal number of follow-ups are recommended. Hence, as pain is exacerbated during withdrawal periods, dental hygiene and subgingival scaling and treatment should be planned outside this event. Some MMT patients may need to be placed on antibiotic or antifungal prophylaxis prior to dental and dental hygiene appointments.²

Discussion

Interprofessional care has an important role in reconstructing patients' identity towards recovery. Dentists, dental hygienists, dieticians, social workers, case managers, physician and others should work closely. Prevention becomes extremely important, and proper oral hygiene should be reinforced

daily, as in any high-risk caries group. Dietary advice should be given as MMT individuals tend to favour meals composed of sugary foods and beverages. Such dietary intake can result from suppression of appetite and increased craving for sweet foods. If at all possible, a low carbohydrate diet with sugar-free snacks should be encouraged,²⁴ and sugar craving should be understood within its effects on oral health.^{2,32} Advocating for cooking food should, however, be cautiously suggested, as it may be dangerous when judgment is impaired secondary to drug use.²¹ For xerostomia, sialogogues can be given and sugar-free chewing gum containing xylitol suggested to stimulate salivary flow. Salivary flow can be restored through the use of parasymphomimetics, such as pilocarpine.²⁴ To counteract the cariogenic effect of the sucrose syrup, methadone can be prepared in sugar-free or sorbitol solutions (an artificial sugar) or methylcellulose (less cariogenic carbohydrate).^{2,24} Hence, remineralizing and desensitising agents, such as fluoride and potassium nitrate, respectively, could be applied in conjunction with restorative and other preventive measures. As part of the interprofessional team, dental hygiene and dental treatment should be integrated into the rehabilitation process to reduce drug-related harm and improve re-socialization. For example, information about proper oral care should be emphasised by both professions to avoid mixed or contradictory messages as per importance or proper daily oral hygiene and frequency of dental and dental hygiene visits. Dentists and dental hygienists can improve oral care in MMT patients through education and advice, and through alternative and less intensive approaches to dental treatment. For example, they can both advocate for less elaborate dental and dental hygiene procedures under an acceptable standard of quality and professionalism.^{6,7,12,13}

Conclusion

We believe that this review adds positively to the knowledge of community dental and dental hygiene clinics, students, health professionals and the community at large. With the highlighted points for consideration, we hope to have increased the knowledge of oral health care professionals and staff working with methadone users. Hence, we hope to have raised awareness of the appropriate oral health promotion information and education for clients under methadone maintenance therapy programs.

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Incorporating Oral–Systemic Evidence into Patient Care: Practice Behaviors and Barriers of North Carolina Dental Hygienists

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Introduction

The dental hygienist's role as an oral health care provider involves examining patients for signs of oral disease, providing treatment and promoting home care that will help restore patients to a state of health and function. In addition, dental hygienists are often advocates for behavior or life–style changes that will promote total body health and well being. For example, dental hygienists routinely provide nutritional and smoking cessation counseling to help patients in achieving a healthier overall life–style.

Part of the dental hygienist's role as a clinician is identifying and treating periodontal disease. It is estimated that approximately 75% of adults in the United States have gingivitis, and about 35% have periodontitis, making periodontal disease a highly prevalent chronic inflammatory condition.¹

In recent years, there has been evidence of an association between periodontal disease and several other conditions, such as diabetes,^{2–5} cardiovascular disease,^{6–11} cerebrovascular accidents (such as stroke),^{12,13} respiratory diseases^{14–17} and adverse pregnancy outcomes, such as preeclampsia, low birth weight and preterm birth.^{18–25} In addition to the conditions listed above, other asso-

Abstract

Purpose: Current research has reported associations between periodontal and systemic health, however, there is little data regarding how dental hygienists are incorporating this evidence into the dental hygiene practice. The purpose of this survey research was to determine what practice behaviors are prevalent among North Carolina dental hygienists regarding the incorporation of oral–systemic evidence into practice as well as perceived barriers to implementation.

Methods: A questionnaire was developed, pilot tested, revised and mailed to 1,665 licensed dental hygienists in North Carolina. After 3 mailings the response rate was 62%, with 52% (n=859) of respondents meeting inclusion criteria. Survey data was analyzed using descriptive statistics and Chi-square analysis.

Results: Respondents were predominately female (99%) with a 2 year degree (84%). While a minority of dental hygienists (20%) reported measuring blood pressure routinely on all patients, a majority (62%) measure blood pressure in select patients. Oral cancer screenings were performed by 89% of respondents. Eight percent record blood sugar levels, but only 3% record HbA1c values. Fifty percent of dental hygienists are extremely likely to refer patients to a medical provider for follow up assessments. Conditions dental hygienists are likely to discuss with patients include tobacco use (89%), pregnancy (84%) and genetics (79%). Significant barriers to implementing oral–systemic evidence include lack of time (52%), concern over legal risks (44%) and lack of education (27%).

Conclusion: North Carolina dental hygienists are implementing some aspects of oral–systemic evidence into practice, but could take a more active role if they had more allotted time, education and training.

Keywords: Dental Hygienist, Periodontal Disease, Oral–Systemic Evidence, Oral–Systemic Disease

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

ciations are actively under investigation, including obesity,^{26,27} kidney disease,^{28,29} cancer,^{30,31} and metabolic syndrome.^{32,33}

According to 2006 data from Centers for Disease Control and Prevention, approximately 70% of the population visit a dental office at least once yearly.³⁴ The dental hygienist is often the dental team member that provides prevention and intervention services. This may make the dental hygienist a critical health care provider to perform periodontal disease-based risk assessment and interventions to potentially prevent systemic complications and improve overall health. The purpose of this study was to assess practice behaviors and perceived barriers of North Carolina dental hygienists regarding the incorporation of oral-systemic evidence into patient care.

Review of the Literature

Health Care Providers' Knowledge, Behaviors and Opinions Regarding Oral-Systemic Disease

In light of the growing evidence regarding oral health and systemic health connections, it is imperative that the roles of the medical provider and oral health care provider are evaluated in terms of risk assessment strategies and practices, opinions regarding the evidence of a connection and practice behaviors concerning patient care. Research has been conducted in this area, and overall findings have indicated low levels of knowledge and formal training.³⁵⁻³⁷ In a study conducted by Lewis et al, pediatricians reported that they felt that they had an important role in identifying dental problems and educating families (90%). However, half of the physicians reported they had no training in medical school or residency concerning oral health.³⁷ Studies conducted by Yuen et al and Vinson et al revealed similar findings, in that the certified diabetes educators polled felt that oral health was important for patient education and care, but that the education practitioners received and their current knowledge levels were lacking.^{35,36}

Research investigations have also reported that medical practitioners demonstrate low rates of performing regular oral exams for patients. A study conducted by Wilder et al indicated that if obstetricians perform oral examinations, they happen at the initial pre-natal visit only or if the patient reports a problem.³⁸ Thomas et al found that, among nurse practitioners, physician assistants and nurse midwives, oral exams were typically performed on pregnant patients at the initial visit, if performed at all, and the majority of practitioners' educational programs did not include oral health education (62%).³⁹

Due to reported low knowledge levels and low rates of education regarding oral health in medical programs, it may be the responsibility of oral health care providers to initiate patient awareness of potential oral-systemic connections. Because the dental hygienist may treat the dental patient multiple times during a year, the dental hygienist could play a primary role in performing risk assessment for oral-systemic disease.

Oral Health Care Practitioners' Knowledge and Practices Regarding Oral-Systemic Disease

Several risk factors for systemic diseases, such as diabetes, cardiovascular disease and cerebrovascular accidents, adverse pregnancy outcomes and others, can be assessed in the dental office. Thorough review of the patient's medical history can provide insight in terms of life style, habits, medications and existing systemic conditions. Assessment of blood pressure, oral cancer screening, periodontal examination, nutritional counseling, tobacco cessation counseling and blood glucose testing can be performed in the dental office.

Two recent studies assessed the curriculum content regarding oral-systemic connections among United States and Canadian dental schools and United States dental hygiene programs.^{40,41} Overall, oral-systemic connections are being formally included in the curriculum, and students are being evaluated on their abilities to assess risks and discuss these topics with their patients. Topics allotted the most time (less than or equal to 7 hours) and most emphasized in their curricula were tobacco use, diabetes and cardiovascular disease. Students in dental hygiene programs were evaluated based on their ability to assess risks most often in regards to tobacco use (94%), diabetes (90%), cardiovascular disease (87%) and adverse pregnancy outcomes (79%).⁴¹ Current graduates are being educated regarding oral-systemic disease, and the next logical step is to assess what dental practitioners are doing to incorporate this knowledge into practice.

Overall, it has been found that dentists are more likely to assess for risks and to discuss systemic health issues with their patients, and that they are less likely to actively manage their patients (e.g. perform finger stick test to assess blood glucose levels). Kunzel et al conducted a survey in which they contrasted general dentists and periodontists involvement in 3 areas of managing diabetic patients: assessment of health status, discussion of pertinent issues and active management of patients.⁴² In terms of active management, 47% of general dentists and 56% of periodontists were categorized as low performers.⁴² Forbes and colleagues

observed similar findings in a 2008 study, in which most dentists polled reported they participated in the assessment and discussion phases of diabetes management, but there was a much lower prevalence of active management.⁴³

A national survey conducted by Boyd et al focused on dental hygienists knowledge and practices regarding periodontal disease and diabetes. Participants reported that they were most likely to provide referral services (54%) and use diabetes education materials (46%). They were least likely to use a glucose monitor to check a patients' blood glucose before or after treatment (83%) or have a glucose monitor in the office and know how to use it (76%).⁴⁴

Barriers to Implementing Research Evidence into Practice

For any field to stay current, or to employ evidence-based practice, it is essential that practitioners are familiar with the research evidence and are capable of implementing it routinely. This proves challenging for many reasons, with studies in the field of nursing illuminating some of those challenges. In a study conducted by Schoonover, registered nurses completed a survey regarding barriers to research utilization.⁴⁵ Barriers reported among this group were lack of authority to change patient care procedures, lack of time to read research and lack of awareness of research. Hutchinson et al conducted a survey of nurses in Australia to assess barriers to, and facilitators of, research utilization in the practice setting. The barriers reported by participants included time constraints, lack of awareness of available research literature, insufficient authority to change practice, inadequate skills in critical appraisal and lack of support for implementation of research findings.⁴⁶ In a more recent study, Chang et al polled nurses in Taiwan regarding barriers to implementing evidenced based practice in nursing homes. The most frequently cited barriers were related to insufficient authority to change practice, difficulty understanding statistical analyses and a perceived isolation from knowledgeable colleagues with whom to discuss the research.⁴⁷

Hughes et al conducted a study to assess how frequently a group of dental hygienists performed screenings for hypertension and barriers to performing the screenings. The results revealed that the majority of respondents were not performing blood pressure screenings, despite the fact that their curricula stressed the importance of this practice for all patients. The most frequently cited barriers were insufficient time in the appointment and minimal value given to the procedure by their employers.⁴⁸

While research provides insight into attitudes, beliefs, knowledge and practice behaviors of medical, nursing and oral health practitioners regarding some specific areas of oral-systemic health, to date there have been no published studies that assess dental hygienists' knowledge, attitudes and practice behaviors regarding oral-systemic health and how they are incorporating evidence into clinical practice. Therefore, the purpose of this study was to assess the practice behaviors and perceived barriers of North Carolina dental hygienists in regards to the implementation of oral-systemic evidence into patient care.

Methods and Materials

A cross-sectional survey of practicing North Carolina dental hygienists was conducted between October 2009 and February 2010. The survey instrument was developed by the research team and pilot tested after approval by the Biomedical Institutional Review Board of the University of North Carolina at Chapel Hill. Pilot testing occurred with 10 dental hygienists, holding various dental hygiene degrees. The survey instrument was revised using feedback from the respondents. The final survey included 39 items and focused on various systemic health issues as they relate to periodontal disease (e.g. diabetes, cardiovascular disease, respiratory disease, etc.). The following sections were included: demographics, practice behaviors, knowledge, attitudes and opinions and barriers. The current paper focuses on the practice behaviors and barriers sections of the survey. The survey instrument, developed in Teleform format, contained Likert-scale questions and close-ended questions. Teleform is a computer program that creates documents which can be scanned into a computer, facilitating speedy and correct data entry.

Names and mailing addresses of the 5,505 licensed dental hygienists in North Carolina were obtained from the North Carolina Board of Dental Examiners. From the original sampling frame, 30% (n=1,665) were randomly selected to receive surveys. The survey instrument, cover letter explaining its purpose and business reply envelopes for return were distributed via mail, utilizing 3 mailings in accordance with the Salant and Dillman methodology.⁴⁹ The mailings occurred between October 2009 and January 2010. The cover letter instructed recipients who were unwilling to participate or no longer provided patient care to return their survey blank, thusly alerting us to their status. To maintain confidentiality, the surveys were numerically coded, and participants were not asked to include any personal information on the survey. The research assistant maintained a linkage file to prevent duplicated mail-

ings to respondents. The linkage file was destroyed at the end of the third mailing.

The data was analyzed using SAS version 9.1 (SAS Institute Inc., Cary, North Carolina), using descriptive statistics. Chi-square analyses were performed to assess whether the following categories were associated with the respondent's age, practice type or practice setting: actively engaged in evaluation of periodontal disease, incorporating systemic health management and perceived barriers to incorporation. Level of significance was set at 0.05.

Results

There were a total of 1,030 surveys returned by recipients (yielding a total response rate of 61.9%). Of these, 859 were completed surveys (yielding a 51.6% usable response rate) and 171 were blank returned surveys. Thirty-two were not deliverable. Respondents were overwhelmingly female (99.5%), with 55% between the ages of 31 and 50. The majority of respondents (84.1%) held a 2 year degree in dental hygiene (associate or certificate). The mean number of years since graduation was 17.7, with a standard deviation of 11.9 (Table I).

Most respondents (84%) indicated that periodontal exams were performed on new patients, and a majority (69.3%) performed periodontal exams at every visit for their periodontal maintenance (D4910) patients. Overall, patients receive periodontal evaluations on a regular basis, ranging from comprehensive full mouth probing to more abbreviated exams, such as periodontal screening and recording and "spot probing" (Table II). The most frequently evaluated indicators of oral health were oral cancer screenings (89.2%), plaque and calculus (91.9%) and gingival appearance (92.%) (Table III).

Sixty-eight percent of respondents reported that the medical history was updated at every visit, and 66% utilized blood pressure cutoffs beyond which no treatment will be provided. Twenty percent of respondents measure blood pressure on all patients, and 62% measure blood pressure on select patients. However, very few (7.6%) record blood

Table I: Demographic and practice characteristics of NC dental hygienists (N=859).

	Respondents	N	%
Age	857		
<30	151	17.6	
31-40	239	27.9	
41-50	235	27.4	
51-59	189	22.1	
≥60	43	5.0	
Dental Hygiene Degree	851		
Certificate/ Associate (2 year)		716	84.1
Bachelors (4 year)		135	15.9
Primary Practice Type	856		
Group private		263	30.7
Solo private		537	62.7
Public health/Other		56	6.6
Primary Practice Setting	817		
Urban		318	38.9
Suburban		335	41.0
Rural		164	20.1
Hrs/week providing patient care	844		
1-10		56	6.6
11-20		116	13.7
21-30		217	25.7
≥31		455	64.7

*The total number of participants who completed the survey was 859, however some participants skipped questions. The total number of responses per item is indicated in the column marked "Respondents". Percentages may not add up to 100 due to rounding.

sugar levels of diabetic patients, and even fewer (2.8%) record HbA1c values (Table IV). The majority of respondents discuss medications (92.9%) and medical diagnoses (69.6%) with all patients. Blood pressure (62.2%) and stress (64.1%) are discussed with some patients. Bone density (58.9%), physical activity (65.4%), cholesterol (65%) and body mass index (BMI) (79.5%) are typically not discussed (Table V).

Only 34% of respondents reported asking about diabetic patients' blood glucose levels, and only 8% asked about HbA1C values. Eighty-nine percent of respondents reported that they were "extremely unlikely" or "unlikely" to assess patients for diabetes using a glucometer (Table VI). However, 61.7% reported that they are "extremely likely" or "likely" to educate patients about the link between oral infection and glycemic control. Fifty percent reported that they were extremely likely to refer patients to medical providers for follow up for signs and

symptoms detected during a dental hygiene appointment. The survey asked whether or not participants had a role in deciding which patients are referred to a medical doctor or dental specialist, and 79% reported that they do.

The health topics which hygienists most frequently discussed with patients were tobacco use (89%), pregnancy (84.1%), genetic issues (79%), diabetes (75.9%) and stress (66.3%). The conditions for which dental hygiene practitioners were most likely to refer patients to a physician were HIV (35.7%), cardiovascular disease (30.5%), respiratory disease (28.1%), stroke (27.2%) and diabetes (25.5%). Practitioners most often ("always" and "frequently") consult with medical providers regarding need for pre-medication (80.2%), coagulation issues (48.5%) and treatment needs for patients with cardiovascular disease (32.4%) (Table VII).

The most frequently reported "significant" barriers were patients' objection to additional fees for services (68.9%), limitations of time in practice schedule (51.5%) and lack of reimbursement from third party payers (46.4%). Lack of education was perceived by 27.4% of dental hygienists as a "significant barrier" and as "somewhat of a barrier" by 61.3% (Table VIII). For this section, the barrier heading "Patients' objection to additional fees for service" was not qualified in terms of whether or not fees already exist, or if the implication was that the practitioners would begin charging for services rendered (such as glucose testing and counseling). The term "services" was also vague, so these phrases were left to the interpretation of the respondents.

The proportion of dental hygienists who actively participate in evaluating patients for periodontal disease was significantly different among the age groups (Table IX). Younger dental hygienists are more likely to be active in evaluating patients for periodontal disease as well assessing and discussing systemic health

Table II: Practice Behaviors as reported by NC dental hygienists regarding periodontal health examinations.

	Respondents	N	%
Periodontal exams performed on new patients	843		
Always		708	84.0
Often		69	8.2
Sometimes		45	5.3
Infrequently		21	2.5
Who performs new patient perio exams	835		
Dentist		183	21.9
Hygienist		615	73.7
Both		37	4.4
Frequency of periodontal exams for adult prophylaxis patients (D1110)	842		
Every visit		314	37.3
Every 6 mos		169	20.1
Every year		265	31.5
Less frequent than once yearly		94	11.2
Frequency of periodontal exams for perio maintenance patients (D4910)	820		
Every visit		568	69.3
Every 6 mos		119	14.5
Every Year		93	11.3
Less frequent than once yearly		40	4.9
Type of probing for adult prophy patients (D1110)	838		
Full mouth probing		433	51.7
PSR		161	19.2
Spot probing		244	29.1
Type of probing for perio maintenance patients (D4910)	816		
Full mouth probing		677	83.0
PSR		75	9.2
Spot probing		64	7.8
Is the patient informed of perio diagnosis	843		
Always		703	83.4
Frequently		118	14.0
Infrequently		22	2.6

issues. The proportion of dental hygienists who perceived barriers to the incorporation of systemic health management was also significantly different among the age groups (Figure 1). Overall, older respondents and those in solo private practice tend to be more likely to perceive barriers as significant.

Table III: Frequency and for whom NC dental hygienists evaluate oral health indicators to determine oral health status

	All Patients		New/Select Patients		No Patients	
	N	%	N	%	N	%
Gingival Appearance	768	92.8	59	7.1	1	0.1
Plaque/Calculus	763	91.9	62	7.5	5	0.6
Oral Cancer Screening	746	89.2	82	9.8	8	1.0
Probing Depths	561	67.7	263	31.7	5	0.6
Bleeding on Probing	524	65.0	260	32.3	22	2.7
Tooth mobility	439	52.7	390	46.8	4	0.5
Furcations	388	47.3	411	50.1	21	2.6
Clinical Attachment Levels	309	39.9	408	52.6	58	7.5
Mucogingival Relationships	279	38.1	365	49.9	88	12.0

Practice type was significantly associated with engagement in managing systemic health issues (Table X) and perception of barriers (Figure 2). Practitioners in public health settings are more likely to be active in managing systemic health issues and are less likely to perceive barriers to the incorporation of systemic health management practices. Dental hygienists practicing in rural settings were least active regarding periodontal evaluation (Table XI). While Chi-square analyses were used to determine statistically significant differences for many areas, practice setting seemed only to affect periodontal evaluation issues.

