



American  
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Hygienists'  
Association

# JOURNAL OF DENTAL HYGIENE

THE AMERICAN DENTAL HYGIENISTS' ASSOCIATION

OCTOBER 2017 • VOLUME 91 • NUMBER 5

- A New Mid-Level Dental Provider in Oregon: Dental hygienists' perceptions
- Factors Associated with the Economic Sustainability of the Registered Dental Hygienist in Alternative Practice
- Impact of State Workforce Policies on Underserved Patients' Access to Dental Care: A longitudinal study
- Oral Health Status of Independent Older Adults in Texas: An observational study of the urban/rural areas
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- Dentsply Sirona/ADHA Graduate Student Clinician Research Abstracts

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

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## The Role of the Dental Hygiene Profession: Reducing the Risk of Obesity, One Sweetened Beverage at a Time

Lisa F. Mallonee, MPH, RDH, RD, LD

Childhood obesity is a major public health concern in the United States. The prevalence of obesity is 17% for children and adolescents aged 2-19 years.<sup>1</sup> A closer look at the statistics show the breakdown as: 8.9% for 2-to 5-year-olds, 17.5 % for 6- to 11-year-olds and 20.5% for those aged 12-19.<sup>1</sup> Children's eating behaviors are a prime culprit, with sugar sweetened beverage (SSB) consumption becoming more widespread and problematic among our youth. Diets high in sugar not only contribute to risk of overweight and obesity but increase the risk of dental caries. The World Health Organization and the 2015-2020 Dietary Guidelines for Americans recommend an energy intake of less than or equal to 10 percent of calories from added sugars.<sup>2,3</sup> Sugar sweetened beverages are one of the primary sources of added sugars in the diet. Soft drinks, sports drinks and fruit drinks are the greatest offenders. Although, 100% fruit juice is comprised of natural sugar rather than added sugar, regular consumption can pose a risk as well. Previously, pediatricians recommended fruit juice consumption as a great source of vitamin C. In a recent release, the American Academy of Pediatrics (AAP) took a strong stance in support of policies that encourage a reduced consumption of fruit juice and an increased consumption of whole fruits. The AAP warns that the sugar content of juice provides excess calories that can lead to weight gain and an increased risk of dental caries.<sup>4</sup>

As a health care professional and educator, I am committed to two interconnected goals: sharing my knowledge, expertise, and passion while also promoting the value of interprofessional collaboration among dental professionals within the wider health care community for greater patient/client outcomes. In January 2016, the American Dental Hygienists' Association (ADHA) announced a cooperative effort with the National Maternal and Child Oral Health Resource Center (OHRC) at Georgetown University, in partnership with the American Academy of Pediatric Dentistry (AAPD), the American Dental

Association (ADA), and the Santa Fe Group to identify opportunities to involve oral health professionals in the battle against childhood obesity. The primary goal of this intercollaborative initiative, funded by the Robert Wood Johnson Foundation, is to assist the OHRC in gaining scientific evidence about the relationship between oral health and childhood obesity, and in turn, develop recommendations and approaches that oral health professionals can incorporate to reduce the risk of childhood obesity.<sup>5,6</sup> This effort involved the development of scientific background papers that were presented at a national conference amidst other key stakeholders in the oral health arena. I was privileged to be one of the individuals asked to provide an evidenced based review and present the findings at the conference. Working alongside colleagues *Linda Boyd, RDH, RD, EdD* and *Cynthia Stegeman, EdD, RDH, RD, CDE, FAND*, we were tasked with addressing the research question: "What skills (e.g. communication counseling) and tools do oral health professionals need to effectively engage children (under age 12) and parents in implementing dietary changes that present childhood obesity and consumption of sugar sweetened beverages?"<sup>7</sup>

So what did we find? What earthshattering evidence is available in the literature that will guide us as a profession to decrease the consumption of SSBs and reduce the risk of obesity? As it turns out, there is limited evidence that addresses *both* SSB consumption and obesity in the dental setting. As a profession, we are doing little to address this issue. Lack of knowledge, concern about how to implement, no clear cut correlation between obesity and oral disease and insecurities surrounding personal weight issues are common reasons identified in the literature for not integrating conversations on this topic during chairside education with patients.<sup>7,8</sup> To make these conversations consistent in chairside education, dental hygienists need more in depth



focus in the dental hygiene curriculum. Continuing education courses, webinars or self-study modules that heighten awareness of childhood obesity and discuss implications for oral health are necessary to provide better guidance on the role of the oral health professional in this area.

Collaborative efforts among the health professions are needed to effectively address the obesity epidemic. The association between obesity and oral health presents an opportunity for oral health professionals to engage with other health care professionals in the prevention and management of this significant public health issue. As a profession, we are uniquely positioned to address SSB consumption and promote positive dietary habits for improved oral health and healthy weight management. After all, we are the gatekeepers of the mouth—where eating and drinking occurs regularly! Whether it is providing education and awareness of SSB consumption in our practice settings, serving as advocates in our communities or getting involved with grass roots efforts on the public policy front; active involvement to decrease SSB consumption and behavioral modifications in the dental setting to reduce risk of obesity is a priority area that must be explored further.

I recently had the opportunity to serve on a panel with other dental hygiene educators of varying backgrounds and niche interests. At the end, the moderator asked each of us to ‘sum up’ the message we wanted to get across to our RDH audience in five words or less. My message that day is my mantra for the dental hygiene profession a large – *Maximize your role in healthcare*. Don’t stand by idly – be a part of the change that moves our profession forward.

**Lisa F. Mallonee, MPH, RDH, RD, LD** is a professor and graduate program director at the Caruth School of Dental Hygiene, Texas A&M College of Dentistry. She received her Bachelor of Science in Dental Hygiene and a Master of Public Health with a coordinated degree in nutrition from the University of North Carolina at Chapel Hill and is dually licensed as a registered dental hygienist and dietitian.

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## A Mid-Level Dental Provider in Oregon: Dental hygienists' perceptions

Amy E. Coplen, RDH, EPDH, MS; Kathryn Bell, RDH, MS;

Gail L. Aamodt, RDH, EPDH, MS; Lynn Ironside, RDH

### Abstract

**Purpose:** Many states are exploring alternative provider models and examining the role of the dental hygienist to address access to care challenges as the United States continues to face increasing demands for oral healthcare services. The purpose of this study was to assess dental hygienists' opinions in the state of Oregon regarding the current limitations of dental hygienists' scope of practice, perceived need for a mid-level provider in Oregon, and personal interest in becoming a mid-level provider.

**Methods:** In December 2013 a survey was mailed to a sample of 1,231 dental hygienists registered in Oregon representing 30% of the licentiates. All licentiates holding expanded practice permits (EPP) were included in the sample (n=351). The following categories were included in the 32-question survey: scope of practice, mid-level provider, current practice, and demographics.