Discussion

The results from this cross-sectional survey of North Carolina dental hygienists indicated that respondents are incorporating some aspects of oral-systemic evidence into patient care. Many respondents indicated they update medical histories at every visit, and evaluate blood pressure prior to treatment. Hygienists are also actively and routinely providing systemic health counseling in some areas, such as tobacco cessation. They reported having a role in deciding who is referred to a medical or dental specialist, and were likely to do so. This speaks to the amount of responsibility that is delegated to dental hygienists and the breadth of

Table IV: Practice Behaviors as reported by NC dental hygienists regarding evaluation of overall/systemic health.

	Respondents	N	%
Medical History (Med Hx) Updated	853		
Every appt.		581	68.1
Every 3–6 mos		94	11.0
Every Year		134	15.7
No regular schedule		44	5.2
Personally Review Med Hx	852		
Always		713	83.7
Often		105	12.3
Sometimes		18	2.1
Infrequently		16	1.9
Blood pressure cutoffs	813		
Yes		533	65.6
No		280	34.4
Diabetic Patients—Blood sugar	858		
Record		65	7.6
Ask About		292	34.0
Not Done		501	58.4
Diabetic Patients—HbA1C	858		
Record		24	2.8
Ask About		71	8.3
Not Done		763	88.9

Table V: Systemic health issues and the patients for whom NC dental hygienists assess or discuss risk.

	All patients		New/Select Patients		No Patients	
	N	%	N	%	N	%
Medications	777	92.9	57	6.8	2	0.2
Medical Diagnosis	584	69.6	238	28.4	17	2.0
Tobacco Use	336	40.2	477	57.1	22	2.6
Alcohol Use	144	17.3	423	50.7	267	32.0
Pulse	101	12.2	326	39.3	403	48.6
Stress	66	6.7	539	64.1	246	29.3
Physical Activity	20	2.4	270	32.3	547	65.4
Body Mass Index (BMI)	19	2.3	152	18.2	663	79.5
Cholesterol	25	3.0	268	32.0	545	65.0
Bone Density	9	1.1	335	40.1	492	58.9

Table VI: Frequency (%) of dental hygienists who are likely to perform/offer oral-systemic services or refer to/contact a medical provider regarding a systemic health issue.

	N	Extremely Likely	Likely	Somewhat Likely	Unlikely	Extremely Unlikely
Refer patients to a medical provider for follow up for signs and symptoms detected during a dental appointment	847	49.8	35.8	9.4	2.7	2.2
Educate patients about the link between oral infection and glycemic control	849	26.7	35.0	20.7	10.6	6.9
Call patient's physician to coordinate treatment	845	23.8	29.9	24.5	12.3	9.5
Offer nutritional counseling to patients	849	20.5	30.5	27.3	13.1	8.6
Offer tobacco cessation counseling	848	20.2	32.4	24.3	12.7	10.4
Refer patients to Quitlines or other cessation services	845	18.0	25.2	27.8	16.4	12.5
Discuss/Counsel obese patients about the risk of systemic disease	850	7.5	13.1	23.2	33.1	23.2
Refer patients to labs/physicians for fasting glucose testing	850	6.6	15.5	18.7	20.8	38.4
Assess patients for diabetes using a glucose monitor	849	1.6	2.6	6.8	33.3	55.6
Perform fasting glucose testing in your office with lab follow up	849	0.1	0.6	1.9	24.7	72.7

Table VII: Frequency (%) with which NC Dental hygienists reported consulting with medical colleagues and/or dental specialists regarding systemic health issues.

	N	Always	Frequently	Occasionally	Rarely	Never
Need for pre-medication	849	45.3	34.9	16.4	2.1	1.3
Coagulation issues	830	26.0	22.5	27.8	13.5	10.1
Patient's medications (e.g. physical/emotional)	830	12.9	19.2	36.5	20.5	11.0
Treatment needs for patients with CVD	828	10.4	22.0	34.5	19.8	13.3
Treatment needs during pregnancy	841	10.3	12.2	25.8	32.7	18.9
High or low blood pressure readings	830	7.2	15.5	32.4	26.5	18.3
Treatment needs for patients with diabetes	828	3.4	10.4	33.5	32.7	20.0
Patient's risk for diabetes	818	2.4	7.2	20.5	38.0	31.8

care rendered in the dental practice setting. If dental hygienists provide regular periodontal exams, and have a role in referring patients, they may be a critical health care provider to assess for oral-systemic risks and managing those risks.

In contrast, the current study found that, while assessment and discussion was ubiquitous among our study population, in-office active management (such as performing a finger stick test to assess for diabetes) was not prevalent. This is similar to the results of studies conducted by Kunzel⁴² and Forbes.⁴³ While a significant portion of the population visits a dental professional regularly,³⁴ many

people may only visit a physician when experiencing signs and symptoms of problems. In light of this, an argument can be made for more active general health screening and management in the dental office. In a recent study of North Carolina dental hygienists regarding educating and counseling patients about obesity, respondents were willing to discuss obesity with their patients, and 65% reported they were "highly confident" or "confident" about their abilities to discuss specific health risks associated with obesity and the importance of weight loss.⁵⁰ In contrast, data from the current study indicated that very few practitioners discuss issues like BMI and physical activity levels

Table VIII: Frequency (%) of NC dental hygienists who reported barriers to incorporation of oral-systemic evidence into practice

	N	Significant Barrier	Somewhat a Barrier	Not a Barrier
Patients' objection to additional fees for services	829	68.9	25.2	5.9
Lack of time in practice schedule	842	51.5	34.3	14.1
Lack of reimbursement from 3rd party payers	796	46.4	37.9	15.7
Concern over legal risks	818	44.1	43.2	12.7
May be perceived by state board as unauthorized practice of medicine	809	39.2	46.0	14.8
Lack of patient acceptance of dental professional providing counseling	839	31.9	54.6	13.5
Lack of education on systemic health	840	27.4	61.3	11.3
Lack of patient education materials	839	21.2	55.9	22.9
Fear of appearing judgmental to the patient/parent	838	21.0	57.3	21.7
Low level of confidence about actively managing patients with systemic health problems	838	15.4	61.1	23.5
Lack of CE opportunities	836	14.5	49.2	36.4
Lack of appropriate referral options within my community	828	12.2	47.2	40.6
Lack of definitive evidence to indicate oral-systemic connections	824	7.5	53.6	38.8

Table IX: The effect of age on practice behaviors.

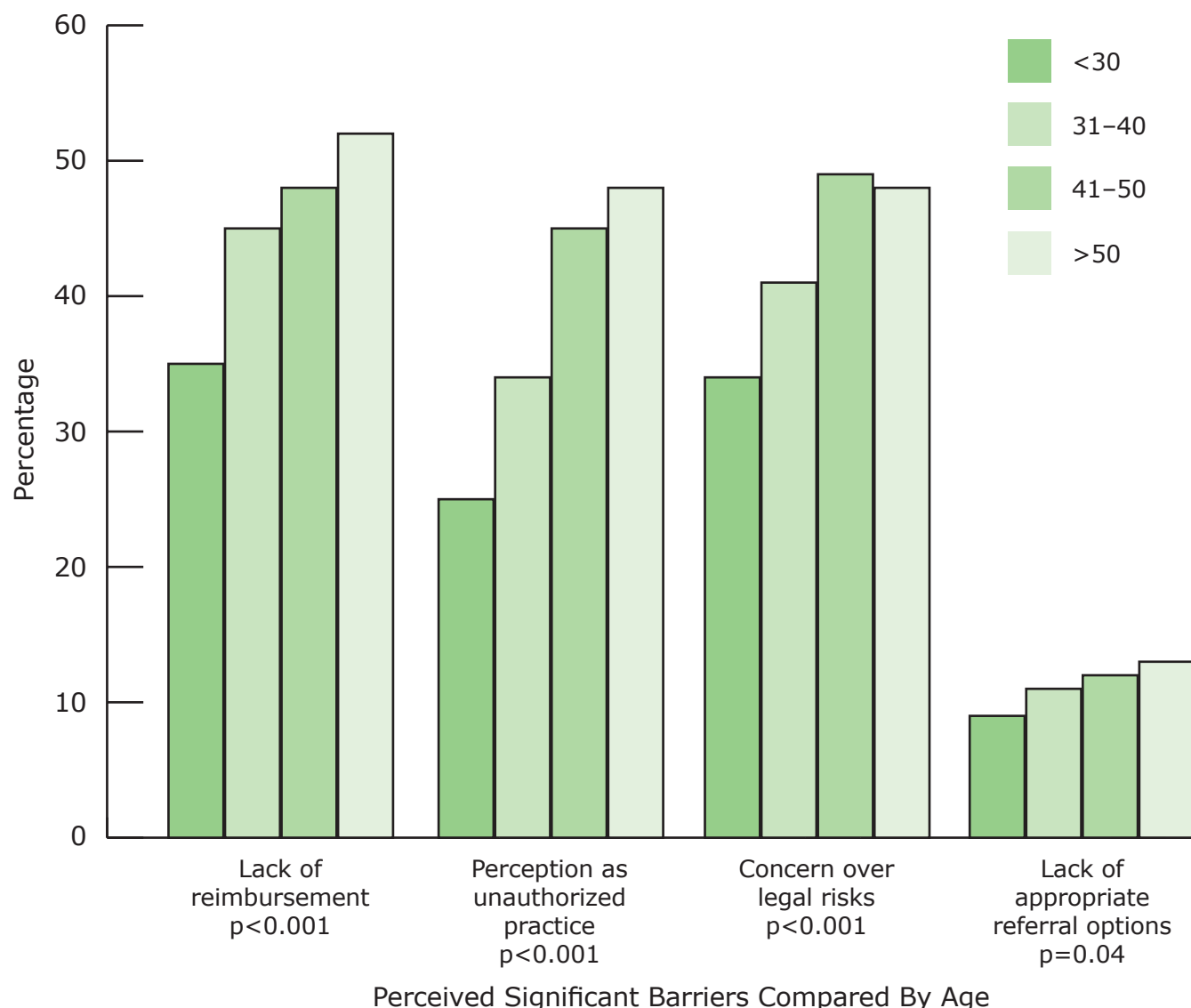
Practice Behavior	Age				P-Value
	<30 (%)	31-40 (%)	41-50 (%)	>50 (%)	
Ask about blood sugar	46	37	30	26	<0.001
Record Blood sugar	12	8	6	6	0.017
Discuss alcohol use with all patients	20	20	19	12	<0.001
Discuss tobacco use with all patients	45	43	42	32	<0.001
Perform full mouth probing for D4910 patients	88	90	78	78	<0.001
Evaluate probing depths for all patients	74	72	70	56	<0.001
Evaluate bleeding on probing for all patients	72	67	64	59	0.03

with their patients. Respondents more frequently consult with physicians regarding health issues that directly affect their process of care than active management of systemic health issues (e.g. coagulation issues and pre-medication needs). These are more immediate issues that can influence the safety of providing treatment the day the patient is scheduled rather than long-term oral-systemic health management.

Overall, younger hygienists (40 years old or younger) were more active in implementing oral-systemic evidence into practice. Also, they were significantly less likely than older hygienists to consider "concern over legal risk" and "perception by board as unauthorized practice of medicine" as

significant barriers. This is perhaps due to changes in dental hygiene curricula regarding the oral-systemic link. In our population, age was statistically correlated to number of years since graduation ($p < 0.001$), and was therefore used as a proxy measurement. Esmeili et al conducted a study assessing general dentists' attitudes and practices regarding patients with diabetes. They found that, compared to those with no formal training, those who had formal training were more likely to feel that they knew how to assess for diabetes, to feel well prepared and effective to intervene and to feel that they had appropriate knowledge about related pharmaceutical products. Dentists who had formal training were 4 times more likely to provide services to address diabetes than those who did not have

Figure 1: Comparison of perceived “significant” barriers by age



any formal training.⁵¹ A recent report on curricula in United States dental hygiene programs found that current graduates are receiving formal training concerning oral-systemic disease.⁴¹ Therefore, they should generally feel more comfortable than older practitioners regarding the incorporation of oral-systemic evidence into practice.

Practitioners in public health settings were more active regarding systemic health management (e.g. asking about, recording and discussing systemic health issues), but were least active in performing periodontal examinations when compared to practitioners in group or solo private practices. Public health dentistry in North Carolina is largely centered around children’s oral health. Local health departments and the dental clinics therein serve mostly children, with limited services for adults. Therefore, the lower rate of periodontal examinations is not surprising. The nature of public health

is typically in prevention and overall health management, so it is encouraging that the data supported active management of health.

The 5 most frequently reported “significant” barriers to implementation of oral-systemic evidence into patient care were patients’ objection to fees (69%), lack of time in practice schedule (52%), lack of reimbursement from third party providers (46%), concern over legal risk (44%) and perception by the dental board as the unauthorized practice of medicine (39%). Interestingly, if “significant barrier” and “somewhat a barrier” were combined to get a picture of what may be perceived as any kind of barrier, lack of education emerged as the second most reported barrier. Patients’ objection to fees remained the top reported barrier. These responses indicate an assumption that patients will be charged for additional services. In the study conducted by Esmeili et al, authors evaluated what

Table X: Effect of practice type on practice behaviors.

	Group Private (%)	Solo Private (%)	Public Health/ Other (%)	P-Value
Ask about blood sugar	32	33	52	0.014
Record blood sugar	8	5	27	<0.001
Ask about HbA1c	6	8	18	0.015
Record HbA1c	4	2	7	0.017
Have blood pressure cutoffs	70	62	81	0.006
Perform full mouth probing for D1110 patients	55	51	41	<0.001
Perform full mouth probing for D4910 patients	84	84	67	0.024
Evaluate probing depths	99	99	91	<0.001
Evaluate mobility	98	98	93	0.016
Discuss pulse with all patients	9	12	28	0.003
Discuss medications with all patients	96	92	92	0.04
Discuss medical diagnoses with all patients	77	67	59	0.001
Discuss alcohol use with all patients	18	15	34	0.004
Discuss BMI with new/select patients	19	16	30	0.04
Discuss bone density with new/select patients	43	40	20	0.022

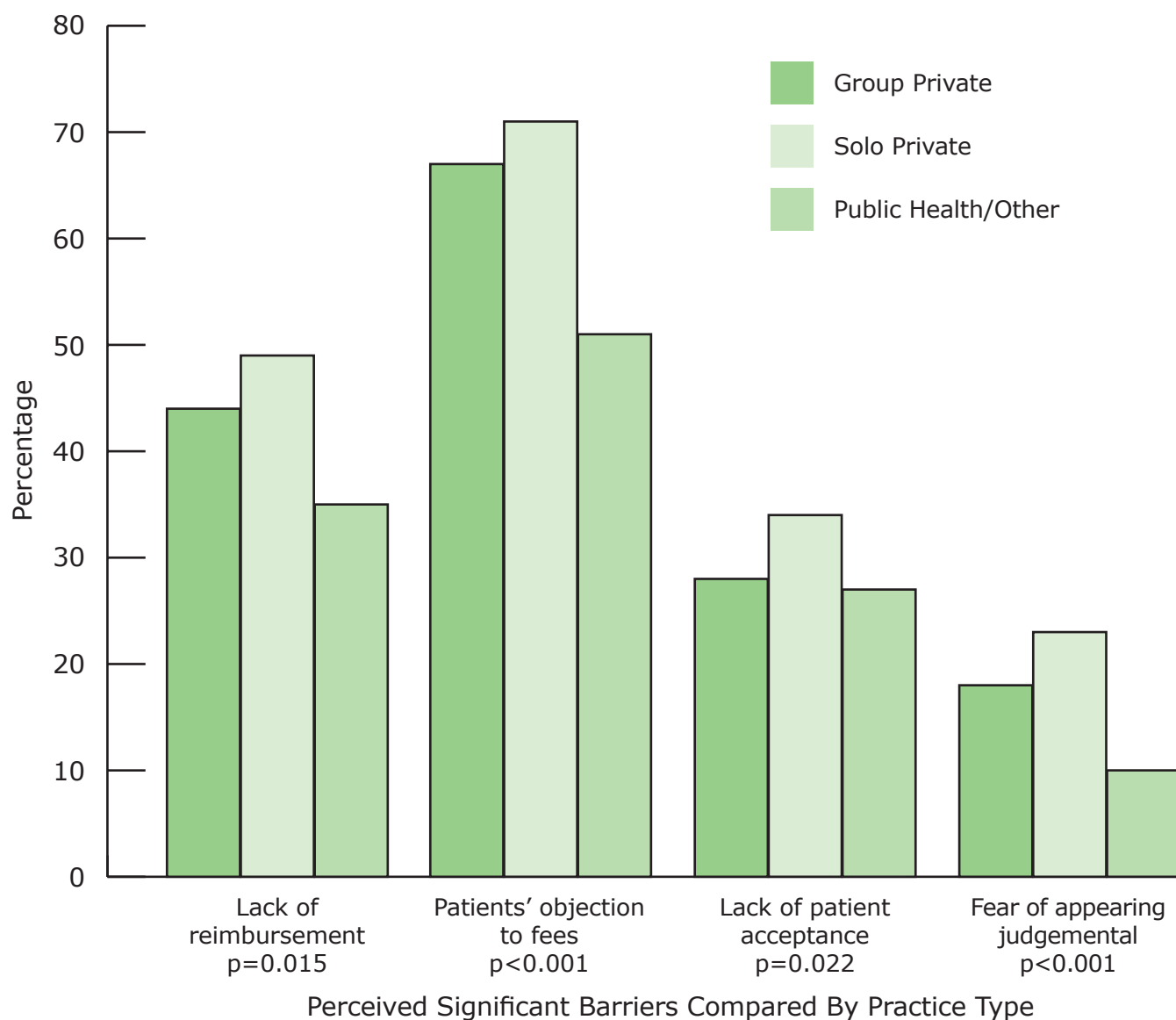
dentists perceived to be barriers to blood glucose measurement. Lack of reimbursement was the most frequently reported barrier (53%).⁵¹ The prevalence of systemic health services and counseling may increase if third party payers provide reimbursement. Another factor that influences dental hygiene care is the hygienist's philosophy of practice. Hygienists' expectations for their own level of professionalism, as well as the expectations of employers and patients, shape the way in which they practice, and what responsibilities they will assume. In striving to achieve "best practices," thorough periodontal evaluation and regular risk assessment through review of patients' medical histories should be a goal for dental hygiene practitioners. Also, if the dental team can collaborate with medical professionals, patients will receive more thorough care. Expectations regarding practices may change as evidence emerges, and perhaps in the future patients will expect more from dental professionals. If this happens, dental care may evolve into a more comprehensive discipline.

Incorporating oral-systemic disease assessment and treatment into patient care will require a level of interprofessional collaboration and education with other health care professionals. Interprofessional education is defined as an educational process that provides health professions students "with experience across professional disciplinary lines as they acquire knowledge and skills in subject areas required in their respective educational programs."⁵² For example, in the "seamless care"

model at Dalhousie University in Nova Scotia, Canada, teams comprised of students from medicine, nursing, pharmacy, dentistry and dental hygiene work together to provide collaborative care to patients transitioning from acute care to the community.⁵³ This learning model utilizes problem-based learning, cooperative learning and opportunities for reflection and integration of learning. Interprofessional education facilitates learning about other professions, as well as attitudes towards implementing a team-based approach.^{54,55} However, the history of interprofessional education in dentistry/dental hygiene in the United States has not been progressive, except in a few instances,⁵⁶⁻⁵⁹ and may take years to achieve. Perhaps oral health care professionals will need to take the lead in educating other health care professionals about the implications of oral disease to systemic health.⁶⁰ Also, continuing education is an avenue that may impact the practice of dentistry. As practitioners become more familiar with the link between oral health and systemic health, integration of this knowledge into patient care might become easier as well as more prevalent. Continuing education, in which dental and medical professionals learn together, may be an ideal route to promoting interprofessional collaboration.

There were certain limitations to this study. Generalizability may be limited due to non-response bias. Those who took the time to complete the survey may have higher levels of interest than others, and thus may be more likely to perform in the

Figure 2: Comparison of perceived “significant” barriers by practice type



questioned areas. If respondents were inherently more proactive, then the results may be skewed to reflect more proactive practices. However, the high response rate gives strength to the results and increases generalizability. Another consideration affecting generalizability may also be the distribution of the survey in North Carolina alone. For example, the relatively restrictive practice act in North Carolina may create a tendency for dental hygienists to be reluctant about more active patient management, producing a lower rate of performance than the national average. A national distribution of the survey would lend considerable insight. Conversely, North Carolina is the tenth most populous state and is growing rapidly.⁶¹

Table XI: Effect of practice setting on practice behaviors

Practice Behavior	Urban (%)	Suburban (%)	Rural (%)	P-Value
Perform periodontal exam at every visit for D1110 patients	40	41	26	0.022
Perform full mouth probing for D1110 patients	50	56	43	0.037
Evaluate probing depths for all patients	70	70	57	0.007
Evaluate mobility for all patients	58	48	52	0.037

North Carolina also ranks tenth in terms of elderly population (65 years and older), with a 2008 estimate of 1,139,052 residents in this category.⁶² As the population ages, people tend to have more

systemic health issues. More active care from oral health care providers is important for the overall health of this population. These population characteristics make North Carolina a state that is representative of the population as a whole.

Conclusion

North Carolina dental hygienists are actively and routinely incorporating some aspects of oral-systemic evidence into patient care. A more active role in patient management would necessitate more time in their practice schedules, and more education and training. Further research in this area is needed. Appropriate next steps may include surveying practitioners on a national level to ascertain practice behaviors and barriers among a more diverse population. Furthermore, entry-level education and continuing education regarding the oral-systemic connection should help ensure incorporation of this evidence into patient care.

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Assessment of the Skills and Education Necessary for a Baccalaureate-Prepared Dental Hygienist to Pursue an Entry-Level Role in Clinical Research

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Introduction

In 1987, the American Dental Hygienists' Association (ADHA) recognized research as 1 of 6 professional roles of the dental hygienist. The ADHA further established a research agenda promoting the advancement of the dental hygiene profession and good oral health.¹ Furthermore, the goal of the ADHA's Division of Research is to expand the involvement of dental hygienists in an array of oral health research initiatives focusing on health promotion and disease prevention, health services research, professional education and development, clinical dental hygiene care and occupational health and safety.¹ Fulfillment of these initiatives through clinical research projects led by dental hygienist investigators will not only play a crucial role in developing evidence-based treatment modalities and clinical techniques, but will also help to advance the dental hygiene profession.¹

By clearly defining the skills and education required for an entry-level position in clinical research, more dental hygienists may consider this career path. Once key entrance criteria are identified, dental hygiene curricula could incorporate this knowledge into the research-related competencies, thereby encouraging new graduates to become involved in the re-

Abstract

Purpose: To assess the skills and education perceived as necessary for a baccalaureate-prepared dental hygienist to pursue an entry-level role in clinical research.

Methods: An electronic survey was developed and distributed to 124 dental hygienists. Participants held at least a baccalaureate level of education and were currently involved in clinical research or had previous clinical research experience.

Results: The survey response rate was 45% (n=56). Of the 56 respondents, 71% (n=40) met all inclusion criteria. The majority of respondents agreed that the University of Michigan Degree Completion and the Society of Clinical Research Associates program competencies align with the skills and education needed to pursue an entry-level role in clinical research. Grant writing skills and the ability to prepare a manuscript for submission to a peer-reviewed journal were not perceived as necessary for an entry-level position.

Conclusion: Clinical research is a viable career option for dental hygienists. Obtaining a baccalaureate level of education will assist with acquiring entry-level clinical research skills. Additional education is necessary to expand clinical research opportunities. Both education and mentoring are integral components for pursuing a career in clinical research. Expanding upon the research-related competencies of dental hygiene program curricula is one avenue for achieving these recommendations.

Keywords: Clinical research, baccalaureate level education, dental hygienists, entry-level clinical role

This study supports the NDHRA priority area, **Professional Education and Development:** Investigate curriculum models for training and certification of competency in specialty areas (e.g., anesthesiology, developmentally disabled, forensics, geriatrics, hospital dental hygiene, oncology, pediatrics, periodontology, and public health)

search field. The objective of this study was to assess the skills and education perceived as necessary for a baccalaureate-prepared dental hygienist to pursue an entry-level role in clinical research.

Review of the Literature

Research is a viable career option for dental hygienists.²⁻⁵ In 2002, the director of the National Institutes of Health (NIH) convened a series of meetings to devise a "roadmap" for medical research in the 21st century, which included oral health.^{6,7} The NIH Roadmap 2002 created additional clinical research opportunities for health professionals, including dental hygienists.

Today, health care is focusing on prevention. As a part of the preventive branch of dentistry, dental hygienists are well suited to contribute to this body of knowledge.⁵ Some years ago, other health professions, such as nursing and pharmacy, recognized the importance of being major contributors to their professional body of knowledge. These health care professionals assumed central roles in clinical research projects, thereby advancing their respective fields.⁵ Dental hygienists should also be major contributors to evidence-based dental research. Unfortunately, as a profession, this task has not been fulfilled.⁵ Moreover, recent studies indicate a lack of interest among those in the profession toward the researcher role.^{8,9} Is the deficit of dental hygienists involved in clinical research related to a lack of understanding of the skills necessary to pursue this career path?

During the 1970 ADHA Annual Session, focus was directed to the importance of research. Emphasis was placed on building a well-defined, well-organized body of knowledge that would promote dental hygiene education, practice and research.¹⁰ The identified need for conducting a systematic approach in dental hygiene research led the ADHA to develop the National Dental Hygiene Research Agenda (NDHRA), which was formulated in 1994.^{10,11} The NDHRA provides a guideline for research topics and is periodically revised to reflect prioritized investigational themes. The overall goals of the ADHA's Division of Research are to expand their involvement in an array of oral health research initiatives and to support association related endeavors that rely on research. The ADHA further supported these initiatives by adopting a model of evidence-based practice, whereby new research would be continually conducted, building a rigorous body of knowledge.

Pursuant of this mission, education is the most essential and integral component baccalaureate-prepared dental hygienists can gain when pursuing a

career in clinical research (Cugini, personal communication, July 2009). The baccalaureate-prepared dental hygienist possesses unique qualifications, such as educational background, patient assessment and management skills and clinical training, all of which align with the skills needed for attainment of a research role (Gilson-Layher, personal communication, July 2009).

A study conducted in 2002 supports the importance of additional education as it relates to preparing dental hygienists for research roles.¹² A survey of 235 program directors in the United States (77% baccalaureate and 23% non-baccalaureate), regarding the incorporation of evidence-based principles into curricula, revealed that the additional education obtained through a baccalaureate program provides more exposure to evidence-based practice and research methods. Results of the survey indicated that evidence-based principles were incorporated to some degree in both baccalaureate and non-baccalaureate programs, but to a much greater degree in baccalaureate programs.

A study conducted in Sweden in 2005 identified that additional education has an impact on the various aspects of research utilization of dental hygienists.¹³ A randomized survey was given to 261 dental hygienists in Sweden regarding their attitudes towards research, research utilization and practices of researching new information. Among the 148 dental hygienists with 2 years of education, a more positive attitude was demonstrated toward research than the 113 hygienists with just 1 year of formal education. Also, the hygienists with more education took a more active role in researching and applying new information.

Cobban et al proposed a model of collaboration as a solution to increasing research involvement among dental hygienists.¹⁴ Cobban suggests that partnerships between less experienced and more experienced dental hygiene researchers in a supportive educational setting would assist with increasing dental hygiene research efforts. The commitment of dental hygiene program directors to incorporate evidence-based principles, research-related competencies and opportunities to work with mentors to gain practical research experience will assist with laying a foundation for baccalaureate dental hygiene graduates to feasibly seek a career in research.

Although dental hygienists can gain exposure and develop research-related competency during their university education, additional training beyond the baccalaureate program will benefit the dental hygienist when choosing to pursue a career in clinical research. Advanced training can be sought through

on-the-job training opportunities, university sponsored workshops and certification programs offered through professional research organizations. The Society of Clinical Research Associates (SOCRA) and Association of Clinical Research Professionals are 2 highly respected certification organizations (Gilson-Layher, personal communication, July 2009).^{15,16}

Though clinical research is a viable career option, a lack of knowledge exists identifying the baseline criteria necessary for a baccalaureate-prepared dental hygienist to follow this career option. The objectives of this study were to identify the skills and education perceived as necessary by experienced dental hygiene researchers to pursue an entry-level role in clinical research, and to compare survey results to research-related competencies of the University of Michigan Dental Hygiene Degree Completion e-Learning Program and the SOCRA certification program.

Methods and Materials

A cross-sectional electronic survey was designed and distributed to dental hygiene researchers. Participants of the survey consisted of a convenience sample of 124 dental hygienists that attended the 2009 North American Dental Hygiene Research Conference. An electronically mailed letter was sent twice during a 1 week period of time. The letter described the project and its intended significance. Included in the letter was an invitation for recipients to participate in the survey via a link to SurveyMonkey.com.

Inclusion criteria included current or previous participation in clinical research and having at least a baccalaureate level of education. Two screening questions were incorporated at the start of the survey to verify that all participants met inclusion criteria. Those participants not meeting all inclusion criteria were removed from the survey.

Eleven Likert-scale survey questions were developed to assess the education, training and skills participants perceived as essential for baccalaureate-prepared dental hygienists to have when pursuing an entry-level role in clinical research. Five of the questions were derived using the University of Michigan Dental Hygiene Degree Completion e-Learning

Program competencies. Six questions were developed from the SOCRA program competencies. Two additional Likert questions were included relating to other aspects of the clinical researcher role. An open-ended question asked what education and/or skills were most helpful for the survey participants

when pursuing a career in clinical research. Two demographic questions identified the participant's educational level and whether they had obtained certification through a research certification program.

A pilot test assessing the survey for content validity was completed using dental hygiene faculty members at the University of Michigan. Modifications to the survey were made based on provided feedback. A second pilot test was then conducted using 4 dental hygienists with current and/or previous clinical research experience. Additional revisions were made based on their input. Prior to conducting the survey, the University of Michigan Institutional Review Board granted the study exemption status.

Results

Two mailings of the survey resulted in a response rate of 45% (56 respondents). Of the 56 respondents, 71% (n=40) met the inclusion criteria (obtaining a minimum of a baccalaureate level of education and having current and/or previous clinical research experience). Of the 124 dental hygienists surveyed, 3 were unable to be contacted as a result of invalid electronic mail addresses

Skills and Education

Respondents were asked to rate their agreement level to 13 questions regarding research-related competencies and skills that are necessary for a baccalaureate-prepared dental hygienist to pursue an entry-level role in clinical research (Table I). Of the 5 questions developed utilizing the University of Michigan Dental Hygiene Degree Completion e-Learning Program competencies, 97.5% agreed that possessing the ability to evaluate and critically analyze professional literature is necessary, while only 2.5% disagreed. The majority of respondents (97.5%) agreed that possessing knowledge of the scientific method and evidence-based decision making is necessary. Again, 2.5% disagreed. The majority of respondents (97.5%) also agreed that understanding the application of scientifically sound technologies and protocols during clinical decision making is necessary for a baccalaureate degree dental hygienist to pursue an entry-level role in clinical research. Only 2.5% disagreed. One hundred percent agreed that possessing effective communication and interpersonal skills is necessary for an entry-level role in clinical research. The majority of dental hygiene researchers (87.5%) agreed that possessing the ability to interact effectively with people of different cultures and backgrounds is necessary, whereas 12.5% were neutral regarding these skills.

Table I: Skills and education the dental hygiene researchers perceive as necessary for a baccalaureate prepared dental hygienist to pursue an entry-level role in clinical research

For an entry-level role in clinical research, the baccalaureate degreed dental hygienist needs to:					
The U of M Dental Hygiene Degree Completion E-Learning Program Competencies	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Possess competency in evaluating and critically analyzing professional literature.	87.5%	10%	0%	2.5%	0%
Possess knowledge of the scientific method and evidence-based decision making.	82.5%	15%	0%	2.5%	0%
Understand the application of scientifically sound technologies and protocols during clinical decision making.	75%	22.5%	0%	2.5%	0%
Possess effective communication and interpersonal skills.	45%	55%	0%	0%	0%
Possess the ability to interact effectively with people of different cultures and backgrounds.	50%	37.5%	12.5%	0%	0%
SOCRA Certification Program Competencies	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Be able to identify and apply the foundations and principles of clinical research ethics.	77.5%	12.5%	5%	5%	0%
Be able to demonstrate knowledge and application of laws, regulations, and standard operating procedures in regulated clinical research.	55%	25%	10%	10%	0%
Be able to distinguish and define the responsibilities of sponsors, monitors, and investigators according to the principles of the International Conference of Harmonization, Good Clinical Practice (ICH/GCP) and the Code of Federal Regulations (CFR).	35%	22.5%	30%	12.5%	0%
Be able to identify and apply regulation guidelines as they relate to informed consent, Institutional Review Boards (IRB)/Independent Ethics Committees (IEC), and financial disclosure.	62.5%	25%	2.5%	10%	0%
Possess the ability to identify the principles of study design, study closure, and record retention.	57.5%	32.5%	5%	5%	0%
Be able to demonstrate knowledge and application of safety reporting requirements as they relate to federal regulations and GCP Guidelines, such as reporting any adverse events, expected/unexpected events, or events that relate to safety in a clinical trial.	60%	25%	10%	5%	0%
Additional Questions Related to Clinical Research	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Possess the skills to prepare a manuscript for submission to a peer-reviewed journal.	27.5%	40%	15%	15%	2.5%
Possess grant writing skills.	7.7%	25.6%	41%	25.6%	0%

Of the 6 questions developed utilizing the SOCRA competencies, 90% agreed the ability to identify and apply the foundations and principles of clinical research ethics is necessary, while 5% were neutral and 5% disagreed. Eighty percent agreed that the ability to demonstrate knowledge and application of laws, regulations and standard operating procedures in regulated clinical research is a necessary skill, compared to 10% who were

neutral and 10% who disagreed. There was less agreement regarding the ability to distinguish and define the responsibilities of sponsors, monitors and investigators according to the principles of the International Conference of Harmonization, Good Clinical Practice and the Code of Federal Regulations. Slightly more than half of respondents (57.5%) agreed, compared to 30% who were neutral and 12.5% who disagreed. The ability to iden-

Table II: Responses to survey based on educational level (B=Bachelor, M=Master, PhD=Doctorate)

For an entry-level role in clinical research, the baccalaureate degreed dental hygienist needs to:	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Possess competency in evaluating and critically analyzing professional literature.	B=7(*2) M=23(*1) PhD=5	B=1 M=2 PhD=1	B=0 M=0 PhD=0	B=0 M=1 PhD=0	B=0 M=0 PhD=0
Possess knowledge of the scientific method and evidence-based decision making.	B=7(*2) M=21 PhD=5	B=1 (*1) M=4 (*1) PhD=1	B=0 M=0 PhD=0	B=0 M=1 PhD=0	B=0 M=0 PhD=0
Understand the application of scientifically sound technologies and protocols during clinical decision making.	B=5(*2) M=20(*1) PhD=5	B=3(*1) M=5 PhD=1	B=0 M=0 PhD=0	B=0 M=1 PhD=0	B=0 M=0 PhD=0
Possess effective communication and interpersonal skills.	B=5(*2) M=10 PhD=3	B=3(*1) M=16(*1) PhD=3	B=0 M=0 PhD=0	B=0 M=0 PhD=0	B=0 M=0 PhD=0
Possess the ability to interact effectively with people of different cultures and backgrounds.	B=3(*2) M=13 PhD=4	B=5(*1) M=8 PhD=2	B=0 M=5(*1) PhD=0	B=0 M=0 PhD=0	B=0 M=0 PhD=0
Be able to identify and apply the foundations and principles of clinical research ethics.	B=6(*1) M=22(*1) PhD=3	B=1(*1) M=3 PhD=1	B=0 M=0 PhD=2	B=1(*1) M=1 PhD=0	B=0 M=0 PhD=0
Be able to demonstrate knowledge and application of laws, regulations, and standard operating procedures in regulated clinical research.	B=5(*1) M=17 PhD=0	B=2(*1) M=5(*1) PhD=3	B=0 M=2 PhD=2	B=1(*1) M=2 PhD=1	B=0 M=0 PhD=0
Be able to distinguish and define the responsibilities of sponsors, monitors, and investigators according to the principles of the International Conference of Harmonization, Good Clinical Practice (ICH/GCP) and the Code of Federal Regulations (CFR).	B=6(*1) M=8 PhD=0	B=1(*1) M=8 PhD=0	B=0 M=8(*1) PhD=4	B=1(*1) M=2 PhD=2	B=0 M=0 PhD=0
Be able to identify and apply regulation guidelines as they relate to informed consent, Institutional Review Boards (IRB)/Independent Ethics Committees (IEC), and financial disclosure.	B=5(*1) M=19(*1) PhD=1	B=2(*1) M=6 PhD=2	B=0 M=0 PhD=1	B=1(*1) M=1 PhD=2	B=0 M=0 PhD=0
Possess the ability to identify the principles of study design, study closure, and record retention	B=5(*1) M=16(*1) PhD=2	B=2(*1) M=9 PhD=2	B=0 M=0 PhD=2	B=1(*1) M=1 PhD=0	B=0 M=0 PhD=0
Be able to demonstrate knowledge and application of safety reporting requirements as they relate to federal regulations and GCP Guidelines, such as reporting any adverse events, expected/unexpected events, or events that relate to safety in a clinical trial	B=6(*1) M=16 PhD=2	B=1(*1) M=6 PhD=3	B=0 M=3(*1) PhD=1	B=1(*1) M=1 PhD=0	B=0 M=0 PhD=0
Possess the skills to prepare a manuscript for submission to a peer-reviewed journal.	B=4 M=7 PhD=0	B=2(*2) M=12(*1) PhD=2	B=0 M=4 PhD=2	B=2(*1) M=2 PhD=2	B=0 M=1 PhD=0
Possess grant writing skills.	B=2 M=1 PhD=0	B=3(*1) M=7 PhD=0	B=1(*1) M=11(*1) PhD=4	B=2(*1) M=6 PhD=2	B=0 M=0 PhD=0

*Indicates the responses from those that have obtained certification through a research certification program

tify and apply regulation guidelines as they relate to informed consent, Institutional Review Boards/Independent Ethics Committees and financial disclosure, were agreed upon as necessary skills by

87.5% of respondents. This is compared to 2.5% neutral and 10% who disagree. Ninety percent agreed that possessing the ability to identify the principles of study design, study closure and record

retention are necessary. Only 5% were neutral and 5% disagreed. Eighty-five percent agreed that the knowledge and application of safety reporting requirements as they relate to federal regulations and Good Clinical Practice Guidelines, such as reporting any adverse events, expected/unexpected events or events that relate to safety in a clinical trial, is necessary. This compares to 10% neutral and 5% who disagree.

There was less agreement among the 2 additional questions related to the clinical research role. Over half of the respondents (67.5%) agreed a baccalaureate degree level dental hygienist needs to possess the skills to prepare a manuscript for submission to a peer-reviewed journal to pursue an entry-level role in clinical research. Only 15% were neutral and 17.5% disagreed. The other question assessed the importance of grant writing skills when pursuing an entry-level clinical role. Forty-one percent were neutral regarding this skill, 33.3% agreed and 25.6% disagreed.