**Results:** A total of 440 surveys were returned for a response rate of 36%. Of the EPP holders, 51% responded to the survey. Over half of respondents (59%) believe that a mid-level provider is needed in the state. Respondents holding membership in the American Dental Hygienists' Association, as well as EPP holders, were significantly more likely to respond that a mid-level dental provider was needed in the state ( $p < 0.0001$ ). Ninety-one percent (n=400) of respondents agreed or strongly agreed that if a mid-level provider was introduced in Oregon, the new provider should be a registered dental hygienist model. Forty-three percent (n=186) of respondents were interested in becoming mid-level providers and 47% (n=203) of respondents believed that the minimum education for a mid-level provider should be a bachelor's degree. The majority, 74% (n=137), of those interested in becoming a mid-level provider indicated a preference in completing their education through online teaching combined with a clinical internship.

**Conclusion:** There is strong support from dental hygienists in Oregon that a need exists for a mid-level dental provider and that this provider model should be dental hygiene based. Individuals interested in developing a curriculum for a mid-level provider should consider including online teaching components with a clinical internship component.

**Keywords:** access to care, alternative practice, dental hygiene workforce models, mid-level providers, public health

This manuscript addresses the NDHRA priority area: **Professional development: regulation** (emerging workforce models)

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### Introduction

As the United States continues to face increasing demands for oral healthcare services, many states are examining alternative provider models as well as the role of the dental hygienist to meet their access to care disparities.<sup>1,2</sup> As a result, consideration of a dental therapist or mid-level provider model has had increasing momentum in a number of states.<sup>3,4</sup> Mid-level providers can perform a wide range of clinical services including restorative procedures and simple extractions as well as the preventive services of a dental hygienist depending on the state. Some

form of dental therapy has existed in New Zealand, Australia, and the United Kingdom dating as far back as 1920, and the role of the dental therapist continues to expand along with the populations served by these individuals.<sup>5</sup> Mid-level provider models have been utilized in at least 53 other countries around the world and evidence shows that they provide safe and effective dental care.<sup>6-8</sup> The US has implemented mid-level dental providers in Alaska, Minnesota, Maine, and most recently Vermont.<sup>3</sup> Dental Health Aide Therapists (DHAT) in Alaska have expanded much-needed access to dental care and prevention

services for more than 40,000 Alaskan Native people living in 81 rural Alaskan communities since 2004.<sup>9</sup> Regulated by the Indian Health Service, Alaska DHATs have demonstrated safe, effective delivery of care and are well received in their communities.

The American Dental Association's Commission on Dental Accreditation (CODA) established standards for dental therapy education programs in 2015. CODA accredited dental therapy programs authorize graduates to perform all the functions defined by the program's state-specific dental board or regulatory agency provided that the curriculum content is presented at the level, depth, and scope required by the individual state.<sup>10</sup>

Despite the impact of dental therapists on access to care in other countries, there continues to be much debate on the qualifications and/or education level of the individuals pursuing alternative workforce pathways in the US.<sup>1,11-13</sup> Dating back to 1974, research showed dental hygienists' ability to prepare cavity restorations to be at least as good as that of dental students.<sup>14,15</sup> In addition, the American Dental Hygienists' Association (ADHA) has actively supported a dental hygiene based workforce model to help deliver dental services and supports the belief that utilizing the existing workforce of over 185,000 registered dental hygienists in the US is the most sensible option.<sup>4</sup> The Advanced Dental Hygiene Practitioner (ADHP) model, proposed by the ADHA, suggests that a master's degree educated practitioner could provide diagnostic, preventive, therapeutic and minimally invasive restorative services directly to the public. The curriculum and competencies for the master's degree level Advanced Dental Hygiene Practitioner (ADHP) were released by ADHA in 2008.<sup>13</sup> While the current CODA standards for dental therapy education programs do not indicate a specific degree, they do advocate for advanced program standing for dental hygienists or dental assistants.<sup>10</sup> The standards also state that dental therapy programs must be sponsored by an institution of higher education which could include allied health institutions.<sup>10</sup>

In 2009, Minnesota became the first state, outside of Alaska, to pass legislation allowing for the creation of a new midlevel provider. Minnesota legislature adopted a version of the ADHA's mid-level provider model, the Advanced Dental Therapist (ADT) while simultaneously adopting the Minnesota Dental Association's Dental Therapist (DT) model. ADT students must be actively practicing licensed dental hygienists and will earn a master's degree upon completion of the education program. Students in the Minnesota DT program earn either a bachelor's degree or a master's degree and are not required to be licensed dental hygienists. While the DTs are able to administer nitrous oxide and local anesthesia, they may not provide dental hygiene services or perform

simple extractions<sup>16</sup> The first graduates of these programs entered the workforce in 2011. Continued research and outcomes assessment is necessary to show the successful integration of both provider models in Minnesota. Initial reports document high patient satisfaction, safe practice, and decreased travel and waiting time for patients' who reside primarily in rural locations.<sup>17</sup> As of this writing, the Minnesota DT program has closed, while the ADT program continues.

A midlevel provider does not currently exist in the state of Oregon. However, similar to 37 other states, Oregon does have a direct access dental hygienist model under the title of Expanded Practice Dental Hygienist (EPDH).<sup>18</sup> EPDHs are able to provide preventive services, without the supervision of a dentist, for patients who are unable to access dental care or live in regions of the state with limited access (Figure 1). While EPDHs have the ability to practice with a wide range of patient populations, the majority of EPDHs practice with either pediatric or elderly populations.<sup>19</sup> Research by Bell et al. demonstrated that Oregon EPDHs are not practicing to the full extent of their permitted abilities, thus potentially lessening their impact.<sup>19</sup> Additional studies identified that practicing EPDHs in Oregon face significant barriers related to reimbursement for services provided in addition to having limited business knowledge.<sup>20,21</sup> Because of the barriers faced by EPDHs as well as evidence of their limited impact since the introduction of the permit in 1997, a logical next step would be the investigation of an alternative provider model in Oregon. To that end in 2011, senate bill 738 was passed approving dental pilot projects in Oregon. Legislative language used for an alternative provider pilot project in Oregon does not necessarily require the individual to be a registered dental hygienist. The legislation specifically states that the pilot projects must achieve at least one of the following: teach new skills to existing categories of dental personnel; develop new categories of dental personnel; accelerate the training of existing categories of dental personnel; or teach new oral health care roles to previously untrained persons.<sup>22</sup> Expanded practice permit (EPP) holders in the state of Oregon are a group of individuals who may have a direct interest in the development of a midlevel dental provider particularly those who have faced significant barriers to providing care due to the current practice limitations of the permit.