In order to gain supplemental data regarding the necessary skills and education for a career in clinical research, the respondents were asked what education and/or skills proved most valuable for them when pursuing a career in clinical research. Of the 35 dental hygienists that responded to the question, 2 major themes emerged: education and mentoring. Education was indicated most often as valuable for pursuing a career in clinical research. The pursuit of a master's degree, obtaining clinical research certification and courses in statistics and research methodology were listed as beneficial for pursuing a clinical research role. On-the-job training, effective communication skills and clinical skills were also identified as being important for pursuing a career in clinical research (Figure 1).

Research Certification and Educational Level Data

The majority of respondents indicated they have obtained a masters level of education (65%), whereas 20% reported having attained a baccalaureate degree and only 15% have obtained a PhD. Table II categorizes the responses by educational level and indicates the number of respondents that have obtained certification through a research certification program. An effort to analyze the survey responses in relation to educational level was attempted by biostatisticians at the University of Michigan. However, statistical analysis was not possible due to the small sample size.¹⁹

The majority of respondents (90%) indicated that they have not obtained certification through a

Figure 1: Important Components for Pursuing a Clinical Research Role



research certification program, such as SOCRA or the Association of Clinical Research Professionals. Of the 4 individuals that have obtained certification, 3 have obtained a baccalaureate degree and 1 a master's degree. There are not enough individuals in both groups (certified and non-certified) to analyze the data to determine if there is a significant difference in the responses based on certification status (Braun, personal communication, October 2009).

Discussion

Baccalaureate-prepared dental hygienists possess the education and skills necessary to pursue an entry-level role in clinical research (Gilson-Layher, personal communication, July 2009). Research is crucial for building a well-defined and well-organized body of knowledge that will assist with promoting dental hygiene education, practice and research.¹⁰ A lack of information exists regarding the education and skills necessary for baccalaureate prepared dental hygienists to pursue a role in clinical research. The survey results will assist dental hygienists by increasing an understanding of the education and skills that are necessary for pursuing an entry-level clinical research role.

Studies support the importance education plays in pursuing the clinical research role (Cugini, personal communication, July 2009).^{12,13} The survey results demonstrate that experienced dental hygiene researchers also believe that education is integral to pursuing a clinical research role. The majority of respondents agreed that the baccalaureate prepared dental hygienist should possess the knowledge and skills addressed in both the University of Michigan Dental Hygiene Degree Completion e-Learning Program and SOCRA research-related competencies. Therefore, it can be assumed that other university programs with similar research-related competencies will prepare baccalaureate dental hygienists for

an entry-level role in clinical research. Certification through a clinical research certification program will also be beneficial for dental hygienists interested in pursuing a clinical research role.

Results from the open-ended question indicate that continuing education beyond the baccalaureate level is beneficial and may provide for additional research-related opportunities. Some respondents commented that many of the skills listed in the questions were skills obtained through education beyond the baccalaureate level and over-time with clinical research experience. The majority (65%) have obtained a minimum of a master's degree education, which may have an impact on these responses. On-the-job training was also indicated as important for pursuing a clinical research role.

The survey did not include an adequate number of individuals to explore for statistical differences between the responses of those from the 3 educational levels. Additional research involving a larger population is necessary to determine whether statistical differences exist between the responses based on educational background (Braun, personal communication, October 2009).

The importance mentoring had for the dental hygiene researchers in pursuing a clinical research role supports the proposed model of collaboration suggested by Cobban et al to increase research involvement.¹⁴ Increasing opportunities for baccalaureate dental hygiene students to work with experienced dental hygiene researchers is one method for students to gain practical clinical research skills. Additional research related to dental hygiene baccalaureate programs and their mentoring opportunities for students could assist with furthering such practices.

Conclusion

The results of this study indicate that research-related competencies, such as those incorporated in the University of Michigan Dental Hygiene Degree Completion e-Learning Program, will assist with preparing a baccalaureate dental hygienist to pursue an entry-level role in clinical research. The results also indicate that obtaining certification through a research certification program, such as SOCRA, may assist with acquiring vital education and skills necessary to pursue a clinical research role. In ad-

dition to education, obtaining the guidance of an experienced mentor also plays an important role when pursuing a career in clinical research.

This study contributes to the existing, but limited, body of knowledge regarding the clinical research role. Additional research is necessary to further gain an understanding of the clinical research role in order to increase research involvement. Further study of research-related competencies incorporated into dental hygiene program curricula may improve the education and skills obtained in these programs. Assessing the mentoring practices among baccalaureate dental hygiene programs may increase the mentoring opportunities available for students interested in a career in clinical research. Expanding research-related knowledge and skills acquired through baccalaureate programs may assist dental hygienists with understanding that research is as viable career option. Increased understanding of the skills and education necessary to pursue an entry-level role in clinical research, combined with providing experienced mentoring, may also have an impact on the clinical research involvement of baccalaureate dental hygienists. Ultimately, increased research involvement from dental hygienists will assist with addressing the NDHRA and furthering the dental hygiene profession.¹

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Nurse Practitioner's and Certified Nurse Midwives' Knowledge, Opinions and Practice Behaviors regarding Periodontal Disease and Adverse Pregnancy Outcomes

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Introduction

Several governmental, dental and medical agendas have been published that state the importance of oral health and overall well being. The first Surgeon General's Report on Oral Health in America emphasized the importance of oral health to general health and well being.¹ The report discussed the emerging associations between oral health and systemic conditions and noted that chronic oral infections can be associated with diabetes, heart and lung diseases, stroke and preterm labor and low birth weight.¹ The United States Department of Health and Human Resource document, Healthy People 2010, outlines a plan for disease prevention and health promotion, including dental health.² A goal of Healthy People 2010 is to improve the health and well being of women, infants and children. Among other conditions, low birth weight and prematurity are indicated as major concerns in the United States.² The 2003 Surgeon General's National Call to Action reflects the work of public and private sectors working collaboratively to achieve the goals of oral health and general health and well being of all Americans.³ In addition, the American Dental Hygienists' Association's National Dental Hygiene Research Agenda, updated in 2007, has emphasized the need for investigation regarding how dental hygienists are utilizing emerging science to reduce risk in susceptible patients.⁴ These documents support the need for increased awareness among health care professionals and patients

Abstract

Purpose: The purpose of this study was to assess the knowledge, opinions and practice behaviors of nurse practitioners (NP) and certified nurse midwives (CNM) regarding periodontal disease and adverse pregnancy outcomes.

Methods: A 45 item survey was developed, approved, pretested, revised and mailed to 404 North Carolina NPs and CNMs who provide prenatal care. Data was entered into an excel database and transferred to SPSS for Windows for complete analysis. Linear regression modeling was used to determine statistical significance.

Results: A total of 219 NPs and CNMs responded to the mailed survey, achieving a response rate of 54%. NPs and CNMs reported having limited knowledge regarding oral health. The majority felt they should collaborate with oral health care professionals to screen patients for periodontal disease. Most agreed they needed more information about periodontal disease and adverse pregnancy outcomes.

Conclusion: NPs and CNMs who frequently examine women could serve an important role in screening for oral health problems and making appropriate dental health referrals. Increased basic and continuing education could prepare these professionals for collaborative care with oral health care professionals. This study suggests that collaboration between NPs and CNMs with dental professionals could lead to improved oral health care for pregnant patients.

Keywords: Periodontal disease, Preterm birth, adverse pregnancy outcomes, oral health knowledge, interprofessional collaboration, nurse practitioners, certified nurse midwives

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.

about the risk factors associated with periodontal disease and other systemic conditions. The purpose of this study is to find out if there is a relationship between nurse practitioners (NP) and certified nurse midwives (CNM) concerning knowledge, opinions

and practice behaviors regarding periodontal disease and adverse pregnancy outcomes.

Review of the Literature

Periodontal Disease and Adverse Pregnancy Outcomes

Periodontal disease may be an independent contributor to systemic conditions, such as heart disease, respiratory diseases, diabetes mellitus, adverse pregnancy outcomes and stroke.⁵⁻¹⁰ Preterm birth is the leading perinatal problem in the United States.¹¹ A low birth weight infant weighs less than 2,500 grams.¹² A preterm infant is classified as late preterm (34 to 36 weeks), moderately preterm (32 to 36 weeks) and very preterm (less than 32 weeks).¹³ Between 1996 and 2006, the rate of infants born preterm in the United States increased more than 16%.¹³

Since the early 1990s, investigators have studied the relationship between periodontal disease and adverse pregnancy outcomes.^{5,14-19} In 1998, Offenbacher et al sought to determine if periodontal infections in pregnant women trigger preterm births.⁵ The results indicated that gingival crevicular fluid and Prostaglandin E2 (PGE2) levels were significantly higher in mothers who gave birth prematurely, or had a low birth weight infant, compared to women giving birth to term and normal birth weight infants. The researchers concluded that periodontal disease is a sufficient infectious challenge to cause preterm birth and low birth rate. More recently, Bogges et al found that women who are pregnant and have moderate or severe periodontal disease early in pregnancy have a risk ratio of 2.3 (1.1 to 4.7) for a small-for-gestational-age infant.¹⁸ Gazolla et al conducted a study to evaluate the effect of periodontal treatment for pregnant women and to determine if this treatment can interfere with pregnancy duration and weight of the newborn.⁹ They found that those in the non-treated group had a higher incidence (79%) of preterm delivery.

The link between periodontitis, preterm birth and low birth weight may be that, in the presence of periodontal disease, lipopolysaccharide exposure, inflammatory mediators and maternal cytokine production in the maternal serum, the patient is at risk for adverse pregnancy outcomes. Periodontal disease serves as a reservoir for lipopolysaccharide, which can target the placenta membrane through the bloodstream.^{5,14} Inflammatory cell mediators TNF α and PGE2, which are produced locally in the oral cavity, can serve as a source of fetotoxic cytokines.¹⁴ An increase in these inflammatory cytokines may contribute to preterm rupture of the mem-

branes and uterine contractions, which can lead to miscarriage or preterm birth.¹⁵ Maternal cytokines, TNF α and prostaglandin production, in response to gram-negative periodontal infection, have been associated with the onset of labor.

A few studies have failed to find a relationship between dental health and pregnancy outcomes.²⁰⁻²³ While the reasons for these results have yet to be identified, overall studies suggest potential benefits for addressing oral health during pregnancy and have confirmed that it is safe to provide dental treatment during pregnancy.²⁴

The cost of treating infants due to adverse pregnancy outcomes is in the billions of dollars each year.²⁵ Therefore, insurance companies are beginning to pay attention to the relationship of poor oral health and certain systemic conditions. Several companies are adding enhanced benefits to dental plans that target high-risk populations. Aetna Inc. has added an additional scaling and periodontal maintenance appointment for pregnant women, those with heart disease and/or cerebrovascular disease and patients with diabetes.^{26,27} Increasing awareness within the insurance companies and the medical community is one of the first steps to improving oral health and educating patients regarding the oral systemic link. However, it may take more than the dental/dental hygiene profession and insurance companies to expand the education needed to improve the oral health condition of pregnant patients.

Pregnant Women's Knowledge and Behaviors Regarding Oral Health

The Center for Disease Control and Prevention (CDC), Division of Oral Health, attempted to look at women's knowledge and attitudes regarding oral health and dental visits during pregnancy. Data was used from the CDC Pregnancy Risk Assessment Monitoring System, which surveys women's attitudes, experiences and behaviors before, during and after pregnancy. The findings showed that most women did not visit the dentist during pregnancy, and of those who reported having oral problems, 50% did not seek care. The qualitative results show that many pregnant women believe that poor oral health is normal during pregnancy and that some dental procedures could harm the unborn child.²⁸

Habashneh et al conducted a study of 625 pregnant women to investigate factors related to the utilization of dental care during pregnancy and to assess their knowledge about oral health during pregnancy and the affect on pregnancy outcomes.²⁹ Only half reported visiting the dentist while pregnant. Even though the socioeconomic status of the

subjects was high, the knowledge of the relationship between oral health and adverse pregnancy outcomes was limited. The authors concluded that oral health education is important before and during pregnancy, because it raises greater awareness of the potential relationship of oral health and adverse pregnancy outcomes.

One way to increase education among pregnant women is through the interprofessional collaboration of all health care professionals that are involved in the care of the patient. Dentists, dental hygienists, physicians and nurses could participate in providing oral health exams, refer patients as needed and educate patients about the oral-systemic link and its possible relationship to adverse pregnancy outcomes. However, limited research has been conducted to investigate the knowledge level and willingness of health care providers to participate in oral health assessment and education.

Physicians' Knowledge and Behaviors Regarding Oral Health

Physicians are in the position to help prevent oral disease, but they may lack the knowledge and skill to do so. Lewis et al reported on a national survey of 1,600 pediatricians and found that 90% felt they had an important role in identifying dental problems and teaching prevention to families, but only half felt they had training in medical school or residency regarding dental issues.³⁰ In addition, only 9% answered correctly in the knowledge section on oral health questions. McCundiff et al showed that only 7% of primary care physicians performed an oropharyngeal cancer examination on patients, and that their knowledge level needed to be more current.³¹

Wilder et al conducted a study with 194 practicing obstetricians in a 5 county area in central North Carolina.³² When asked about the description of gingivitis, 95% answered correctly, but only 67% correctly answered the question regarding the description of periodontitis. When asked about the causes or what is associated with periodontal disease, 94% correctly answered bacteria, although 73% answered tooth decay, 69% said aging and 51% answered excess dietary sugar. Only 22% looked into patients' mouths at initial prenatal examination. That number rose to 48% when a problem was mentioned by the patient. Fifty percent rarely or never recommended a dental examination. However, 84% considered periodontal disease to be as important a risk factor to adverse pregnancy events as those currently known in obstetrics practice. This study concurred with others that there is limited incorporation of oral health assessment or education in medical settings.

At the University of Washington (UW), investigators estimated that medical students received about 2 hours of lecture on oral health during their 4 years of medical school.^{33,34} In 2005, a new oral health elective was created at the UW Medical School to provide medical students with the knowledge, attitude and skills to graduate and provide preventative dental care. The lectures were taught by 9 pairs of medical and dental faculty. After each lecture there was a clinical laboratory or an interview with a patient to enable the medical students to get practical experience. Dental students served as volunteers during the laboratory exercises, and they assisted the medical students during the performance of oral exams and the application of fluoride varnish. The results of the pre- and post-test of oral health attitudes, confidence and knowledge were that the medical students' attitudes toward oral health were more positive at the completion of the course, and their confidence in identifying oral disease was higher ($p < 0.001$).

Nurses Knowledge and Behaviors Regarding Oral Health

Nurses are extremely important to the care of patients in all aspects of their health. They are in an ideal position to screen for dental disease, refer for dental care and promote good oral health. In the January 2008 issue of *Maternal Child Nursing*, Clemmens and Kerr introduced a Nurses' Plan of Action to respond to "largely preventable diseases," namely oral health problems.³⁵ The authors stressed the need for nurses to understand the range of oral health problems associated with systemic and chronic health conditions. However, with little integration of oral health topics in nursing curricula, it is unlikely that this will be accomplished quickly.³⁶

One hundred and fifty-eight United States primary care nursing centers were surveyed to determine to what extent they provide oral health screening, education and referral services for patients.³⁷ The study also identified factors that encourage or discourage these services. Results found that 49% almost always screen patients for gum infections and oral lesions, 20% reported teaching their patients how to perform oral cancer self-examinations and 19% were informed about the effects of xerostomia. Most reported infrequently referring patients for treatment of oral conditions. Factors that discouraged referrals were lack of referral resources and unavailability of health care professionals to provide on-site basic oral health services in the centers. Factors that encouraged the integration of oral health services into primary care nursing centers were an appreciation for the benefits of oral health and being knowledgeable to perform oral health services. This

data provides support for the collaboration of oral health care professionals and nurses to expand oral health services.

Nurse Practitioners and Certified Nurse Midwives

A NP is a post master's degree nurse with a focus in areas such as family, adult, pediatric or women's health care. NPs gain knowledge and skills in advanced comprehensive assessment, diagnostic reasoning and the management of health problems. They work in prenatal clinics and are in ideal positions to implement and direct educational programs for expectant mothers.³⁸ Nurse midwives have been practicing since the 1920s, however, the criteria for credentialing CNMs was approved in 1994. It has been reported that 70% of women who receive care from CNMs are vulnerable to poor health outcomes due to socioeconomic status and ethnicity, among others.³⁹ Many times, NPs and CNMs are the individuals implementing screenings, referrals and the promotion of oral health in pregnant women. However, little is known about their potential role in decreasing periodontal disease in expectant women.

The purpose of this study was to assess the knowledge, opinions and behaviors of NPs and CNMs regarding periodontal disease and adverse pregnancy outcomes. The study was conducted via a mailed questionnaire. The questions addressed knowledge and behaviors regarding periodontal disease and adverse pregnancy outcomes, opinions/perceptions of the NP's and CNM's role relative to oral health and demographics and personal oral health experience.

Methods and Materials

The survey instrument was developed by the research team and approved by the Biomedical Institutional Review Board at the University of North Carolina (UNC). It consisted of 45 open and closed ended questions and Likert scale questions. Pilot testing occurred with 5 prenatal care providers. After revision and final approval, it was mailed to all NPs and CNMs (n=404) who provide prenatal care in North Carolina.

The sample was randomly selected from a mailing list obtained from the North Carolina Medical Board. A cover letter explaining the purpose of the study and the importance of participation was included along with an information request form that was used in an incentive drawing for 5 gift cards. Subjects were asked to return the completed surveys in the stamped return envelope 3 weeks after mailing. A second mailing was conducted 6 weeks later.

Data Analysis

Descriptive statistics reporting percentage frequency distributions of responses for NPs and CNMs characteristics, knowledge and practices were run using SPSS statistical software. After an examination of bivariate associations of independent variables and referral, a logistic regression model was developed to test the effects of nurses' knowledge and training on the likelihood of providing dental care services while accounting for years in practice. To facilitate interpretation of the regression parameter estimates, categorical variables were created from the continuous summary scores for the 7 explanatory variables by using either the upper or lower 20 to 35% of responses as one category or the other responses as another.

Results

Demographics

A total of 219 NPs and CNMs responded to the mailed survey, achieving a response rate of 54%. Thirty surveys were returned due to insufficient address. Eighty-five percent of participants reported providing prenatal care in North Carolina to an average of 45 patients per week (range 1 to 350). Almost half of those surveyed reported working in a publicly funded facility. The majority of respondents had provided prenatal care for more than 6 years. Thirteen percent have been told they have periodontal disease and 96% rated their oral health as good or excellent (Table I).

Oral Periodontal Examinations: Sixty-two percent of the nurses reported looking in a patients' mouth (oral health examination) as part of routine care at the initial prenatal visit. Six percent reported never looking in the patient's mouth. The remainder looked only if the patient identified a problem. Twenty percent indicated that it was the responsibility of dental professionals to provide the exam.

Practice Behaviors

Participants were asked what prenatal care services are provided at their work setting. Ninety-eight percent reported providing low risk care to patients, while 84% reported providing non-stress tests. Only 32% reported providing dental screenings as part of prenatal services, while 20% reported providing dental care (Table II).