Although the ADHA supports a dental hygiene based mid-level provider model, there is no documented research on dental hygienists' opinions or interest in pursuing a mid-level provider license. It is reasonable to assume that Oregon dental hygienists who are also members of ADHA would likely support a mid-level provider model utilizing a dental hygienist. If a pilot program similar to Minnesota's ADT or DT were to be implemented in

## Figure 1. Practice Settings for Oregon Expanded Practice Permit Holders

An expanded practice dental hygienist may render all services within the scope of practice of dental hygiene without the supervision of a dentist to patients of the following facilities or programs who, due to age, infirmity or disability, are unable to receive regular dental hygiene treatment:

- Nursing homes
- Adult foster homes
- Residential care facilities
- Adult congregate living facilities
- Mental health residential programs
- Facilities for mentally ill persons
- Facilities for persons with developmental disabilities
- Local correctional facilities and juvenile detention facilities
- Public and nonprofit community health clinics
- Adults who are homebound
- Students or enrollees of nursery schools and day care programs and their siblings under 18 years of age
- Primary and secondary schools, including private schools and public charter schools
- Persons entitled to benefits under the Women, Infants and Children Program
- Patients in hospitals, medical clinics, medical offices or offices operated by nurse practitioners, physician assistants or midwives.
- Patients whose income is less than the federal poverty level
- Other populations that the Oregon Board of Dentistry determines are underserved or lack access to dental hygiene services

Oregon currently licensed dental hygienists would be needed to enter any dental hygiene based programs. The purpose of this study was to assess Oregon dental hygienists' opinions regarding the scope of practice limitations of dental hygienists; perceived need for a mid-level provider in Oregon; and personal interest in becoming a mid-level provider in Oregon.

### Methods

A 32-question survey was developed in consultation with the chair of the Oregon Dental Hygienists' Association Government Relations Council. The survey

instrument contained both closed and open-ended questions in the following categories: scope of practice, mid-level provider, current practice, professional association membership, and demographics. The scope of practice questions focused on perceptions of limitations in current scope of practice as well as knowledge of the Oregon Expanded Practice Permit. The mid-level provider questions focused on the perceived need of a mid-level provider, personal interest level in becoming a mid-level provider, and mode of education delivery for a midlevel provider in Oregon. Current practice questions were focused on the respondent's current employment. This study was approved as exempt by the Pacific University Institutional Review Board.

A current list of registered dental hygienists and expanded practice permit holders was obtained from the Oregon Board of Dentistry in the fall of 2013. At that time, there were 4,101 registered dental hygienists in Oregon; 356 licentiates also held an EPP. All EPP holders were selected to receive the survey while the remaining 875 participants were randomly selected from the total number of licentiates. To examine the content validity of the survey, it was piloted tested with 5 expanded practice dental hygienists and subsequently revised. A total of 1,231 individuals, or 30% of the Oregon registered dental hygienists were selected to receive the survey; 351 of the total number held EPPs.

A paper survey was mailed in December 2013 to 1,231 registered dental hygienists in Oregon. A follow-up reminder postcard was sent one week after the initial mailing. A second mailing was sent in January of 2014 to all non-respondents. The surveys were numerically coded for confidentiality. A linkage file was maintained solely to facilitate the second mailing. Once data collection was completed, the linkage file was destroyed. The mailing included a consent document explaining the purpose of the study and confidentiality. In addition to a copy of the survey and the consent document, a business reply envelope was included; consent was implied by return of the survey.

Surveys were manually entered into SPSS (version 22, IBM) for data analysis. For questions related to scope of practice limitations, two investigators determined the preliminary categories for the analysis of qualitative data. Each investigator categorized the answers individually and the answers were then compared. Interrater reliability was assessed and discrepancies were identified. It was determined that discrepancies were due to oversight and differing interpretation. Investigators corrected oversights and resolved differing interpretation through discussion. Additional categories were added if at least three individuals answered similarly. If a response had less than three respondents reporting similarly the response was placed in the "other" category. Anywhere consensus could not be reached

on a particular answer it was also placed in the "other" category.

Frequency distributions are provided to describe the findings, and Chi-Square tests were used to investigate whether possible factors such as level of education, holding an expanded practice permit, age, and professional association membership had a relationship to the midlevel provider questions. Expanded practice permit status and professional association membership were selected as explanatory variables because it was anticipated that individuals with those characteristics may have a greater interest in advancing the profession and expanding the scope of practice for dental hygienists.

## Results

A total of 440 surveys were returned for a total response rate of 36%. One hundred eighty-one of the respondents held an expanded practice permit resulting in a 51% response rate for the total number of expanded practice permit holders in the state. The average age of survey respondents was 47 years; 98% (n=434) were female. Additional demographic information such as level of education, years since graduation, age categories and type of practice

**Table I.** Respondent Demographics

Highest Degree Held (n=440)	n (%)
Associates/Certificate	180 (41%)
Bachelor's	225 (51%)
Masters	33 (7%)
Doctorate	2 (1%)
Years Since Graduation (n=436)	n (%)
Less than 5 years	89 (20%)
6-10 years	75 (17%)
11-15 years	50 (12%)
16-20 years	42 (10%)
Greater than 20 years	180 (41%)
Practice Setting (n= 440)	n (%)
General Dentist	327 (81%)
Public Health	78 (19%)
Education	38 (9%)
Periodontics	30 (7%)
Own their own Business	25 (6%)
Pedodontics	19 (5%)
Research	6 (2%)
* % add up to greater than 100 as participants were asked to check all that apply	

setting is summarized in Table I.

Thirty-nine percent (n=161) of respondents believed that their scope of practice was limited. Younger dental hygienists (those in the 20-30 year, and 31- 40 year range) were significantly less likely to believe their scope of practice was limited. (Table II) A significantly higher percentage of ADHA members compared to non-members believed that their scope of practice was limited, 46% compared to 35% respectively. (Table III) Respondents who believed their scope of practice was limited were asked via an open-ended question regarding responsibilities they believed were appropriate for a dental hygienist to provide. Responses included independent practice (27%), ability to provide a diagnostic exam (23%), being able to drill and fill teeth (18%), and the ability to do simple extractions (12%). (Table IV)

**Table II.** Opinions on scope of practice limitations based on age (n=413)

	20-30 yrs old n (%)	31-40 yrs old n (%)	41-50 yrs old n (%)	51 yrs or older n (%)
Yes: Scope of practice is limited	14 (24%)	30 (30%)	33 (47%)	84 (46%)
No: Scope of practice is not limited	45 (76%)	69 (70%)	38 (53%)	100 (54%)
p<0.001*				

**Table III.** Opinions on scope of practice limitations based on ADHA membership. (n=421)

	Scope of Practice is Limited n (%)	Scope of Practice Not Limited n (%)
ADHA Member	73 (46%)	86 (54%)
Not an ADHA Member	91 (35%)	171 (65%)
p=0.023*		

The majority of respondents, 59%, (n=258) believed a mid-level provider was needed in Oregon and 43% of those individuals (n=186) were personally interested in becoming a midlevel provider. (Table V) A significantly higher percentage (p<0.0001) of ADHA members (70%), those holding an expanded practice permit (71%), and those who believed their current scope of practice was limited (61%), were personally interested in becoming mid-level providers

**Table IV.** Additional responsibilities appropriate for a dental hygienist to provide. (n=135)

Duty	n (%)
Independent Practice	37 (27%)
Diagnostic Exam	31 (23%)
Drill and fill	24 (18%)
Simple Extractions	16 (12%)
Prescription writing	12 (9%)
Midlevel provider	9 (7%)
Local anesthetic w/o supervision	8 (6%)
Scoop and fill	8 (6%)
Silver Nitrate	8 (6%)
Other	30 (22%)
<i>% add up to greater than 100 as participants were asked to check all that apply**</i>	

(Table VI). No other factors were identified that significantly influenced respondents' likelihood to be personally interested in becoming a mid-level provider. Ninety-one percent (n=400) of the respondents agreed or strongly agreed that if a midlevel provider was introduced in Oregon, that individual should be a registered dental hygienist. (Table VII) When asked what level of education would be necessary for a midlevel provider, the highest percentage of respondents, 48%, believed education resulting in a bachelor's degree would be sufficient (n=205), followed by 39% believing in education resulting in a master's degree (n=167), and 14% believing in only requiring clinical education (n=60). Respondents currently holding a master's degree or higher as well as membership in the ADHA had a significantly higher percentage of respondents (p<0.001) who believed a master's degree should be the degree attained by a mid-level provider (Table VIII

**Table V.** Opinions on mid-level provider

	Yes n (%)	Neutral n (%)	No n (%)
Midlevel provider needed (n=439)	258 (59%)	119 (27%)	62 (14%)
	Interested	Neutral	Not Interested
Interested Personally in becoming a midlevel provider (n=433)	186 (43%)	131 (30%)	116 (27%)

**Table VI.** Personal interest in becoming a midlevel provider

<b>Interest level in becoming a midlevel provider based on ADHA membership (n=437)</b>			
	Yes n (%)	Neutral n (%)	No n (%)
ADHA Member	114 (70%)	37 (23%)	12 (7%)
Not an ADHA Member	143 (52%)	81 (30%)	50 (18%)
p<0.0001*			
<b>Interest level in becoming a midlevel provider based on holding an expanded practice permit (n=437)</b>			
	Yes n (%)	Neutral n (%)	No n (%)
Holds EPP	128 (71%)	33 (18%)	19 (11%)
Does not hold EPP	128 (50%)	86 (33%)	43 (17%)
p<0.0001*			
<b>Interest level in becoming a midlevel provider based on the belief that the current scope of practice is limited. (n=413)</b>			
	Interested n (%)	Neutral n (%)	Not Interested n (%)
Yes: scope of practice is limited	97 (61%)	38 (24%)	24 (15%)
No: scope of practice is not limited	80 (31%)	86 (34%)	88 (35%)
p<0.0001*			

and Table IX). The most feasible avenue cited for delivering the education, for those personally interested in becoming mid-level provider (n=181), was online education delivery of theory combined with a clinical internship (Table X).

## Discussion

Older, more experienced dental hygienists were more likely to believe their scope of practice was limited, as well as those who were members of the ADHA. Many of the responsibilities cited as appropriate duties to increase the scope of practice were the same responsibilities that a mid-level provider would be able to perform (diagnostic exams, place restorations, and perform simple extractions). Those who believed their scope of practice was limited were also more likely to be personally interested in becoming mid-level providers. Based on the results of this survey, it appears that there is greater interest in expanding the dental hygiene scope of practice, the longer the hygienist has been practicing.

Over half of dental hygienists in the study sample believe that a mid-level provider is needed in Oregon. The number of respondents who believed a mid-level provider was needed was significantly higher among individuals holding an EPP and membership in the ADHA. An overwhelming majority of all respondents believed that if a mid-level provider model were to be developed in Oregon, it should be someone who is already a registered dental hygienist. This opinion stands in agreement with other groups, including the ADHA, who believe that a dental hygiene based model taps into an existing workforce with a long history of demonstrated effectiveness, and expands their education and scope of practice as a means to provide much-needed oral health care services

**Table VII.** Opinions about qualifications of a midlevel provider in Oregon (n=440)

	<b>If midlevel provider was introduced in Oregon, should it be a dental hygienist? n (%)</b>
Strongly Agree	312 (71%)
Agree	88 (20%)
Neutral	27 (6%)
Disagree	8 (2%)
Strongly Disagree	4 (1%)

**Table VIII.** Opinion on education necessary for midlevel provider based on respondent's current level of education. (n=413)

	<b>Associates/ Certificate n (%)</b>	<b>Bachelors n (%)</b>	<b>Master's degree or higher n (%)</b>
Education resulting in a master's degree	41 (24%)	103 (47%)	20 (57%)
Education resulting in a bachelor's degree	98 (56%)	95 (43%)	11 (32%)
Clinical training only	34 (20%)	22 (10%)	4 (11%)
p<0.001			

**Table IX.** Opinion on level of training for midlevel provider based on ADHA membership. (n=430)

	<b>ADHA Member n (%)</b>	<b>ADHA Non-member n (%)</b>
Training terminating with a master's degree	85 (52%)	81 (30%)
Training terminating with a bachelor's degree	59 (37%)	145 (54%)
Clinical training only	18 (11%)	42 (16%)
p<0.001*		

**Table X.** Type of education most feasible for individuals interested in becoming a midlevel provider (n=181)

	<b>n (%)</b>
Online with clinical internship	137 (74%)
Evening and weekend onsite program	62 (34%)
Traditional onsite program	14 (8%)
<i>% add up to greater than 100 as participants were instructed to check all that apply</i>	

to individuals who otherwise lack access.<sup>23,24</sup> However, the pilot bill passed in Oregon does not require that the individuals in the demonstration programs be dental hygienists.<sup>22</sup> While a number of survey respondents indicated a personal interest in pursuing a mid-level provider credential, the overall pool of registered dental hygienists available to fill a mid-level provider education program is potentially large.

Dental hygienists holding bachelor's and master's degrees as well as membership in the ADHA were more likely to believe the minimum education for a mid-level provider should be at the master's degree level when compared with dental hygienists holding an associate's degree and were non-members of the ADHA. This group believed that advanced education resulting in a bachelor's degree would be sufficient for a mid-level provider. Contrary to the ADHA's position on advanced education for mid-level providers,<sup>12,13</sup> the majority of the survey respondents believed that a bachelor's degree is sufficient. However, Oregon ADHA members had consistent opinions with their national association believing that a master's degree should be the degree for a mid-level provider. Individuals with an associate's degree in Oregon who expressed interest in becoming a mid-level provider made up 37% of the total number of individuals with a personal interest in pursuing this career pathway. The implications of an education curriculum resulting in a master's degree could potentially disqualify individuals who currently hold an associate's degree interested in pursuing this career pathway unless there is potential for individuals to earn a bachelor's degree in the process.