When asked what referrals were made for their prenatal patients in the last 12 months, the following was reported:

Table I: Respondents Practice Demographics & Personal Oral Health

Prenatal Care Providers (n=218)	
Yes	85% (186)
No	15% (32)
Patients Seen Each Week (n=181)	
Per week	1–350
Mean	45
SD	43
Practice Setting	
General Practice	10% (19)
Solo	1% (1)
Group	13% (29)
Specialty Practice	37% (64)
Public Health/Government	40% (70)
Hospital Practice	10% (17)
Other	2% (4)
Number of Years in Practice (n=187)	
Less than 1 year	1% (1)
1–2 Years	10% (19)
3–5 Years	14% (27)
6–10 Years	24% (45)
11–20 Years	34% (64)
More than 20 years	17% (31)
The Last Time You Received Dental Care (n=180)	
Within the last six months	79% (142)
6 months–1 year ago	13% (23)
1–2 Years ago	7% (12)
2 or more years ago	2% (3)
Never	0% (0)
Last Examination to Assess the Health of Your Gums (n=181)	
Within the last six months	79% (143)
6 months–1 year ago	13% (23)
1–2 Years ago	7% (12)
2 or more years ago	2% (3)
Never	0% (0)

Table II: Prenatal care services provided in setting

	Yes	No
Biophysical Profile (BPP) (n=161)	67% (108)	33% (53)
Childbirth Classes (n=159)	55% (88)	45% (79)
Dental Care (n=140)	20% (28)	80% (112)
Dental Screening (n= 142)	32% (45)	68% (97)
Genetic Consultation (n=152)	44% (67)	56% (85)
High Risk Care (n=167)	77% (128)	23% (39)
Low Risk Care (n=177)	98% (173)	2% (4)
Non Stress Test (NST) (n=177)	84% (149)	16% (28)
Nutrition Consultation (n=170)	78% (132)	22% (38)
Ultrasound Examinations (n=168)	82% (137)	19% (31)

*Not all respondents answered every question

Table III: NPs' and CNMs' beliefs associated with Periodontal Disease (n=219)

Bacteria	83% (182)
Smoking	77% (168)
Tooth Decay	76% (166)
Excess Sugar Consumption	62% (135)
Aging	54% (119)
Genetics	52% (113)
Child Bearing	42% (92)

*Not all respondents answered every question

- 97% reported referring for genetic screening
- 96% for nutrition
- 95% for childbirth preparation
- 93% for Women Infant & Children Supplemental Feeding Program
- 89% for social work involvement
- 86% for dental health

When asked what trimester is recommended for

patients to initiate dental treatment, 56% reported the first trimester, 39% reported the second trimester and 1% identified the third trimester.

Knowledge

Participants were asked about factors contributing to gum disease. Eighty-three percent reported bacteria, 77% reported smoking and 76% iden-

Table IV: Opinions of NPs and CNMs about Periodontal Disease

	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
I am trained to provide an oral exam (n=183)	4% (7)	37% (67)	37% (68)	19% (35)	3% (6)
I am comfortable looking in a patient's mouth and determining if they have gum disease (n=184)	3% (5)	45% (83)	39% (71)	10% (18)	4% (7)
My knowledge about periodontal disease is current (n= 183)	1% (1)	19% (35)	60% (109)	14% (25)	7% (13)
Nurse practitioners, physician assistants and nurse midwives should be taught about periodontal health (n= 183)	52% (96)	47% (86)	0%	0%	1% (2)
I need additional information about periodontal disease and its impact on adverse pregnancy outcomes (n=184)	30% (56)	61% (112)	6% (11)	2% (3)	1% (2)
My patients are knowledgeable about the importance of good oral health during their pregnancy (n= 183)	3% (5)	18% (33)	50% (91)	25% (45)	5% (9)
Nurse practitioners and nurse midwives should be taught how to perform a cursory examination to determine health or disease (n=184)	40% (72)	54% (99)	2% (4)	0%	5% (9)
Nurse practitioners and nurse midwives should perform periodontal examinations to determine if a patient needs to be referred to a dentist (n= 184)	28% (52)	50% (92)	14% (26)	1% (2)	7% (12)
Nurse practitioners and nurse midwives need to collaborate with dental professionals to reduce a patient's risk of having an adverse pregnancy outcome (n=184)	43% (79)	52% (95)	2% (3)	0%	4% (8)
I am comfortable referring patients with dental problems (n= 184)	57% (105)	40% (74)	2% (4)	0%	1% (1)
Periodontal disease is a risk factor for adverse pregnancy outcomes (n=184)	41% (75)	49% (90)	1% (2)	0%	9% (17)
If a patient has periodontal disease she is more likely to have adverse pregnancy outcomes than a patient with healthy gums (n=184)	34% (63)	51% (94)	2% (3)	0%	13% (24)

tified tooth decay as being associated with gum disease. However, 62% erroneously thought that excess sugar consumption is associated with gum disease (Table III).

Regarding knowledge about gingivitis, 67% identified it as a reversible redness/swelling of the gums, and 49% as a potentially reversible infection. When asked about periodontitis, 65% percent indicated that it is a potentially reversible infection of the gums, while 27% identified it as tooth decay. Ninety-three percent correctly answered that periodontitis is worse than gingivitis.

Opinions

One section of the survey asked the opinions of NPs and CNMs about periodontal diseases and their role in oral health assessment and education (Table IV). When asked if they were trained to provide an oral exam, only 41% answered affirmatively. Ninety-four percent indicated that they should be

taught how to perform a cursory examination to determine health or disease, while 95% said they need to collaborate with dental professionals to reduce a patient's risk of having an adverse pregnancy outcome. Eighty-seven percent agreed that in recent years an association has been made between periodontal disease and adverse pregnancy outcomes, and 85% agreed that if a patient has periodontal disease she is more likely to have adverse pregnancy outcomes than a patient with healthy gums. When asked to identify the single most important reason for not providing an oral health exam, 20% indicated that it was the responsibility of dental professionals.

Table V reports the results of the logistical regression analysis for providing dental services. Interestingly, NPs and CNMs who had a dental clinic present in the primary practice setting, or were educated in an institution near a dental school, performed more dental services in the work setting.

Discussion

With the possible oral-systemic links that have been identified between periodontal disease and certain systemic conditions, it is imperative that all health care practitioners be aware of a woman's oral health condition.⁴⁰ Nurses are in an ideal situation to identify and refer women that need dental care. Prevention through education is needed by all prenatal care providers to teach mothers the importance of oral health for themselves and ultimately their babies.⁴¹

With increased awareness regarding potential oral-systemic links, health care providers must collaborate to educate pregnant patients before and during pregnancy. In the present study, 95% of North Carolina NPs and CNMs agreed they need to collaborate with dental professionals to reduce patients' risk of having an adverse pregnancy outcome. However, few reported having sufficient oral health content in their professional school curriculums, and only a few reported being adequately trained to provide an oral health examination. Only 20% reported being up to date in oral health issues and periodontal disease. The authors of this study suggest that increased oral health education in NPs and CNMs academic programs could increase the knowledge level regarding periodontal disease and adverse pregnancy outcomes and potentially benefit pregnant women and their infants. In addition, the authors strongly promote increased collaboration between NPs, CNMs and oral health care professionals to coordinate and provide better care for pregnant patients. While 62% of providers reported conducting an oral health examination as part of routine care at the initial prenatal visit, 6% reported never looking in the patient's mouth, and 40% looked only if the patient identified a problem. The majority want additional information regarding periodontal disease and adverse pregnancy outcomes. Therefore, training nurses how to provide a visual screening for oral health problems is also recommended. For practicing nurses, continuing education courses on periodontal disease and systemic conditions could be developed by the dental community. Also, having oral health referral sources available for nursing professionals so they can easily refer pregnant women for oral health care needs might facilitate the process and promote better oral health care for pregnant women.

Pregnant women who have bleeding gingiva, loose teeth, oral malodor or inflammation should be referred to a dentist, dental hygienist or dental clinic. Nurses could proactively identify dental clinics that will accept expectant mothers who have no insurance or who have financial barriers. In the current study, 69% reported that they knew

Table V: Results of logistic regression analysis for providing dental services (n=160)

Variables	Odds Ratio	P-Value
Years in practices (5 years or less vs. 6 or greater)	0.13	0.20
Dental clinic present in primary practice setting (Yes vs. No)	0.008	<0.05
Dental training in the curriculum (Yes vs. No)	1.10	0.90
Dental school present in institution where nursing training was received (Yes vs. No)	11.3	<0.05
Dental Knowledge (Range 0–9, 9=higher dental knowledge)	2.3	<0.05

dentists who they can refer patients to if needed. The number of potential referral sources could be increased through a collaborative effort between dentists, dental hygienists, NPs and CNMs.

It was interesting to find that dental services by NPs and CNMs were increased if the professional had been educated in a setting near a dental school. Perhaps this is a "call to action" on the part of dentistry and dental hygiene to play a larger role in further educating our nursing colleagues about the importance of oral health and to also provide training on oral screening techniques and proper referral for treatment needs. New York University's Dental School and Nursing School have sought to combine their curriculum to provide comprehensive care to all patients.⁴²

Participants in this study who had a dental clinic present in the primary practice setting were more likely to perform dental services. One would assume that having a clinic nearby eases the process of referral. Again, oral health care professionals such as dental hygienists and nurses need to work collaboratively to find mechanisms to access oral health care for patients in need.

A few limitations of this study warrant discussion. While a larger response rate was anticipated, the response rate of 54% is sufficient to assess the knowledge and practice behaviors of nurses regarding periodontal disease and adverse pregnancy outcomes. While non-response bias was examined, none was determined to be present. However, non-response bias cannot be fully assessed with the information provided from the medical board. The results might not have external validity and may not be generalized to other states.

Future studies might investigate a model for oral health promotion through a collaborative model. Another study might address the impact of including oral health content and diagnostic techniques in curricula of NPs and CNMs to assess knowledge levels and practice behaviors of these professionals who care for pregnant women.

Conclusion

Most NPs and CNMs reported that their basic nursing education did not include oral health in the curriculum. Therefore, few prenatal care providers feel that they are adequately trained to provide an oral health examination and refer for potential dental needs. Increased oral health education in NP and CNM programs could increase the knowledge level regarding periodontal disease and adverse pregnancy outcomes and potentially impact pregnant women's oral health. In addition, the current study concludes that oral health care professionals need to collaborate more with NPs and CNMs to improve the oral health care of pregnant patients. There are many opportunities in various work settings for nurses to educate, promote oral health and provide risk assessment to women.

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Disclosure

One of the authors serves on the Scientific Advisory Board for Colgate Oral Pharmaceuticals.

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Interface with a Community Feeding Team to Address Oral Health of Special Needs Children: A Pilot Project

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Introduction

Oral health is integral to overall health and well-being. Oral Health in America: A Report of the Surgeon General states "there is a 'silent epidemic' of oral disease which is affecting our most vulnerable citizens."¹ In response to key findings in the Surgeon General's report, the National Call To Action To Promote Oral Health was written to encourage private and public entities to collaborate to address the issues of oral health disparities, including those with disabilities and special needs.¹

Review of the Literature

In an effort to bring together the medical and dental community to address oral health as a component of overall health, The American Academy of Pediatric Dentistry (AAPD) and the Children's Dental Health Project (CDHP) initiated a project titled The Interface Between Medicine and Dentistry in Meeting the Oral Health Needs of Young Children.² The project examined the challenges surrounding the provision of oral health care to children under 5 years of age.² In particular, the white paper developed by this project focused on access to care issues and strategies for overcoming these challenges.

One of the groups most in need of anticipatory guidance and prevention identified by the AAPD and CDHP project were children with special health care needs (CSHCN),³ who are defined as "those who have serious physical, behavioral or emotional conditions that require health and related services beyond those required by children generally."⁴

Achieving and maintaining optimal oral health for CSHCN is challenging due to the complex issues this group faces both in medical and dental care. Issues encountered by CSHCN and their caregivers when trying to access oral health care include accessibility, financial, psychosocial, physical, communication and medical.³

Abstract

Purpose: Children with special health care needs (CSHCN) are most in need of anticipatory guidance and prevention. Achieving and maintaining optimal oral health is challenging, due to the many challenges this group faces both in medical and dental care. The purpose of this pilot project was to identify the educational needs of health professionals on a feeding team to prepare them to provide anticipatory guidance to special needs children, along with preliminary investigation into the role of the dental hygienist in improving the oral health of the CSHCN served by the feeding team.

Methods: Small focus groups were used to determine educational needs of the feeding team and provide initial identification of the role of the dental hygienist on the feeding team.

Results: The needs assessment indicated interest in an in-service to address connections between oral health and feeding issues, i.e. problems related to tube feeding and oral hypo- and hypersensitivities of the CSHCN.

Conclusion: This project suggests there is a role for the dental hygienist on the feeding team to provide preventive dental care and referral as well as education for caregivers and therapists. Future research is needed to further delineate the role of the dental hygienist on the feeding team as well as implementation of a model for integrating them into this multidisciplinary team.

Keywords: Oral health, Health care disparities, Dental care for disabled, Children with disabilities, Interdisciplinary Health Team

This study supports the NDHRA priority area, **Health Services Research:** Assess the impact of dental hygiene services on the outcomes of care for patients with special health care needs

Given the complexity of the special needs patient, Casamassimo suggests the following providers have a role to play in attaining and maintaining optimal oral health: dentist, dental hygienist, dental assistant, primary care physician, specialty physician, allied therapist and patient and/or caregiver.³ One of the challenges to creating interdisciplinary partnerships is the lack of education and experience in caring for children with special needs for dental professionals and the tendency of dental professionals to work in isolation from other health professionals.⁵ In addition, other non-dental health professionals have little or no education in the area of oral health issues, which leaves them ill-prepared to reinforce developmentally appropriate anticipatory guidance.⁶

One of the steps in the Washington State Collaborative Action Plan on Oral Health Access for Special Populations is to provide basic training in oral health to non-dental professionals who care for CSHCN, including physicians, nurses, physician assistants and dietitians, among others.⁷ One way this might be accomplished is by working with multidisciplinary feeding teams who care for some of the most challenging special needs children. The Washington State Department of Health suggests the dynamic interdisciplinary approach utilized by community feeding teams appears to be an opportunity for the dental hygienist to interface with the feeding team in providing preventive oral health education and preventive services in the form of collaborative, sustainable models of health care.⁸

Feeding Teams: An Interdisciplinary Approach to Care

A feeding team is an interdisciplinary or multidisciplinary team of health professionals who work collaboratively in evaluating and assessing issues surrounding feeding to avoid duplication of efforts and to assist in prioritizing nutrition issues faced by CSHCN.⁹ Professional members of the feeding team typically include a physician, nurse, registered dietitian, speech therapist, physical therapist and occupational therapist, among others.⁹ The teams evaluate oral motor skills, dental health, feeding practices, dietary intake and caregiver expectations. Assessment and intervention may include, but is not limited to, assessing swallowing ability, therapeutic feeding techniques, proper positioning, appropriate quantities of food, adequate dietary intake to meet nutrient needs and appropriate use of feeding tubes.⁹

Children with special needs comprise 18% of the population and are at greater risk of developing oral disease, and dental care is reported to be the

number one unmet health care need.^{4,10} A national survey in 2005 found 81.1% of CSHCN require preventive dental care, with 24.2% needing other dental care. In addition, the survey found 6.3% were not able to obtain preventive dental care and 2.6% were not able to obtain other dental care.¹¹ As licensed oral health professionals skilled in providing oral health promotion and prevention services, the dental hygienist is in a unique position to interface with the members of the community feeding team to provide them with the knowledge needed to support parents and caregivers with anticipatory guidance, preventive dental care and referral for other dental care.

Common Issues Addressed by Feeding Teams in Special Needs Children

Although it has been estimated that 3 to 10% of all children have feeding problems, 26 to 90% of those with special needs are affected.¹² Medical conditions, medications and feeding problems of special needs children may ultimately affect tooth development and increase the risk for dental caries, periodontal disease and fungal infections.¹³

Gastroesophageal Reflux Disease

Gastroesophageal reflux disease (GERD) is one of the most common gastrointestinal disorders in children and infants. However, many children outgrow it around 1 year of age.¹⁴ GERD is the regurgitation of stomach acid contents into the oral cavity because the lower esophageal sphincter does not close properly, causing troublesome symptoms.^{14,15} CSHCN are predisposed by neurologic and oral-motor disorders to chronic GERD.¹⁴

Research suggests children with GERD have significantly higher levels of salivary mutans streptococci than children without GERD.¹⁶ The combination of an acidic environment, along with bruxism or hyperactive bite common in CSHCN, results in a more rapid rate of erosion, which may result in increased pain and sensitivity from pulp exposure.¹⁷ However, the research demonstrates inconsistent results in regard to the development of caries in children with GERD.^{16,18} Preventive treatment for GERD includes lifestyle changes along with medications or surgery.

Oral, Pharyngeal and Esophageal Motor and Sensory Disorders

Oral, pharyngeal and esophageal motor disorders may occur when structure, function or maturation of these systems are disrupted.¹⁹ These motor disorders are associated with many feeding

issues impacting a child's oral health. The etiology of these motor disorders includes: neurological disorders, intellectual disturbances (such as mental retardation and dementia), traumatic brain injury, central nervous system disorders (such as cerebral palsy), intra-oral and structural problems (congenital clefts or missing teeth) and the loss of extra-oral integrity (aggressive cancer therapy).¹⁹

This complex of motor disorders can result in signs and symptoms such as loss of muscle tone of the cheeks and lips, resulting in sialorrhea (drooling) and prolonged oral clearance of food, trouble closing lips, unclear speech, bruxism, oral hyposensitivity or hypersensitivity, tongue thrust, biting on eating utensils during meals and dysphagia (difficulty swallowing).^{19,20}

Sialorrhea

Sialorrhea results in a number of issues, such as malodor, dehydration and chapping of the lips with a risk for secondary fungal infections.²¹ Sialorrhea is common in CSHCN with neurological impairment, such as cerebral palsy.²¹ In addition, it is associated with GERD.²¹ Excessive salivation is also more common in CSHCN who were taking 4 or more medications and who use gastrostomy tubes (G-tubes).²²

Excessive saliva interferes with the cohesiveness of the bolus, resulting in swallowing difficulties and a choking hazard.²³ Difficulty with forming a bolus also slows the rate of oral clearance, keeping food in contact with the teeth for longer periods of time and increasing the risk for dental caries.^{24,25}

The term posterior drooling refers to the situation when saliva pools in the hypopharynx rather than spilling out over the lips.²⁶ Normally, the swallowing reflex would be stimulated, but in some cases there is a loss of oral-sensory perception, resulting in dysphagia.²⁶ As a result, there is risk of gagging, vomiting, choking and aspiration of saliva and oral bacteria into the trachea or lungs. While it has long been believed posterior drooling is common in CSHCN with cerebral palsy, research now suggests it may be due to poor oral motor function and/or dysphagia rather than sialorrhea.^{26,27}

Sensory Processing Disorders

Children with sensory processing disorders have difficulty dealing with information from the senses (auditory, visual, touch and oral), which present challenges in providing dental care.²⁸ CSHCN with hyposensitivity become desensitized to stimuli and may not experience pain in the same way as other

children. For instance, there are a number of case reports of autistic children with hyposensitivity extracting their own teeth along with other self-injurious behaviors.^{29,30}

Persons fed by tube exhibit higher levels of oral hypersensitivity as a result of non-oral feeding.³¹ These children require desensitizing therapy, such as touch and massage therapy.³¹ Although a team approach is utilized to deal with sensory processing disorders, the occupational therapist is critical in assisting with desensitizing the client to oral hygiene procedures and would benefit from working with a dental hygienist. A process of desensitization therapy for oral self-care begins with touch to the lips with gloved fingers, followed by a foam swab (Toothette®), and then progresses to a tooth brush.³² If sensory hypersensitivity is not addressed, it may develop into facial or oral defensiveness, which is a conditioned response to stimuli that is perceived to be unpleasant by the child.³³ Oral defensiveness may present as reflex biting, lip pursing, facial grimacing, crying, gagging, head turning or pushing away things coming towards the mouth or face.³³ An oral assessment of a small group of CSHCN reported 50% of children with autism (n=39) and other developmental disabilities (n=16) exhibited oral defensiveness.³⁴ Oral defensiveness requires a team approach for resolution.

A hyperactive bite (tonic bite reflex) is a forceful, sustained jaw closure occurring after stimulation of the teeth or gums.³⁵ It is often difficult to release and may cause damage to any object placed between the teeth. The tonic bite reflex may prohibit the caregiver from providing oral hygiene care, such as basic tooth brushing and flossing.