The American Association of Public Health Dentistry Panel, charged with the principles, competencies and curriculum for educating dental therapists, advocates both a 2-year postsecondary level of training, or an additional year training program as part of a dental hygiene curriculum.<sup>25</sup> In addition, California educators who were surveyed on the level of education necessary for an ADHP model implemented in medical settings reported approximately half of educators believed a dedicated master's degree was necessary and one third of respondents believed a baccalaureate level plus an ADHP certificate was sufficient.<sup>11</sup> This is important information for those planning pilot programs to consider. Would individuals with an associate's degree be able to apply directly to pilot programs, or would they need additional prerequisites or a bachelor's degree to qualify? Most bachelor's degree completion programs for dental hygiene require two additional years of education. This could present a major barrier for interested candidates currently holding an associate's degree with the time required to attain the necessary credentials in addition to the financial cost. Still, only about 25% of the respondents to this survey believed that clinical education only would be a sufficient level of education for a mid-level provider. It appears that the majority of Oregon dental hygienists

support a midlevel provider model that awards at least a bachelor's degree.

People who were personally interested in becoming a midlevel provider were more likely to be members of ADHA, hold an EPP, and believe their scope of practice is limited, demonstrating that these individuals already possess a high degree of motivation. This also supports the assumption that EPP holders and professional association members strongly support the advancement of the profession and expansion of the scope of practice for dental hygienists. The majority of individuals personally interested in becoming a mid-level provider believe that a program delivered online combined with a clinical internship is the most feasible option compared with evening and weekend programs or the traditional onsite program. The traditional education process for mid-level dental providers internationally has been two years postsecondary education although several countries indicated that the training of therapists and dental hygienists has been combined into a three year academic program.<sup>8</sup> While a side-by-side comparison of existing dental therapist curriculum content and length has been provided in the Kellogg report on training new dental health providers in the U.S.<sup>26</sup>, the utilization of a flexible curriculum for individuals working full-time as registered dental hygienists has not yet been explored. Based on the results of this survey, it is necessary to explore innovative ways to deliver training for mid-level providers while still maintaining a high level of competency to ensure the quality of care delivered.

CODA standards for the dental therapist educational programs has encouraged innovation and experimentation with alternative ways of providing the required education and training, assuming the standards are met and competency can be demonstrated.<sup>10</sup> A possible alternative curriculum model would feature the initial clinical instruction onsite at the education facility with the additional clinical competencies demonstrated and met through external sites where the dental hygienist is employed. This would require each site to have a dentist who has agreed to oversee the clinical education of the student. This model would also reduce the cost of equipment, faculty, and supplies required to perform all required clinical instruction at an institution. A limitation of this model would be the potential for issues of calibration with the dentists overseeing students' work. More investigation is necessary to find the right educational delivery for candidates who wish to continue full-time employment while perusing mid-level provider education.

As of this writing, two pilot programs have begun the educational phase of programming as a result of legislation in Oregon. At this time neither program has pursued a model utilizing a registered dental hygienist to the extent of the ADHP. Workforce Pilot Project 100, "Oregon Tribes Dental Health Aide

Therapist," approved in February 2016, focuses on designing a new level dental provider and is modeled after the Alaska DHAT.<sup>27</sup> Workforce Pilot Project 200, "Training Dental Hygienists to Place Interim Therapeutic Restorations", approved in March 2016 focuses on teaching new skills to existing categories of dental hygienists.<sup>28</sup> The Oregon Health Authority has stated it hopes to see additional pilot programs coming forward.<sup>27,28</sup> While the ongoing pilot programs are independent of utilizing a dental hygiene based model, the results of this study indicate a conceivable opportunity for stakeholders to invest in a dental hygiene based mid-level provider model in Oregon.

## Conclusions

There is strong support from practicing dental hygienists in Oregon for a new mid-level provider model utilizing a registered dental hygienist. Many of the barriers that are believed to limit the practice of EPP dental hygienists involve procedures that are within the scope of practice of a mid-level provider. A large pool of interested candidates exists across the state of Oregon and should be recruited for pilot programs seeking to teach new skills to the existing categories of dental professionals. To reach these interested individuals, the most feasible model for educational delivery is an online format for didactic skills combined with a clinical internship. With increasing legislation supporting pilot programs to explore implementation of alternative workforce models in oral healthcare across the country, flexible models of education should be explored.

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# RESEARCH

## Factors Associated with the Economic Sustainability of the Registered Dental Hygienist in Alternative Practice

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### Abstract

**Purpose:** The purpose of this study was to investigate key factors associated with the economic sustainability of the Registered Dental Hygienist in Alternative Practice (RDHAP).

**Methods:** An invitation to participate in a 38-question electronic survey was sent via postal mail to 440 RDHAP licentiate addressees obtained through the Dental Hygiene Committee of California (DHCC). Legal restrictions did not allow for obtaining the RDHAP licentiate email addresses from the DHCC. The survey was disseminated via email to the 254 RDHAPs who were members of the California Dental Hygienists' Association. Additional invitations to participate were made via flyer distribution at an RDHAP symposium, and on RDHAP only social media sites.

**Results:** The response rate was an estimated 16%. While 44% of the RDHAPs reported some employment in a traditional dental practice, given the opportunity, 61% of these respondents indicated that they would practice exclusively as an RDHAP. With regard to practice strategic planning and alliances, 31% felt that dentists lacked knowledge of the RDHAP, and 25% indicated dentists were resistant to this workforce model. Regarding RDHAP practice staffing patterns, 75% indicated not having any employees. When asked about business systems, 64% had solo, portable practices and 16% had standalone practices. Economic sustainability challenges included practice business/equipment expenses (29%), insurance/reimbursement issues (21%), patient flow (19%) and RDHAP visibility (14%).

**Conclusions:** RDHAP practices face challenges including the need for strategic planning and intra- and inter-professional alliances, efficient and effective patient flow, optimal staffing patterns and effective business systems. Focus on enhancing RDHAP visibility within the dental and medical communities should be a priority. In addition, further research should explore RDHAPs aligning with community-based clinics, Federally Qualified Health Centers and Dental Support Organizations (DSOs) with a commitment to disease prevention in addition to the financial resources and staff to manage practice business systems.