Medications

Advances in medicine allow CSHCN to live to adulthood with chronic diseases and disabilities. Medical conditions and disease in these children require a wide range of medications based on their individual needs. These children usually take these medications in liquid form which contain higher levels of sucrose, ranging from approximately 3 to 6 grams per dose.³⁶ Children taking medications long-term are at increased risk for dental caries.³⁷ In addition to the increased caries risk from sucrose-containing medications, side effects such as xerostomia may further increase the risk. Xerostomia is a side effect of over 400 medications, however there is a lack of evidence in regard to its prevalence in pediatric populations.^{38,39} Given the issues CSHCN face from the side effects and sucrose content of medications, it is critical to ad-

dress dietary guidelines and oral self-care to reduce cariogenic activity and risk for dental caries.

Failure to Thrive

No matter what the cause, feeding problems, along with the medical conditions and medications utilized in the care of the CSHCN, often results in failure to thrive. The definition of failure to thrive varies, but it is generally described in children as inadequate physical growth for age with weight falling below the fifth percentile on standardized growth charts.⁴⁰ Failure to thrive can be classified as inadequate calorie intake, excess metabolic demand, defective utilization or poor absorption of nutrients.⁴⁰

CSHCN require high calorie diets for catch-up growth. The medical nutrition prescription in toddlers and children calls for additional caloric intake which may be provided with a high protein nutrient dense diet with added fats, such as adding cheese and peanut butter to foods. Children may also use high calorie liquid supplements to meet their protein and caloric needs. Unfortunately, parental anxiety over failure to thrive can result in children receiving snacks and juices that are high in carbohydrates, have little nutritional value and can potentially increase the risk for dental caries, as well as complicate management of failure to thrive.⁴¹⁻⁴³ This underscores both the importance of oral hygiene care and the role of diet in the development of dental caries.

Enteral Nutrition

Many CSHCN have feeding issues related to gastrointestinal disorders, neuromuscular disorders, cardiopulmonary disorders, failure to thrive and prematurity which require enteral nutrition or tube feeding to ensure adequate nourishment and hydration.^{44,45}

While there are no statistics on the number of children receiving tube feeding, according to the federal Medicaid statistics for the years 1989 to 1992, there were 152,000 adults and children receiving tube feeding.⁴⁶ The ultimate goal for overall long-term health and gastrointestinal health is to transition the child to consumption of food by mouth. The transition from tube feeding to oral feeding involves progressing from feeding tube only with no oral consumption, tube feeding while introducing snacks consumed orally and, finally, to tube feeding for liquids with solid foods consumed orally.

For children requiring nutrition support longer

than 4 weeks, surgical placement of a feeding tube is required to ensure adequate nutrition. These types of feeding tubes may be in place for variable lengths of time, ranging from a few months to a lifetime. The most common type of feeding tube is the G-tube, which is surgically placed through the abdominal wall into the stomach.⁴⁴ This type of tube may also be referred to as a PEG (percutaneous endoscopically guided gastrostomy) and appear to be quite safe and effective even in very small infants.⁴⁴ Another type of feeding tube is the gastrojejunostomy tube (GJ tube), which is placed surgically by inserting the feeding tube through the abdominal wall into the jejunum. The GJ tube is used most frequently in children with severe GERD. These feeding tubes are used to provide the bulk of the child's nutritional needs, however, most children may still be able to eat small amounts of food orally.⁴⁵

Although research in regard to the oral health of these children is limited, the available evidence suggests CSHCN with G-tubes tend to have significantly more plaque and calculus accumulations in spite of regular oral hygiene and dental care.²² CSHCN also have significantly higher levels of oral pathogens implicated in aspiration pneumonia, such as *Haemophilus influenzae*, with trends toward more gram negative enteric rods.²² These children are also more likely to have had aspiration pneumonia than children without a G-tube.²² For this reason, proper oral hygiene to optimize plaque removal is imperative to minimize the risk for aspiration pneumonia.

Given the challenges children with special needs encounter, this project was designed to begin exploration of the role the dental hygienist might play on a multidisciplinary feeding team. The purpose of this pilot was twofold: to identify the educational needs of the health professionals at The Children's Therapy Center (CTC) to prepare them to provide anticipatory guidance to special needs children, and a preliminary investigation into the role of the dental hygienist in improving the oral health of the special needs children served by the feeding team.

Project Description

The CTC feeding team comprises one of Washington's community feeding teams, which function under the State Department of Health, CSHCN Program and address the feeding and nutritional needs of special needs children. The group participating in the project included 26 (n=26) professionals and staff members consisting of physical therapists, speech therapists, occupational therapists, family

resource coordinator, caregivers and procurement and development staff member.

Phase 1: Educational Program

The investigator met with the CTC director, who is also a speech therapist, to discuss feeding issues addressed by the CTC's therapists. The CTC director served as an intermediary by facilitating presentation of the project to the therapists. The needs assessment was conducted with 3 open-ended questions sent via internal e-mail to the staff members of the CTC. Eight CTC members (30.7%) responded, providing a total of 6 topics of interest. Responses indicated interest in an in-service presentation to address the topic of connections between feeding issues and oral health of the special needs child (Table I).

In a follow-up focus group with 2 therapists, the needs of the target population were further defined. A literature review was also conducted to further elucidate the key issues related to oral health promotion for special needs children in order to develop educational objectives for the in-service. Based on the literature review and input from therapists, an in-service program titled Oral Health Care Needs and the Special Needs Child was developed. The topics for the program included:

- Oral health problems associated with tube feeding
- Medications and sugar content
- Early childhood caries and transmission of bacteria
- Preventive measures for the special needs child
- Adaptations and oral hygiene self-care
- Healthy snacks
- Resources for access to dental care

In-service objectives included:

- Provide an understanding of the oral health care needs of the special needs child
- Provide an understanding of the impact of feeding issues on the risk factors for oral disease
- Identify preventive measures addressing these risks

Table I: Needs Assessment of CTC Staff

Identification of Need	Number of Responses Indicating Need for Topic
1. Are there specific issues which impact the oral health of the CSHCN? If so, what are these conditions?	
Problems related to tube feeding	8
Oral motor dysfunction	8
Oral hypersensitivity and hyposensitivity	6
GERD	6
Access to care (finding providers, finding providers who accept Medicaid and DSHS coupons, and finding resources/referrals for care)	4
Aspiration pneumonia	2
2. Are there topics related to oral health that you would like to learn more about? If so, what are these topics?	
Basic introduction to oral health	7
When should child first see have a dental exam and frequency	2
GERD	6
Preventive care	6
Effects of medications on the teeth	1
3. Are there neurological impairments or developmental conditions which put the CSHCN at greater risk for oral health related problems? If so, what are these conditions?	
Cerebral palsy	5
Cystic fibrosis	4

- Identify resources for access to dental care for the special health care needs child

The methods selected for the in-service included presentation software using visual images and text in slide format, along with small group discussion of the concepts being presented to reinforce key concepts. This allowed for meeting the needs of a variety of learning styles and, more importantly, allowed for accommodation of the learning needs of the hearing impaired participants. An interpreter was also present to aid in translating the verbal information for the hearing impaired.

Following the in-service program, an evaluation was conducted in the form of a 5 item survey in a Likert-scale format using a 1 to 5 rating scale (strongly agree to strongly disagree). Four of the items focused on the value of the presentation and effectiveness of the presenter, with 1 item aimed at learning if the group felt dental hygienists should be a part of the feeding team (Table II).

Table II: In-Service Evaluation Results

	Strongly disagree=1 (n)	Somewhat disagree=2 (n)	Neutral neither=3 (n)	Somewhat agree=4 (n)	Strongly agree=5 (n)	Percentage Somewhat or Strongly Agreed
The information presented will be useful to me in my work with this population of children	0	0	0	3	19	21/22=95%
The topics were presented at an appropriate level of understanding	0	0	0	1	21	21/22=95%
The presenter demonstrated knowledge of the topic and was able to convey the information	0	0	1	1	20	20/22=91%
The dental hygienist plays a valued role in the multidisciplinary, collaborative approach	0	1	0	2	19	19/22=86%
The one-hour time allotment was appropriated for the information presented	0	3	3	2	14	19/22=86%

Phase 2: Feeding Team Questionnaire

The item on the in-service program evaluation used to assess the value of the dental hygienist on the feeding team read: "The dental hygienist plays a valued role in the multidisciplinary, collaborative approach." Based on strong agreement with the statement by participants (86%) (Table II), a questionnaire was developed to further explore the role of the dental hygienist on the feeding team. The CTC director assisted with development of the questionnaire.

The feeding team questionnaire consisted of 6 open-ended questions aimed at gathering information from the therapists about the perceived need for a dental hygienist as a member of the feeding team, to assess the therapists' knowledge of the services provided by the dental hygienist, and to seek input into the roles in which the dental hygienist could contribute to the interdisciplinary approach of the feeding team.

The investigator prepared an introduction in which she presented the nature of the project and solicited participation on the part of the therapists in completing the feeding team questionnaire, which was distributed via e-mail. An attachment of the Oral Health Care Needs and the Special Needs

Child presentation that was previously presented to the CTC staff during a weekly in-service meeting was also provided. Four therapists responded via e-mail to the questions.

Responses to question #1 (Do you see a need for an oral health component to the feeding team?) indicated all respondents felt there was a need for an oral health component. Comments included "It seems like an excellent opportunity to educate and problem solve with families who deal with feeding issues that may lead to dental problems" and "I can think of many opportunities addressing oral health; we could really improve access to care..." Topics suggested in response to question #2 (If so, what topics and information might this include?) included: time of first dental visit, eruption patterns, nutritional issues (ex: children with cerebral palsy), sugar in medications, gastro-esophageal reflux disease and acid oral environment, oral health information for caregivers, oral health risk factors and preventive measures, along with referral sources who understand their unique needs. In response to question #3 (How do you see this oral health promotion and prevention being delivered?), respondents indicated "It would be helpful for a dental hygienist to educate caregivers and the feeding team" and be available "for difficult situations," "make printed educational materials

Table III: Priority of Oral Health Prevention and Promotion Services

Oral Health Prevention & Promotion Services	Priority #1	Priority #2	Priority #3	Priority #4	Priority #5
Provide dental care and referral for dental services	n=3	n=1			
Provide the therapists with training on addressing oral hygiene care for persons with oral hypo- and hypersensitivities		n=2	n=1	n=1	
Provide in-service oral health intervention presentations to the therapists; provide on-site oral health intervention presentations to children, parents, and caregivers. Have a "dental day" at CTC		n=1	n=3		
Provide oral health assessment and monitor oral health needs	n=1			n=3	
Provide printed oral health related materials and resources to therapists and caregivers; explain the use special oral hygiene devices.					n=4

available for the feeding team and caregivers" and "hold "clinic day" at CTC". For question #4 (Were you aware that in Washington state, a dental hygienist is licensed to provide preventive services to underserved populations, persons in designated rural areas, and Medicaid-eligible children?), 3 of the 4 respondents were not aware the dental hygienist could provide preventive services to these populations. In response to question #5 (Do you currently utilize any type of personalized oral health assessment forms?), all respondents reported oral health assessment forms were not utilized, but they felt it would be a benefit to clients.

These same 4 therapists selected and prioritized the 5 oral health prevention and promotion services which they would most like to see delivered by the dental hygienist as a member of the feeding team (Table III).

Discussion

Literature about the role of the dental hygienist on interdisciplinary teams is limited. This pilot project explored the role of the dental hygienist on feeding teams who provide services to CSHCN. The findings from this pilot project are consistent with the available literature.⁴⁷⁻⁴⁹ The primary research in this area suggested the dental hygienist plays a role on the interdisciplinary dysphagia team.^{47,48} Nowjack-Raymer also proposed a role for the dental hygienist in the coordination of the clinical cleft palate team, but primary research in this area is lacking.⁴⁹

The purpose of Phase 1 was to identify the educational needs of the health professionals at the CTC to prepare them to provide anticipatory guidance to special needs children. Based on initial needs assessment with a sample of CTC members, 6 topics of interest were identified, focusing on the connections between feeding issues and oral health of the special needs child. Of primary interest to the group was oral health related to tube feeding, oral motor dysfunction, oral preventive care, oral hyper- and hyposensitivity and GERD. The in-service evaluation suggested the information was well received and of interest to the feeding team. Eighty-six percent of participants (n=22) strongly agreed that "The dental hygienist plays a valued role in the multidisciplinary, collaborative approach." This suggested need for future research to identify the role of the dental hygienist on the feeding team, as well as implementation of a model for integrating them into this multidisciplinary team.

The purpose of Phase 2 was preliminary investigation into the role of the dental hygienist in improving the oral health of special needs children served by the feeding team. A small focus group (n=4) participated in the feeding team questionnaire, which is a significant limitation and limits generalization of the findings. However, the preliminary findings suggest there is a role for the dental hygienist as a contributing member on the interdisciplinary feeding team. The highest priority identified was dental care and referral with providing education and training for feeding team members and caregivers. Based on

the recommendations in Phase 2, this project calls for further investigation into the possible aspects of care provisions, such as anticipatory guidance and education for caregivers, monitoring and continued support for optimal oral self-care, sealants, fluoride varnish and oral prophylaxis.

Although dental hygienists in most states in the United States are not able to perform restorative care, dental hygiene graduates are competent in providing oral health prevention and promotion services. However, the ability of dental hygienists to perform preventive dental care in alternative settings is limited in many states by dental practice acts. Washington is 1 of approximately 30 states the American Dental Hygienists' Association (ADHA) indicates as direct access states.⁵⁰ Direct access means the dental hygienist can initiate treatment based on their assessment of the patient's needs, without the specific authorization of a dentist. They are able to treat the patient without the presence of a dentist, and can maintain a provider-patient relationship. Dependent upon the specifications of the dental practice acts in the direct access states (regarding providing care in alternative settings), dental hygienists are in a position to initiate collaborations with interdisciplinary teams, such as the feeding team, to increase access to preventive oral health promotion and care.

In Washington, the law allows the dental hygienist to practice unsupervised in specified alternative settings to serve individuals with disabilities.⁵¹ Given that community feeding teams are state funded entities and are often located in health care facilities caring for populations covered by Medicaid, it is likely this setting would qualify as a direct access setting for the dental hygienist. However, since direct access is not available in all states, more research into the value of dental hygienists on multidisciplinary teams is needed in order to demonstrate the need to expand unsupervised dental hygiene practice.

In addition to the need for the dental hygienist to have direct access to participate on the multidisciplinary feeding team, direct reimbursement by Medicaid and insurance companies is also a consideration. Washington is 1 of approximately 15 states which directly reimburse dental hygienists for services under the Medicaid program.^{52,53} Expansion of

direct reimbursement is likely to be dependent upon research and outcome assessment of the cost effectiveness of dental hygienists in alternative settings in reducing medical and dental costs. This is an area where significant research is needed and the dental hygiene profession may want to look towards other health care providers for models on how this can be accomplished. Beginning in the 1990s, dietetics began generating cost effectiveness data for nutrition services and, as a result, registered dietitians are not only Medicaid providers, but can also be reimbursed for certain nutrition services by Medicare.^{54,55} The American Dietetic Association makes cost effectiveness data available as a member benefit to aid in advocacy efforts, which may be something the ADHA may be able to provide in the future once adequate research is conducted.

Conclusion

The experience of working with the feeding team at CTC provided insight and perspective to the interdisciplinary nature of the teams along with preliminary information about the oral health needs of persons served by feeding teams and the potential role of the dental hygienist as a member of the interdisciplinary team. The project was reciprocal in nature, in that it served to inform the feeding team members of the services and expertise a dental hygienist is able to contribute, as well as providing the dental hygienist with an understanding of the dynamic interdisciplinary nature of the feeding team. In moving towards interdisciplinary teams, it will be critical to continue this collaborative approach with mutual respect for the value each member brings to the team.

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Inter-examiner Reliability of Salivary Diagnostic Tests in a Practice-based Research Network

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Introduction

Patients' salivary characteristics, such as flow rate, pH and buffering capacity, may provide information about future caries risk.¹⁻³ Presently, there are several commercially available test kits and methods for measuring salivary characteristics. The salivary diagnostic tests available chair-side today evolved from a laboratory method developed by Ericsson for measuring the buffering capacity of saliva electrometrically.⁴ Ericsson's test was correlated with an increase in dental caries and is still considered the standard today. The first chair-side method of assessing buffering capacity was developed and commercialized a couple of decades later. In this method, the laboratory pH meter was substituted with a liquid colorimetric pH indicator in a test tube to which a known volume of stimulated saliva was added.⁵ This technique was further simplified for chair-side use to a pH indicator strip that was impregnated with acid.⁶ To use the buffer strip, the clinician places a drop of the patient's saliva on the acid test pad and determines the color reading produced. Both methods only determine crude estimates of buffering capacity within the range of low ($\text{pH} \leq 4.0$), intermediate ($\text{pH} = 4.5$ to 5.5) and high ($\text{pH} \geq 6.0$). Using this range, they have been compared to Ericsson's test and have been shown to be valid measurements of salivary buffering capacity in the low to intermediate range, with a tendency to underestimate the values in the high range (not considered clinically sig-

Abstract

Purpose: Patient salivary characteristics are being measured as part of the Northwest PRECEDENT (Practice-based REsearch Collaborative in Evidence-based DENTistry) study on caries risk assessment. Prior to the implementation of these salivary diagnostic tests in a practice-based cohort study, inter-examiner reliability was assessed for resting salivary pH, stimulated salivary flow rate, pH and buffering capacity.

Methods: An initial evaluation of inter-examiner reliability of the 4 salivary tests was conducted among 6 dental auxiliary examiners using a convenience sample of 40 dental students. An incomplete block design was used to assign samples to examiners (3 examiners per sample and 20 samples per examiner). Inter-examiner reliability testing was conducted on a patient population representative of the practice-based network in 4 member practices. Two dental assistants per practice independently conducted the salivary tests on samples provided by a random selection of 20 to 25 patients. A separate analysis was performed for each study. For each test, an inter-examiner reliability index was computed.

Results: Results from two studies are reported. In the first, stimulated salivary flow rate demonstrated excellent inter-examiner reliability, and resting salivary pH showed high inter-examiner reliability, while buffering capacity and stimulated salivary pH had moderate and very low inter-examiner reliability, respectively. In the second, inter-examiner reliability was excellent for the stimulated salivary flow rate and the resting salivary pH. The inter-examiner reliability for the stimulated salivary pH was also high and the stimulated salivary buffering capacity test had moderate reliability.

Conclusion: The small variance in stimulated salivary pH and buffering capacity in dental students may have artificially made the reliability appear low in the first attempt at inter-examiner reliability testing. In the second study, all 4 tests had an acceptable performance.

Keywords: Inter-examiner reliability, salivary diagnostic tests, dental practice-based research networks, caries risk assessment

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 population

nificant).⁶ Additionally, the reliability of the original buffer strip method was tested by adding each saliva sample to duplicate strips, which were found to have consistent reliability.⁶ However, there is a lack of evidence in the literature on inter-examiner reliability using the various salivary tests to measure salivary characteristics. This test of reliability is especially important if the salivary characteristics are to be measured across multiple practice settings and by a variety of clinicians in a practice-based research network.

There is increasing interest in dental practice-based research networks and the types of research protocols that can be carried out in these settings.⁷⁻¹⁰ In a given network, a research study may be carried out by upwards of 100 independent dental practitioners. Among the challenges for networks is evaluation of inter-examiner reliability for tests and measurements that are used in carrying out the protocols in practitioners' offices. Two studies described here illustrate methods that may be employed for establishing inter-examiner reliability for the protocols used in the private practices of a practice-based research network.

Northwest PRECEDENT (Practice-based REsearch Collaborative in Evidence-based DENTistry) is 1 of 3 dental practice-based research networks funded and established in 2005 by the National Institute of Dental and Craniofacial Research.¹¹ Member-dentists in the PRECEDENT network are drawn from the 5 state region of Washington, Oregon, Idaho, Montana and Utah. Faculty and staff at the University of Washington (UW) and the Oregon Health & Science University Schools of Dentistry have oversight and management responsibilities for the network. There are 216 fully trained member-dentists in the network including a sub-network of 44 orthodontists.

The practitioner-members suggest topics of research interest and the academic centers organize and develop protocols and materials for conducting studies in the network practices. One of the topics of primary interest to practitioners is the validity of techniques that are available for caries risk assessment. To this end, Northwest PRECEDENT is conducting Study 002: Salivary Markers in Caries Risk Assessment. This study will evaluate the contributions of historical, environmental and behavioral factors and salivary characteristics to caries risk. The primary outcome measure is caries incidence in permanent teeth over 2 years.

Prior to the implementation of tests measuring salivary characteristics in this cohort study on caries risk assessment in a practice-based setting, 2 inter-examiner reliability studies were conducted.

The objective of this report is to investigate the inter-examiner reliability of 4 salivary diagnostic tests: resting salivary pH, stimulated salivary flow rate, pH and buffering capacity in 2 populations. The first study, Reliability Study 1, was conducted on a convenience sample of dental students from the UW. The second, Reliability Study 2, was performed with patient-populations representative of the practice-based network in 4 private practices of PRECEDENT member-dentists. Reliability Study 2 also assessed the feasibility of conducting these 4 tests and an additional 2 tests (resting salivary consistency and resting salivary flow rate from labial salivary glands) by dental personnel in practice-based settings.

Methods and Materials

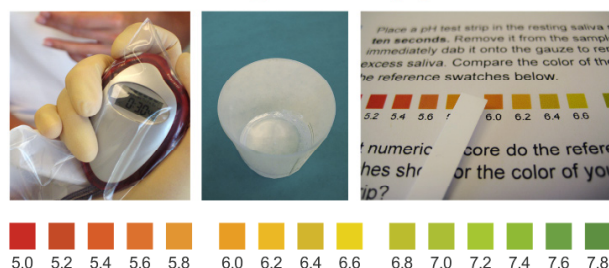
Protocol development established 6 salivary diagnostic tests to be used in Study 002. The salivary characteristics selected had to have evidence of potential to predict future caries.¹⁻³ In addition, Northwest PRECEDENT practitioners expressed that it was important that the in-office methods for salivary testing be easy-to-use and feasible to employ in a busy private practice or community clinic setting. Because they had to be easy-to-use chair-side by dental auxiliary personnel, microbiological tests were considered too cumbersome at the time to be practical, as they required special handling, a counter-top incubator and delayed reporting of results.

The salivary characteristics recorded in Study 002 are:

1. Resting salivary consistency: the appearance of the saliva is visually assessed as watery and clear or thick, sticky and frothy (Normal: watery and clear)
2. Resting salivary flow rate from labial salivary glands: the lower labial buccal mucosa is dried and the rate of secretion from the minor salivary glands is timed, up to a maximum of 90 seconds (Normal: 60 seconds or less)¹²
3. Resting salivary pH: the patient expectorates saliva (without stimulation) into a collection cup. The pH of the saliva is immediately evaluated with a pH test strip. The strip is compared to a reference chart that is provided in the data collection form (Normal: pH 6.5 to 7.5)¹ (Figure 1)
4. Stimulated salivary flow rate: the patient chews a wax pellet and expectorates into a collection cup regularly for 5 minutes. The volume of saliva is measured by reading the level of the watery component. The milliliters per minute flow rate is calculated for analysis (Normal: 1 ml per minute or greater)² (Figure 1)

Figure 1: Illustrations of the four salivary tests evaluated for inter-examiner reliability

Resting Salivary pH



Record the numerical score for the color of the test strip:

Score

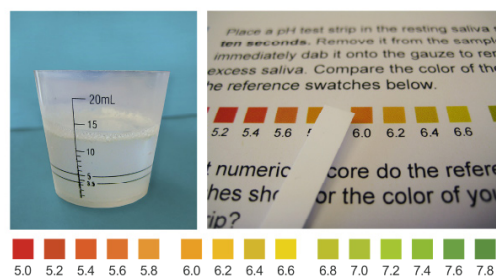
Stimulated Salivary Flow Rate



Measure the volume of saliva:

mL

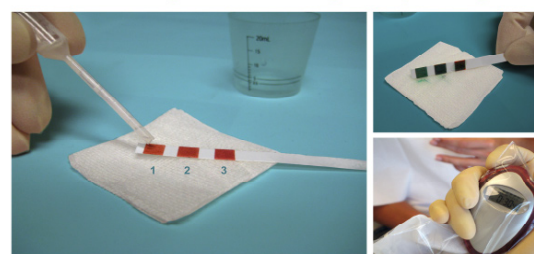
Stimulated Salivary pH



Record the numerical score for the color of the test strip:

Score

Salivary Buffering Capacity



	GREEN	BLUE/GREEN	BLUE	RED/BLUE	RED/GREEN	RED	OTHER
What color is Square 1?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
What color is Square 2?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
What color is Square 3?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. Stimulated salivary pH: the pH of the stimulated saliva sample is directly measured with a second pH test strip (Normal: pH 6.5 to 7.5)¹ (Figure 1)
6. Stimulated salivary buffering capacity: a drop of stimulated saliva is placed via pipette onto each of the 3 pads on a buffer test strip. Each pad presents a different acid challenge. The color produced on each pad by the saliva is evaluated and the corresponding verbal description on the data collection form is checked. No reference chart of colors is provided (Figure 1). The pads are individually scored from 0 to 4 (red=0, green=4). The buffer strip may have a cumulative score from 0 to 12. Examiners are not informed of the scoring code or of the significance of the colors (Normal: 10 to 12 points total per manufacturer)¹³

used in Study 002, the next step developed a set of instructions for performing the tests, which were then pilot tested in a focus group setting. These instructions, which included photographs illustrating the 6 tests and reference charts for pH values, also served as the data collection instrument. Five dental assistants (not color blind) of varying levels of experience working in the dental clinics at the UW School of Dentistry were asked to participate in the focus group.

Using the data collection form with instructions for each of the salivary tests, the dental assistants individually performed the tests on a volunteer without any additional training, with the exception of the opportunity to read the instructions prior to the clinic session. The lead coordinator for Northwest PRECEDENT observed each dental assistant as salivary tests were conducted, and the coordinator evaluated the results. After the clinic session the dental assistants assembled to discuss performing the salivary tests, the feasibility and amount of time required, the instructions provided and recommendations for training. Based on their feedback, the instructions were modified and a detailed training protocol was developed.

Salivary test kits for Study 002 containing all the necessary components for the 6 tests were developed and assembled by PRECEDENT staff. It was practical to use a commercially available buffer test strip (the Saliva-Check buffer test strip from GC Corporation, Tokyo, Japan). Additionally, timers are supplied to all practices (Figure 2).

Focus Group

After finalizing the salivary diagnostic tests to be

Reliability Study 1

The purpose of this reliability study was to evaluate the degree to which dental staff, trained to perform and evaluate the results of the salivary tests, give consistent and reliable results when examining the same saliva samples. Inter-examiner reliability was evaluated for 4 of the 6 salivary tests used in Study 002: resting salivary pH, stimulated salivary flow rate (5 minute volume), pH and salivary buffering capacity (Figure 1). The resting salivary consistency test and the evaluation of resting salivary flow rate from labial salivary glands required a clinical exam that was not feasible to perform on the dental student volunteers during a class laboratory session. The UW Institutional Review Board approved the study using an oral consent process, as no identifying information was collected as part of the study and saliva samples were immediately discarded after the tests were completed.

To establish whether or not there is good inter-examiner reliability for these salivary tests, 5 UW dental assistants, different from the dental assistants who participated in the focus group, were recruited. These dental assistants were not color-blind, and were as similar as possible to the persons who would be performing the salivary tests in the dental practices of Northwest PRECEDENT. They were trained to perform and evaluate the salivary tests prior to participating in this reliability study. The training protocol involved a review of the salivary test instructions and kit components with the lead coordinator. The dental assistants then performed a practice run to administer the tests unsupervised on a volunteer. The lead coordinator clarified any questions raised when the dental assistants reported on their practice session.

During a regularly scheduled class session in the dental school simulation laboratory, 40 dental students provided salivary samples for inter-examiner reliability testing. One hour prior to the collection of salivary samples, the students were reminded that they must abstain from smoking, eating, drinking (except water), tooth brushing and using mouthwash. The students provided a resting salivary sample and a stimulated sample following the collection protocol for the salivary tests.

The 40 paired, numbered samples were immediately transported to a biomedical laboratory, where the 5 dental assistant examiners and the lead coordinator completed the 4 salivary tests on 20 pairs of samples. An incomplete block design was used to assign 20 pairs of samples to each examiner, and each sample was evaluated by 3 examiners. The examiners first evaluated all 20 assigned stim-

Figure 2: PRECEDENT salivary test kits



ulated saliva samples for flow rate (5 minute volume). After flow rate evaluation was completed, the examiners evaluated the stimulated salivary pH, buffering capacity and resting salivary pH for their assigned samples.

Reliability Study 2

The second reliability study had 2 objectives. The first was to evaluate the inter-examiner reliability of 4 of the 6 salivary tests (same tests as in Reliability Study 1) among dental assistants in practice-based settings. The resting salivary consistency test and the resting salivary flow rate from labial salivary glands could not be evaluated for inter-examiner reliability in the practice setting, as these tests were required to be performed directly on the patient, and saliva collection would change the patient's oral environment from the first to the second evaluation. The second objective was to assess the feasibility of using the 6 tests to measure salivary characteristics in a practice-based setting by evaluating the time required for completion of the tests.

Four Northwest PRECEDENT practices volunteered as sites for the inter-examiner reliability testing. It required 2 dental assistants to be available to evaluate the saliva samples back-to-back. The practice sites received study binders containing in-depth instruction on study conduct, including the Patient ID Log, phone recruitment script, Staff Log and training requirements, Manual of Procedures (MOP), salivary test instruction/data collection forms and consent forms. PRECEDENT assembled salivary test kits were provided to the sites. The lead coordinator held a conference call with the 2 salivary administrator dental assistants in each practice. The call reviewed, in detail, the

study protocol, MOP and the required training. Each dental assistant practiced administering the 6 salivary tests on an office volunteer with the dentist observing. Dentist certification of the salivary practice runs were faxed to PRECEDENT prior to starting the study.

The UW Institutional Review Board approved the study protocol using the oral consent process for patients. A random sample of 20 to 25 patients per practice was selected using an assigned systematic sampling interval (every Nth patient) based on a typical weekly patient schedule in order to recruit approximately 1 patient per day. Patients age 9 years and older who spoke English were eligible to participate.

After consent to participate in the study was obtained, it was confirmed that the patient had abstained for the previous hour from smoking, eating, drinking (except water), tooth brushing and using mouthwash. The first dental assistant (DA1) timed and performed the 6 salivary tests on the patient in the following order: resting salivary consistency, flow rate from labial glands, resting pH, stimulated salivary buffering capacity, pH and flow rate (5 minute volume). The patient's participation in the study was complete at that point. Within a maximum of 10 minutes, the second dental assistant (DA2), blind to DA1's results, evaluated the same samples to determine the inter-examiner reliability for 4 of the 6 tests in the following order: measurement of stimulated salivary flow rate (5 minute volume), buffering capacity, pH and resting salivary pH. The saliva samples were then discarded. The dental assistants' roles were not interchangeable.

Statistical Analysis

Separate analyses of reliability of the salivary diagnostic tests were conducted for the 2 studies. Descriptive statistics (mean and standard deviation (SD)) were calculated for each of the tests. Reliability was measured for each test using the intra-class correlation coefficient (ICC), which is defined as the correlation between 2 test results obtained by 2 different examiners for the same patient. The ICC and 95% confidence interval (CI) was estimated using an analysis of variance method.¹⁴ For Reliability Study 1, a balanced incomplete block design was used with both examiner and subject as random effects. For Reliability Study 2, examiner and subject were nested within practice, and practice, examiner and subject were random effects. Statistical analyses were conducted using Stata version 8 and were independently validated.¹⁵ The following scheme was used for interpretation of ICC val-

ues: 1) $ICC \leq 0.2$ (no or very low agreement), 0.21 to 0.40 (low agreement), 0.41 to 0.60 (moderate agreement), 0.61 to 0.80 (high agreement) and 0.81 to 1.00 (excellent agreement).¹⁶

Results

Reliability Study 1

Identifying information for the participating dental student subjects, such as age and gender, was not collected. However, the mean age of the entire class of students was 26 years old and 38% of the class was female. The mean stimulated salivary flow rate (calculated from the 5 minute volume) was 1.78 ml per minute, with a mean stimulated salivary pH of 7.61. The resting salivary pH mean was 7.28. Buffer pad 1 had a mean score of 3.83, buffer pad 2 had a mean of 3.63 and buffer pad 3, the strongest acid challenge, had a mean of 1.67. This resulted in an overall buffer capacity mean score of 9.13 (Table I).

The assessment of stimulated salivary flow rate demonstrated excellent inter-examiner reliability ($ICC=0.96$). The resting salivary pH showed high inter-examiner reliability (0.76), while the stimulated salivary pH had a very low ICC (0.08). The stimulated salivary buffering capacity test, with the 3 test pad scores summed, had moderate inter-examiner reliability ($ICC=0.43$), with very low reliability of the first and second test pad challenges ($ICC=0.02$ and 0.20) and moderate reliability of the third acid challenge ($ICC=0.46$) (Table I).

Reliability Study 2

Among 4 Northwest PRECEDENT dental practices, 85 patients were recruited for inter-examiner reliability testing. The number of patients in each age category, as designated for Study 002, were as follows: age 9 to 17 ($n=23$), age 18 to 64 ($n=45$) and age 65+ ($n=17$). DA1 conducted the 6 salivary tests in a mean time of 13 minutes per patient, with a range of 8 to 17 minutes ($SD=2.2$ minutes). The average time between DA1 and DA2 conducting their respective salivary tests was 5.5 minutes ($SD=9$, median=3, interquartile range=1 to 7 minutes).

The first 2 salivary diagnostic tests, resting salivary consistency and resting salivary flow rate from labial salivary glands were conducted by DA1 only. Resting salivary consistency was thick and frothy in 18% of the participants. The mean time for the labial glands to produce saliva was 41 seconds ($SD=25$, median=35, interquartile range=22 to 53 seconds). A cut-off of 90 seconds was used for the

Table I: Summary of the salivary tests for Reliability Study 1

Salivary Test	Mean (SD)	ICC (95% CI)
Rate (ml / minute)	1.78 (0.74)	0.96 (0.93–0.98)
Resting pH	7.28 (0.33)	0.76 (0.62–0.85)
Stimulated pH	7.61 (0.17)	0.08 (0.00–0.29)
Buffer pad 1	3.83 (0.49)	0.02 (0.00–0.23)
Buffer pad 2	3.63 (0.55)	0.20 (0.00–0.41)
Buffer pad 3	1.67 (1.49)	0.46 (0.26–0.64)
Buffer capacity	9.13 (1.71)	0.43 (0.22–0.61)

12 participants who did not produce labial gland saliva within the test time limit.

For each patient's saliva samples, 4 salivary characteristics were evaluated and recorded by both DA1 and DA2. The mean stimulated salivary flow rate (calculated from the 5 minute volume) in this patient population was 1.29 ml per minute, and the mean pH of the stimulated saliva was 7.42. The mean resting salivary pH was 6.67, and the stimulated salivary buffering capacity mean score was 7.34 (Table II).

Assessment of stimulated salivary flow rate (ICC=0.94) and resting salivary pH (ICC=0.82) demonstrated excellent inter-examiner reliability, while stimulated salivary pH (ICC=0.80) showed high inter-examiner reliability. The stimulated salivary buffering capacity test had moderate reliability (ICC=0.55) (Table II).

Discussion

Two reliability studies assessed 4 salivary tests in a convenience sample of dental students and a sample of dental patients from 4 representative PRECEDENT practices. The inter-examiner reliability of stimulated salivary flow rate and resting salivary pH were considered very good in both studies, but the stimulated salivary pH and buffering capacity were not acceptable in 1 study.

In Reliability Study 1, the small variation in stimulated salivary pH and buffering capacity among the dental students may have artificially made the reliability appear low. For this reason, it was determined that further inter-examiner reliability testing enrolling a wider variety of subjects with a potentially greater variation in salivary characteristics was needed. The follow-up study was conducted in a sample of PRECEDENT practitioner offices with a patient population representative of the dental practices where these tests are intended to be used.

Table II: Summary of the salivary tests for Reliability Study 2

Salivary Test	Mean (SD)	ICC (95% CI)
Rate (ml / minute)	1.29 (0.78)	0.94 (0.91–0.96)
Resting pH	6.67 (0.46)	0.82 (0.74–0.88)
Stimulated pH	7.42 (0.27)	0.80 (0.71–0.87)
Buffer pad 1	3.64 (0.66)	0.23 (0.01–0.42)
Buffer pad 2	2.67 (1.53)	0.46 (0.25–0.60)
Buffer pad 3	0.99 (1.45)	0.27 (0.05–0.46)
Buffer capacity	7.34 (2.74)	0.55 (0.37–0.68)

In Reliability Study 2, the reliability of stimulated salivary flow rate and resting salivary pH were consistent with Reliability Study 1, while the stimulated salivary pH and buffering capacity tests had a better performance. The stimulated salivary pH presented a high agreement. While the reliability of the individual pads with different acid challenges for the buffering capacity test was low or at the low end of moderate (pad 2), the overall buffering capacity test score had improved moderate reliability.

The lower reliability of the buffer capacity may have been due to the ambiguity in color interpretation of the buffering strip test pads with the 3 different acid challenges. A reference chart is not available as a visual aid for evaluation of the colors as it is for the pH tests. This result correlates with the evaluation of the earlier chair-side tube method of estimating salivary buffering capacity, where the method was precise only within the crude criteria of low, intermediate and high buffer capacity compared to the standard electrometric method.¹⁷ This tube method evolved into the buffer strip method used today. Other buffer strips continue to use the low, intermediate and high criteria, rather than attempting to measure buffering capacity at differing levels of acid challenge. Those buffer strips that use the low, intermediate and high criteria provide a color reference chart for evaluating the results. A similar guide for color interpretation could improve the precision of evaluating the results from the buffer test strip employed in these studies.

The 4 dental practices conducting this study found the salivary diagnostic tests easy to incorporate into the routine of the day. Dental personnel were quickly and easily trained to perform the tests and patients were accepting of the procedures. The greatest challenge was for patients to remember not to eat, drink (except water), brush their teeth or use mouthwash within the hour prior to their appointment. In some cases, the office staff contacted patients an hour before the appointment to provide a reminder. New technology in the form of automated

electronic texting of appointment reminders has the ability to minimize this problem in the future.

Practice-based research networks have been established to assess their ability to influence the evidence-base of dental practice.¹¹ There is a question whether a practice-based network can or should attempt to perform strict calibration and reliability testing of measures in their studies, or whether the variability and lack of calibration can be tolerated because it is off-set by the large numbers of evaluations that can be made in a network.^{8,18-20} Some practice-based research network participants advocate for less emphasis on measurement calibration and reliability because that reflects the "real-life" setting of dental practice. To do otherwise might not be palatable to practitioners.⁹

If practice-based networks are to provide the best possible evidence-base for the practice of dentistry, then sound scientific methodology is an appropriate goal when conducting research. In a network setting, where multiple examiners are collecting data and taking measurements, it is possible to establish a means to assess the inter-examiner reliability of tests and measurements used. The process described here was the basis for a training protocol whereby all examiners had the same detailed level of instruction and practice in performing procedures prior to study initiation. The training protocol having been established, inter-examiner reliability was evaluated for the salivary tests used. When equivocal results were obtained, further testing was determined to be necessary, along with possible adjustments to the training and procedures employed. In this case, further testing established adequate inter-examiner reliability levels for use of these tests and training protocol in the study on Salivary Markers in Caries Risk Assessment, Study 002 of the Northwest PRECEDENT network.

Conclusion

Patients' salivary characteristics may provide information about future caries risk. Prior to implementation of tests measuring salivary characteristics in a cohort study on caries risk assessment in a

practice-based research network, 2 inter-examiner reliability studies were conducted, the first on a convenience population of dental students, and the second with patient-populations representative of the practice-based network. These studies demonstrated acceptable inter-examiner reliability for 4 salivary diagnostic tests: stimulated salivary flow, pH, buffering capacity and resting salivary pH. In addition, it showed that it is feasible to perform the 6 tests measuring salivary characteristics in practice-based settings in terms of time, personnel required and patient acceptance.