**Keywords:** Registered Dental Hygienist in Alternative Practice, oral care, direct access, sustainability, intraprofessional alliances, interprofessional alliances, patient flow, personnel staffing

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### Introduction

The "silent epidemic" of oral disease affects one out of every five people in the United States.<sup>1</sup> This epidemic disproportionately affects racial and ethnic minorities and children who live below federal poverty levels, and highlights the disparities in access to oral health care.<sup>1</sup> Barriers impeding access to care for these vulnerable and underserved populations are due in large part to socioeconomic barriers and the limited number of providers that accept Medicaid, or due to living in underserved areas that may not be well populated with dental providers.<sup>1</sup>

#### Direct Access Workforce Models

The profession of dental hygiene is working to address access to care issues through legislative

efforts expanding dental hygienists' ability to "directly access" vulnerable and underserved populations. The American Dental Hygienists' Association defines direct access as "the dental hygienist initiating treatment based on his or her assessment of the patient's needs without the specific authorization of a dentist, treating the patient without the presence of a dentist, and maintaining a provider-patient relationship."<sup>2</sup> Currently, 39 states have direct access workforce models with each state defining the setting for services.<sup>2</sup>

Dental hygiene direct access providers focus on delivering preventive services to vulnerable populations such as those in long-term care facilities, the disabled and elderly, school-aged children, preschool children in Head Start, and migrant

workers.<sup>3</sup> Direct access also addresses the Institute for Health Care Improvement's Triple Aim, an approach to optimizing health system performance through (a) improving patient experience of care, (b) improving the health of populations, and (c) reducing per capita cost of health care.<sup>4</sup> In 2013 the National Governors Association published a paper which concluded that the underserved, especially children, were gaining access to care through state programs that allowed the expanded use of the dental hygienist.<sup>5</sup> The ability of the dental hygienist to practice in these alternative settings promotes better oral health through the delivery of safe and affordable preventive care.<sup>5</sup>

In most states, a modification of the supervision requirement waives the need for the dentist to examine the patient prior to receiving dental hygiene services.<sup>3</sup> This allows for the dental hygienist to access patients first to initiate care, in the settings and within the scope of practice defined by each state. Supervision ranges from general, to remote, to none depending on the state.<sup>3</sup> In a number of states that have remote general or remote supervision, collaborative practice agreements are developed between the dental hygienist and the dentist outlining the dental hygiene services that can be provided, describing how the dentist will remain in contact with the dental hygienist, and defining follow-up care protocols.<sup>3</sup>

Direct access model requirements vary from state to state and may include further education for certification/licensure and/or a specific number of hours of previous clinical experience.<sup>2,3</sup> Additionally, state laws also may require the dental hygienist to obtain their own professional liability insurance, have referral and emergency protocol documentation, and may include practice-related data reporting.<sup>3</sup> Furthermore, public health related continuing education courses may also be an element of the law.<sup>3</sup> Despite dental hygiene's efforts to increase access, barriers exist for providing care. A study conducted by Delinger et al. examining the Extended Care Permit direct access model in Kansas identified funding, lack of knowledge about this model's scope of practice, practice sustainability, and lack of availability of practice sites as barriers.<sup>6</sup> Coplen and Bell, in their study of Expanded Practice Dental Hygienists (EPDH) in Oregon, found challenges with insurance reimbursement, lack of knowledge/acceptance of EPDHs, equipment/maintenance costs, issues obtaining a collaborative agreement, as well as with finding a cooperating facility.<sup>7</sup>

### **California's Registered Dental Hygienist in Alternative Practice (RDHAP)**

In 1973 California created the Health Manpower Pilot Project (HMPP) in order to evaluate expanded workforce models, and to explore alternative ways to deliver health care to populations that did not have

access.<sup>3,8</sup> In 1981, the dental hygiene pilot, HMPP 139, began raising funds for the project. In 1986 and 1987, groups of dental hygienists participated in training cycles, and provided care in approved sites through 1990.<sup>8,9</sup> This pilot concluded that dental hygienists were able to provide safe and effective care, under remote supervision of a dentist, with no increased risk to patients' health and safety.<sup>9,10</sup> The project also found that dental hygienists practicing in this way satisfied their patients, provided appropriate referrals, and charged lower fees.<sup>10</sup>

As a result of this pilot project, legislation was passed in California in 1998 creating licensure for the Registered Dental Hygienist in Alternative Practice (RDHAP), a direct access workforce model. RDHAPs are licensed dental hygiene professionals who provide preventative and therapeutic services to patients with limited access to dental care including those with special needs.<sup>3</sup> With a collaborative agreement with a dentist, the RDHAP delivers dental hygiene services to homebound clients, in school settings, clients in residential care facilities, skilled nursing facilities, state/federal/tribal institutions, public health clinics and community centers.<sup>11</sup> RDHAPs may also establish stand-alone practices in communities that have been designated as dental Health Professional Shortage Areas (HPSAs).<sup>11</sup> An RDHAP can care for a patient for up to 18 months before needing a prescriptive order from a physician or a dentist to continue to see the patient, subsequently this order must be updated every two years.<sup>11</sup> RDHAPs must have a bachelor's degree or the equivalent, three years of clinical experience with a minimum of 2000 practice hours during the 36 months prior to licensure.<sup>11</sup> Licensure is awarded after completing 150 hours of classes in subjects relating to working in alternative settings, submitting to the Dental Hygiene Committee of California (DHCC) a signed collaborative agreement with a dentist, and passing the state examination on "Ethics and Law."<sup>11</sup>

Although the access to oral health care need is great in California, not all of the 540 licensed RDHAPs are actively practicing.<sup>12</sup> Wides et al. identified some of the challenges and barriers of maintaining a viable practice such as ergonomic issues related to treating patients in non-traditional settings as well as the challenge of treating vulnerable populations with complex needs.<sup>13</sup>

Additional barriers to the RDHAP practice included reimbursement and payment issues from insurance companies such as Denti-Cal, scope of practice limitations pertaining to patient care, and lack of public awareness.<sup>13</sup> *The Good Practice: Treating the Underserved Dental Patients While Staying Afloat* report by Scott et al. provides a health economist's perspective of how to sustain a community-based practice.<sup>14</sup> These concepts are also relevant and important to the economic sustainability of the RDHAP practice.

The purpose of this study was to investigate the economic sustainability of the RDHAP practitioner as it pertains to the need for strategic planning and alliances, efficient and effective patient flow, optimal staffing patterns, and effective business systems, as identified in the Scott et al. report.<sup>14</sup> While the number of RDHAP providers is increasing, there is limited information on their practice economics. The fiscal realities of RDHAP practice may also have implications for other direct access models across the country.

## Methods

This cross-sectional descriptive study surveyed a convenience sample of RDHAPs in the state of California. The University of Michigan Health Sciences and Behavioral Sciences Institutional Review Board determined this research as exempt from IRB oversight (HUM00092316).

A 38 question, electronic survey focusing on RDHAP economic sustainability was developed based on the four key concepts cited in the Scott et al. report and in consultation with faculty from the University of Michigan (U-M), research directors from the American Dental Hygienists' Association (ADHA), the President of the Dental Hygiene Committee of California (DHCC), and faculty from University of California in San Francisco (UCSF).<sup>11</sup> In addition, a survey research expert from the U-M Center for Research on Learning and Teaching (CRLT) provided guidance on the instrument's development. Thirty-two multiple choice, two Likert scale, and four open ended questions were disseminated in Qualtrics survey software. To determine content validity, the survey was pilot tested by five dental hygienists, three of whom were direct access dental hygiene providers in states other than California, one held an expanded function permit in another state, and one was a government administrator of a direct access program in another state. Revisions to the survey were made based on feedback provided.

As of 2014, the DHCC reported there were 540 licensed RDHAPs. However, by law, the DHCC was not able to release the licentiate email addresses. Thus, in October 2014, multiple approaches were taken to invite RDHAPs to participate in this study. All approaches included an introduction describing the purpose of the project, the intended significance, and informed consent.

- The DHCC was legally allowed to release postal mailing addresses of RDHAPs, however, their address database was not fully up-to-date at the time of this study. Thus a postcard announcing the survey, that included the survey link, was sent via postal mail to the addresses of 440 RDHAPs available from the DHCC.
- As of 2014, 254 of the 540 licensed RDHAPs were members of the California Dental Hygienists'

Association (CDHA). On October 20, 2014, the California Dental Hygienists' Association (CDHA) distributed the survey electronically to 254 member RDHAPs. A follow-up email reminder was sent two weeks later.

- A flyer, including a link to the survey, was distributed at the CDHA symposium for RDHAPs on October 24, 2014.
- The survey link was also posted on two social media websites that were accessible only to RDHAPs.

Statistical Package for the Social Sciences (SPSS) version 22 was utilized for data analysis. Survey results were analyzed by obtaining descriptive statistics, specifically the number of respondents and percentage of respondents for each survey item.

## Results

There were a total of 98 responses out of a potential 540 survey recipients. Of those, 88 provided complete data for an estimated response rate of 16%. This response rate is an estimate, as it cannot be certain that all 540 RDHAPs received the survey. Respondent demographic data is provided in Table I, including practice related information. Of note, 44% continue to be employed in a traditional clinical dental practice as a registered dental hygienist (RDH). Interestingly, only 19% work exclusively in a RDHAP practice, however if given the opportunity 61% reported that they would practice exclusively as an RDHAP.

### Strategic Planning and Alliances

The respondents were asked a series of questions focusing on practice strategic planning and alliances. One question focused on challenges in obtaining collaborative agreements with dentists (Table II). Thirty one percent felt that dentists lack knowledge of the RDHAP practice, 25% listed dentists' resistance to the workforce model, 18% cited dentists' concern that collaborative agreements increased their liability, and 26% had no issues obtaining a collaborative agreement.

In addition to a collaborative agreement, RDHAPs are required to obtain a prescription from a dentist or physician in order to continue treatment after seeing a patient for the first 18 months. Thirty-four percent reported no challenges in obtaining a prescription, and 7% indicated that these prescriptions were acquired exclusively from physicians (Table II).

Work practice agreements need to be developed with facilities/sites where RDHAPs practice. Participants were asked about challenges, if any, regarding establishing work practice agreements with sites (Table II). The greatest challenge identified was lack of agency administration/staff knowledge of the RDHAP (31%). The response of "no challenges" was indicated by 8%.

**Table I.** RDHAP Survey Participant & Practice Demographics (N=88\*)

<b>Gender</b>	<b>Frequency (%)</b>	<b>Member of ADHA</b>	<b>Frequency (%)</b>
Female	87 (99%)	Yes	75 (87%)
Male	1 (1%)	No	11 (13%)
<b>Age</b>		<b>Currently working as RDHAP?</b>	
25-34	7 (8%)	Yes	63 (73%)
35-44	15 (17%)	No, but have in the past	9 (10%)
45-54	31 (35%)	Never worked as RDHAP	14 (16%)
55-64	26 (30%)		
65 and over	9 (10%)		
<b>Race/Ethnicity (Select all that apply)</b>		<b>Not currently practicing as an RDHAP (reasons why)?</b>	
White	70 (80%)	Not financially profitable	5 (36%)
Hispanic	11 (13%)	Too difficult physically	4 (29%)
Asia	6 (7%)	More difficult than I thought to start a practice	3 (21%)
African American	1 (1%)	Lacked support/guidance from RDHAP program after completion	1 (7%)
Other	4 (5%)	Moved	1 (7%)
<b>Level of Degree</b>		<b>Never practice as an RDHAP (reasons why)?</b>	
Associates/Certificate	18 (20.5%)	Cost of starting a business outweighed benefit	4 (22%)
Bachelor's Degree	51 (59%)	Patient flow (number of patients, establishing a business, physical/financial issues)	4 (22%)
Master's Degree	18 (20.5%)	Other job commitments	2 (11%)
		Not prepared/fearful of business ownership	2 (11%)
<b>RDH license for</b>		<b>In addition to RDHAP practice, are/were you working elsewhere?</b>	
5 years or less	4 (5%)	RDH clinical practice	47 (44%)
6-10 years	10 (12%)	RDHAP practice only	20 (19%)
11-15 years	12 (14%)	Teach in RDH, RDHAP, or DA program	18 (17%)
16-20 years	15 (17%)	Public Health	13 (12%)
More than 20 years	45 (52%)	Corporate health/product Educator	4 (4%)
		Government position	3 (3%)
		Corporate sales	1 (1%)
<b>RDHAP license for</b>		<b>Given the opportunity would you practice as an RDHAP exclusively?</b>	
5 years or less	42 (49%)	Yes	43 (61%)
6-10 years	35 (41%)	No	17 (24.5%)
11-15 years	5 (6%)	Undecided	10 (14.5%)
16-20 years	3 (3%)		
More than 20 years	1 (1%)		

\*Where totals are less than 88, all respondents did not answer the question.

The top five responses identified as challenges in accessing patients in underserved settings were collaboration with on-site dentists (19%), difficulty contacting appropriate agency personnel (16%), Denti-Cal coverage and billing (15%), difficulty obtaining insurance provider status (14%), and difficulty contacting/explaining RDHAP scope of practice to the care-giver/responsible party (13.5%) (Table II). Four percent responded that there were no challenges to accessing patients in underserved settings.

### Patient Flow

The top four RDHAP practice settings respondents identified in the survey were residences of the homebound, residential facilities for those with developmental disabilities, residential/assisted living facilities, and nursing home/skilled nursing centers. An overview of the averages of the number of locations the RDHAP worked within each setting, number of days per week worked, as well as hours and number of patients seen per day is shown in Table III.

### Staffing Patterns

A series of questions were asked about RDHAP practice staffing patterns. Seventy-five percent reported having no employees. (Table IV) Those without employees were asked to state the reason. The respondents indicated they did not have enough work to justify an additional employee (39%), or expenses (i.e. salaries and taxes) were too great (24%). Table IV provides an overview of the number and type of employees hired by RDHAPs along with the days per week worked.