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Raising Oral Health Awareness Among Nephrology Nurses

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Introduction

According to the National Kidney Foundation, 26 million Americans have chronic kidney disease (CKD).¹ Given the prevalence of conditions such as diabetes and hypertension, it is estimated that an additional 20 million people are at an increased risk for developing CKD.¹ Research suggests chronic kidney disease can give rise to a wide spectrum of oral manifestations affecting the hard or soft tissues of the mouth.^{2,3} Likewise, periodontitis may contribute to the burden of systemic inflammation in these patients.^{3,4} Unfortunately, patients with CKD and their health care providers are often unaware of the oral complications of the disease, as well as the multiple systems that can be affected. The complexity of care for patients with CKD reinforces the need for collaboration between health care providers. The purpose of this study was to raise oral health awareness by providing educational seminars to health care providers, specifically nephrology nurses.

Abstract

Purpose: The complexity of care for patients with chronic kidney disease (CKD) reinforces the need for collaboration between health care providers. The purpose of this study was to raise oral health awareness by providing educational seminars to health care providers, specifically nephrology nurses.

Methods: Educational seminars entitled "Oral Health and Chronic Kidney Disease" were delivered by calibrated dental hygiene educators to nurses in 3 different regions in the United States. The nurse participants (n=106) were given randomly assigned pre- and post-tests, assessing their knowledge of oral health and its relation to CKD.

Results: Pre-tests revealed that nurses had little knowledge of oral health and its relation to CKD. Regardless of questionnaire order, a significant increase of knowledge was observed for both groups (p-value≤0.015), increasing from 61 to 76% on average.

Conclusion: Incorporating interdisciplinary education increases nurses' knowledge and may lead to greater quality of life outcomes and improved overall health in patients with CKD.

Keywords: kidney disease, interdisciplinary collaboration, nurses' oral health awareness

This study supports the NDHRA priority area, **Clinical Dental Hygiene Care:** Develop and test interventions to reduce the incidence of oral disease in special at-risk populations (diabetics, tobacco users, cardiac patients and genetically

Review of the Literature

The prevalence of CKD has heightened the medical profession's awareness of this serious and growing problem in the United States. Systemic complications associated with CKD include cardiovascular (hypertension, congestive heart failure and pericarditis),^{1,5,6} gastrointestinal (anorexia, nausea, vomiting, generalized gastroenteritis, peptic ulcer disease, stomatitis and candidiasis),^{1,6-8} neuromuscular, hematologic and dermatologic systems.^{1,7,8} In 2005, Protor et al reviewed current literature surrounding oral and dental aspects of renal disease and reported conditions that are important for nephrology and dental professionals to know.² The most significant findings are discussed below.

Gingival Enlargement

Gingival enlargement, secondary to drug therapy, is the most reported oral manifestation of renal disease.⁹⁻¹⁶ Gingival enlargement can be induced by cyclosporine and/or calcium channel blockers. Cyclosporine is an immunosuppressant used in organ transplant recipients and has numerous side effects, such as gingival overgrowth.¹⁷ Regular clinical monitoring of cyclosporine-related gingival enlargement is essential, since squamous cell carcinoma and Kaposi's sarcoma have been reported within such gingival lesions.¹⁰

Oral Biofilms

Studies have indicated that the oral hygiene of hemodialysis patients is worse than that of the general population.^{7,18,19} Greater calculus formation, gingivitis, caries, atrophy of the alveolar bone, pathologic mobility proportional to bone resorption and tooth loss have been observed.²⁰ Pocket formation and necrotic teeth found under crowns, bridges and fillings have also been found in patients with CKD. In a study of 45 hemodialysis patients, all had some form of periodontal disease and oral debris, and 64% had severe gingivitis and a higher-than-normal score for the DMFT (decayed, missing and filled teeth) index.²¹

Xerostomia

Symptoms of xerostomia can arise in many individuals receiving hemodialysis, due to restricted fluid intake, as well as side effects of drug therapy.^{1,2} This predisposes the patient to dental caries, gingival inflammation and difficulties with speech. In addition, xerostomia may lead to infections such as candidiasis and acute suppurative sialadenitis.¹⁷

Mucosal Lesions

A wide range of oral mucosal lesions has been described in individuals receiving dialysis and allografts, particularly white patches and/or ulcerations. Uremic stomatitis may manifest as white, red or grey areas of the oral mucosa. Oral mucosal macules and nodules of unknown etiology have been described in 14% of individuals receiving hemodialysis.^{1,2} In addition, the oral mucosa in patients with anemia may appear pale.^{1,2}

Malodor

Uremic patients may have an ammonia-like oral odor. In some instances, CKD can give rise to altered taste sensation. These patients report a metallic taste or the sensation of an enlarged tongue. Because of their immunocompromised state, hemodialysis patients and allograft recipients have increased susceptibility to candidal infections, such as pseudomembranous, erythematous and chronic atrophic candidosis.^{1,2,18,22}

Osseous and Dental Changes

A wide range of osseous changes of the jaw accompany chronic renal disease. These reflect a variety of defects of calcium metabolism due to increased parathyroid activity. The most classically described osseous change is the triad composed of the loss of lamina dura, demineralized bone and lo-

calized radiolucent jaw lesions, such as giant cell granuloma or Brown tumor.² Delayed eruption of permanent teeth has been reported in children with CKD. Narrowing of the pulp chamber of teeth of adults with CKD can also occur. Non-carious tooth loss is more prevalent in individuals with CKD than in the general population.²

Nutritional Deficiencies

Oral symptoms related to vitamin and mineral deficiencies are common in patients with CKD. Manifestations may include cheilosis of the lips from vitamin B deficiency, bleeding gums, tooth loss, gingivitis from vitamin C deficiency and pale lips/tongue. Iron deficiency may manifest orally as a bald tongue, scarlet tongue, atrophied tongue and filiform atrophy. Other possible oral manifestations from nutritional deficiency may include extra oral dermatitis, lichenification around the mouth, peeling of the lips and poor taste acuity.^{1,2,22}

Periodontal Disease

Diseases showing low-grade inflammation, such as diabetes and hypertension, are commonly associated with CKD.¹ Several studies hypothesize that chronic periodontal inflammation may contribute to the chronic systemic inflammatory burden associated with CKD.^{4,23-25} There is evidence to support a mechanistic link among inflammation, atherosclerosis and CKD. Inflammatory biomarkers, such as C-reactive protein and interleukin-6, have been shown to be elevated in CKD.^{4,23-27} Several studies have suggested that untreated dental infection in immunosuppressed individuals could potentially contribute to morbidity and transplant rejection.⁷ A United States population-based study (n=11,955) suggested the importance of considering multiple risk-factors, including periodontal status, because this improves the identification of individuals at high risk for CKD, and may ultimately reduce its burden.⁴ Further research is needed to evaluate the causal inferences regarding the role of periodontal pathogen burden and its contribution to systemic inflammatory burden of CKD.

Interdisciplinary Collaboration

Given the potential for poor oral health to increase risk for systemic disease, it is extremely important that the medical and dental communities be knowledgeable with regard to the oral-systemic relationship so that health care services can be delivered collaboratively. Numerous studies have assessed medical and other health care professionals' knowledge, attitudes and practices with regard to oral health. The majority of these studies have

identified an existing gap in knowledge and practices among medical providers with regard to oral diseases. Quijano et al found that internal medicine trainees had inadequate knowledge regarding periodontal disease and were generally uncomfortable with performing a simple periodontal examination.²⁸ Southern found that, among the nurses surveyed (n=100), their knowledge of oral health status, signs and symptoms of oral disease was inadequate.²⁹ Lewis et al studied pediatricians' attitudes and practices related to the oral health of children 0 to 3 years old and found that only 54% of surveyed pediatricians reported examining the teeth of more than half of their 0 to 3 year old patients. The most common barrier to participation in oral health-related activities in their practices was lack of training, as less than 25% had received oral health education in medical school, residency or continuing education.³⁰ Results from additional studies assessing pediatricians' knowledge and current practices related to oral health have found that further training is needed to enhance confidence, expertise and knowledge of preventive screening and referral.³¹⁻³⁴

Several studies point to an increased awareness of the oral-systemic relationship among medical providers, but suggest limited incorporation of dental care into clinical medical practice. Wilder et al surveyed obstetricians and found that most were knowledgeable of the potential role of periodontal disease as a pregnancy risk factor but did not look into their patients' mouths at initial prenatal examinations.³⁵ A study by Shenoy et al found that the gynecologists' knowledge was high regarding the oral manifestations of periodontal disease, but knowledge was low regarding periodontal disease as a risk factor for pre-term low birth weight babies.³⁶ Reed et al assessed the oral cancer knowledge and experience of medical students in an academic setting and found that students did not receive adequate exposure to oral cancer prevention and detection practices.³⁷ Andersson et al found that, although nurses were aware of the impact of oral health in old age, their attitude was that this was a matter for dentistry.³⁸ Canto et al found that family physicians were aware of the major risk factors for oral cancer when taking a medical history, but less than 24% provided an oral cancer examination to patients 40 years of age and over.³⁹

In order to build the relationships that are integral to implementing collaborative health care services, educational interventions have been used to increase awareness of chronic diseases among health care providers. Overwhelmingly, the literature supports that even brief educational interventions can enhance health provider knowledge. Educational sessions have been found to improve knowledge

and attitudes in the areas of breast cancer assessment,⁴⁰ chronic pain,⁴¹ pediatric mental health management,⁴² awareness and use of geriatric service⁴³ and prescription standards.⁴⁴ A dental hygiene education program for nursing staff increased nurses' knowledge and self-confidence with regard to the provision of oral care to nursing home residents.⁴⁵ Small group workshops taught by medical and dental educators led to an increase in oral knowledge for medical students.⁴⁶

Methods and Materials

The subjects of this study were nurses who work with renal patients at the University of Minnesota hospitals (n=106). The nurses were invited to attend an educational seminar entitled Oral Health and Chronic Kidney Disease, held at the University of Minnesota, School of Nursing. Participation was voluntary and subjects could opt out of the study by choosing not to complete the questionnaires. No demographic data was asked in order to protect anonymity and participant confidentiality. Informed consent was obtained after explaining the purpose of the seminar and the purpose of the questionnaires.

Three dental hygiene educators presented a single, 2 hour educational seminar to renal nurses in 3 university settings: Virginia Commonwealth University, the University of Minnesota and the University of New Mexico. The educators calibrated by collectively researching literature for the creation of uniform seminar content and delivering the information to participants in a lecture format using identical Microsoft Power Point presentations.

To assess the effectiveness of the educational seminars, a single questionnaire was administered to participants as a pre- and post-test. Because the pre- and post-test were the same, data collected from 2 of the initial sites, the University New Mexico and Virginia Commonwealth University, were discarded because the pre-test could prompt participants to pay attention to particular information, and thereby show an effectiveness effect. For the third site, the University of Minnesota, this shortcoming was addressed by creating 2 questionnaires, A and B, and by administering them at random as pre- and post-tests to eliminate a learning effect from taking 1 questionnaire twice. Only these subjects from the third site are evaluated here. Each questionnaire consisted of 10 multiple-choice questions and were color-coded and sequentially numbered for identification and comparison of the pre- and post-surveys. The subjects (n=106) were given randomly assigned pre- and post-tests that assessed their knowledge of oral health and its re-

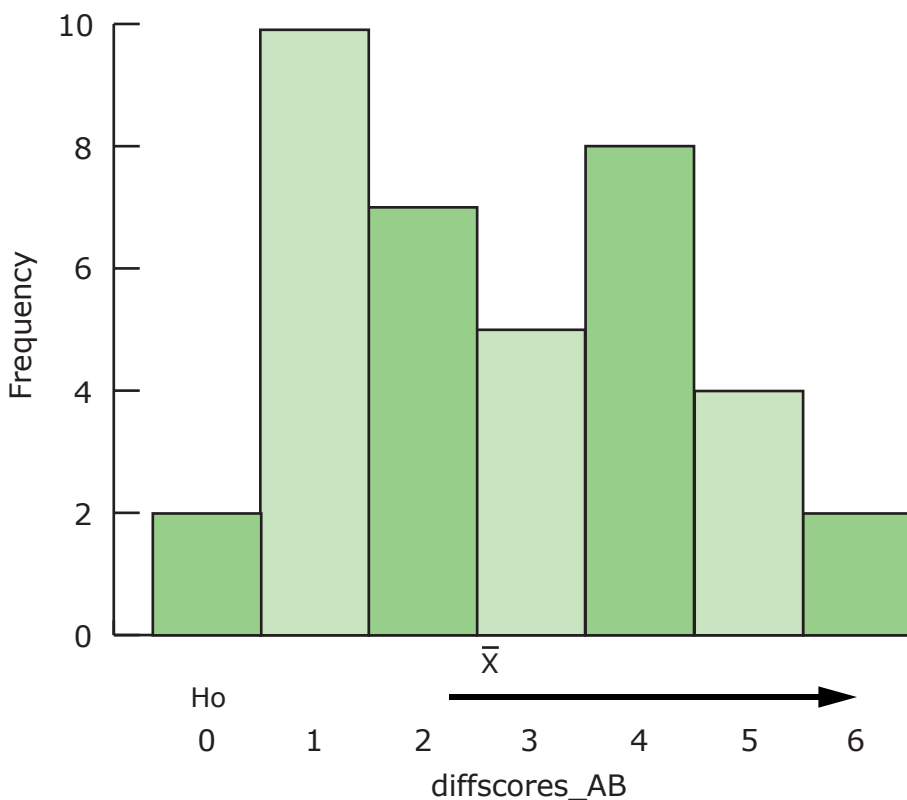
lation to CKD. Scores for the pre- and post-questionnaire were tallied and the score of the pre- was subtracted from the score of the post- so that a positive difference reflected an increase in knowledge. A natural consequence of this design is that 2 groups emerge, those who were assigned the A in the pre-, designated by AB, and those taking B in the pre-, designated by BA. The central hypothesis of the study was that the educational seminar would increase nurses' knowledge of oral manifestations of CKD. The null hypothesis states that there would be no difference between the pre- and post-test.

A 2 sample paired t-test was first performed to indicate whether there is a questionnaire order effect. Separate 1 sample paired t-tests were then performed to indicate whether the increase for each group was significant. Five participants failed to take at least 1 questionnaire, which were excluded from analysis. Questions left blank (only a few among all questionnaires) were considered incorrect. The University of Minnesota Institutional Review Board approved this study as exempted research.

Results

The estimated questionnaire effect was that the AB group had an average improvement of 2.21 more than the BA group, a significant difference with a 2 sample t-test (p -value<0.0005). Therefore, it is important to account for this effect in the individual group improvements. The individual improvements for each group were significant. Figure 1 and 2 shows the distribution of score differences for the AB and BA groups, respectively, with the point labeled HO reflecting the null hypothesis of no improvement. Group AB increased an average of 2.71 (p -value<0.0005), and group BA increased an average of 0.50 (p -value=0.015). Therefore, a significant increase in knowledge was gained. Pre-tests revealed that nurses lacked an understanding of oral health and it's relation to CKD, but understood more after the seminar. Regardless of questionnaire order, a significant increase of knowledge was observed for both groups (p -value≤0.015), increasing from 61 to 76% on average.

Figure 1: Histogram of diffscores_AB (with Ho and 95% t-confidence interval for the mean)



Discussion

As the prevalence of CKD continues to escalate in the United States, dental professionals will see an unprecedented number of patients with CKD and end stage renal disease. Because oral health is a critical component of overall general health, it is critical that the nephrology team be aware of the oral complications that CKD and its treatment can cause. Additionally, nephrology nurses need to be aware that periodontal disease and other oral infections may compromise organ transplant. An understanding of these issues may assist renal nurses in recognizing early oral manifestations, providing basic patient education and, when necessary, making referrals to address these concerns. Likewise, the dental professional must understand the basic pathologic process involved in the management of patients with CKD.

Based on the results of this study, it is recommended that educational institutions initiate curriculum innovations that provide the foundational abilities necessary to support an interprofessional approach to health care. The focus of interdisciplinary collaboration in patient treatment should be on promoting mutual understanding, trust and respect, increasing effective communication

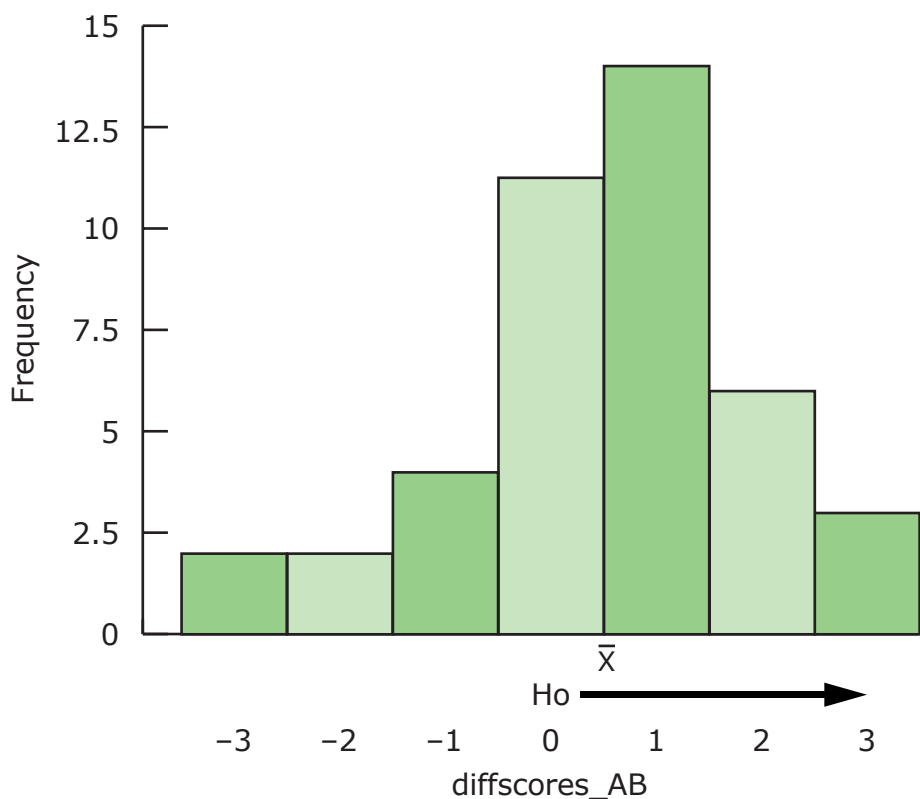
and recognizing the importance of self, peer and team assessment among health care professionals. Supporting evidence in the literature suggests that interdisciplinary seminars and/or other educational strategies similar to the one in this study can improve oral health knowledge among health care professionals. However, instructional efforts to increase providers' dental knowledge and opinions of the importance of oral diseases must include components that address self-efficacy in translating knowledge into clinical practice. In addition, more research is needed to evaluate means to sustaining the knowledge gained in educational seminars and whether educational interventions are efficacious in translating knowledge to practice.

Although inconclusive, there is a growing body of research supporting disease processes related to the oral systemic health link. CKD provides a good example of how a systemic condition can affect oral health and why further research in this area is needed. To improve patient outcomes, a collaborative plan between dental and renal professionals must be established. Dental hygienists, nurses, dieticians and nephrologists are ideal candidates to begin working together for the improved health of patients with renal disease.

Conclusion

The evidence supports that an educational intervention increases nurses' knowledge of oral health and CKD. As evidence-based practice evolves in nephrology and dentistry, a structured means of communication between these 2 disciplines must be established. CKD provides an example of the

Figure 2: Histogram of diffscores_AB (with Ho and 95% t-confidence interval for the mean)



link between oral and general health. Raising oral awareness among nephrology nurses can potentially lead to greater quality of life outcomes and improved overall health in patients with CKD. It is recommended that educational interventions designed to promote interdisciplinary collaboration continue in order to benefit patients with oral-systemic health-associated conditions.

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