### Business Practice Systems

Participants were asked about their business practice systems. (Table V) Sixty-four percent of the respondents have solo portable followed by 16% with stand-alone (brick and mortar) practices. Smaller percentages of RDHAPs reported that they worked in group practices (13%), for Federally Qualified Health Centers (FQHCs) (6%), or for Head Start programs (1%).

**Table II.** Practice Strategic Planning and Alliances

Questions (Select all that apply for each question)	Frequency (%)
<b>Challenges obtaining a collaborative agreement</b>	
Dentists lack of knowledge of RDHAP	30 (31%)
Dentists are resistant to RDHAP workforce model	24 (25%)
No challenges experienced	25 (26%)
Dentists feel there is an increased liability	17 (18%)
<b>Challenges obtaining a prescription from DDS/MD</b>	
No challenge experienced	30 (34%)
Dentists lack of knowledge of RDHAP practice	15 (17%)
Patient is not a "patient of record"	12 (13%)
Dentists are resistant to the RDHAP model	10 (11%)
Dentist feel there is and increased liability	10 (11%)
Use only physician	6 (7%)
Physician lack of cooperation with RDHAP	6 (7%)
<b>Challenges obtaining work practice site agreements</b>	
Agency administration/staff lack of knowledge of RDHAP practice	41 (31%)
Resistance from agency administration	35 (26%)
Resistance from on-site dentist	28 (21%)
On-site dentist lack of knowledge of RDHAP practice	18 (13%)
No challenges experiences	11 (8%)
Dental corporation took over facility	1 (1%)
<b>Challenges accessing patients in underserved settings</b>	
Collaboration with on-site dentist	30 (19%)
Difficulty contacting appropriate agency personnel	26 (16%)
Denti-Cal coverage and billing	24 (15%)
Difficulty obtaining insurance provider status	23 (14%)
Difficulty contacting/explaining RDHAP scope of practice to caregiver/responsible party	22 (13.5%)
Frail/medically complex nature of patient	15 (9%)
Ability to obtain permission for treatment	14 (8.5%)
No challenge experienced	7 (5%)

With regard to practice income, the participants were asked to estimate the percentages of their overall practice income from a variety of sources. Five sources of income were identified with Denti-Cal being the most frequent source. (Table V)

RDHAPs were also asked if they tracked data related to their practice. Gross monthly income (21%), total monthly expenses (20%)

**Table III.** Practice Patient Flow

Sites	Number of Locations			Days/Week			Hours/Day			Patients/Day		
	Range	Mean	n	Range	Mean	n	Range	Mean	n	Range	Mean	n
Residences of the Homebound	1-100	9 sites	37	1-3	1 days/wk	24	1-6	2 hrs/day	25	1-8	2 pts/day	29
Residential Facilities for those with Developmental Disabilities	1-90	15 sites	15	1-3	1.5 days/wk	12	1-9	5 hrs/day	12	1-10	6 pts/day	13
Residential/ Assisted Living Facilities	1-20	5 sites	31	10-5	1 days/wk	19	1-8	3.5 hrs/day	21	1-8	3 pts/day	22
Nursing Homes/ Skilled Nursing Facilities	1-90	11 sites	37	1-5	1.5 days/wk	29	1-10	4 hrs/day	31	1-13	5 pts/day	31

and monthly production (17%) were the three most frequently monitored. Thirteen percent stated they did not track any practice related data. (Table V)

Respondents were asked to report gross and net incomes. Thirty-one RDHAPs indicated they worked part-time and reported their annual gross income. The range of annual gross incomes for those RDHAP's working part-time was \$0.00-150,000.00 and the mean amount was \$23,454.45. For those who reported net income, the range was from (-) \$11,765.00-90,000.00 with the mean being \$11,584.13. Gross income for full-time practice was identified by 13 respondents with a range of \$0.00 - 254,000.00 and mean of \$108,307.69. The net income range was \$0.00-180,000.00 and the mean was \$91,900. (Table V)

One of the final questions on the survey asked the RDAHP to identify the two greatest challenges in attaining economic sustainability. The top four themes that emerged included practice expense as it pertains to business and equipment (29%), insurance/reimbursement issues (21%), patient flow (19%) and RDHAP visibility (14%). (Table VI)

## Discussion

Identifying key factors associated with the economic sustainability of the RDHAP brought attention to several important points. The majority of the RDHAP survey respondents held their RDH license for at least 16 years and their RDHAP licenses for 10 years or less. When asked where they were

employed in addition to their RDHAP practice, almost half indicated that they also continued dental hygiene clinical practice. It is possible that RDHAPs continue to practice as an RDH to subsidize their overall income.

There were 10% of the respondents who had practiced as RDHAPs but were not currently practicing because it was (a) not financially profitable, (b) too difficult physically and (c) it was difficult to start a practice. These results align with the reasons for not practicing that were identified in the study by Wides, et al.<sup>13</sup> and Coplen and Bell.<sup>7</sup> In addition to those who had previously worked as an RDHAP but currently were not, 16% of those respondents indicated they had taken the RDHAP educational training but had never practiced. Three out of the four response themes for this question revolved around economics including (a) the cost of starting a business outweighed the benefit, (b) patient flow issues (number of patients, establishing a business, physical/financial issues) and (c) not being prepared/fearful of business ownership. Taking these respondents in combination with those who had worked, but were not currently practicing as an RDHAP, it appears that economic challenges emerge early on for some RDHAPs and in some cases ended their RDHAP career before it even started.

Even though economic challenges were identified, a majority of all RDHAP respondents stated that they would choose to work as an RDHAP exclusively. This aligns with the finding in the Wides et al. report that stated that RDHAPs have high job satisfaction.<sup>13</sup>

**Table IV.** Staffing Patterns

Employees		
Question		Frequency (%)
<b>Do/did you have any employees?</b>		
No		43 (75%)
Yes		14 (25%)
<b>If you do/did not have any employees, why not?</b>		
Not enough work to justify employee		30 (39%)
Expenses (i.e. salaries, taxes)		18 (24%)
Administrative time and complexity of managing payroll, insurance, etc. for employee		15 (20%)
I prefer to work alone		13 (17%)
Number of Employees & Days/Week Worked		
Employee	Number of Employees (Range) (Mean) (n)	Number of Day/Week Worked (Range) (Mean) (n)
Other RDHAPs	1-5 2 RDHAPs n=7	1-6 3 days/wk n=6
Dental Assistants	1-4 2.5 Assistants n=10	1-5 2 days/wk n=9
Office Staff	1-4 2 Office Staff n=9	1-5 3 days/wk n=9

When asked by Wides et al. what motivated them to practice, "personal satisfaction" was the highest response.<sup>13</sup> Although RDHAP practice appears to have obstacles, the desire to provide dental hygiene direct access care to underserved populations remains strong.

Strategic planning and the development of alliances are important aspects of any business or practice and can affect economic sustainability. Strategic intra- and inter-professional alliances must be developed and strengthened both within the dental community and with other professionals that serve vulnerable populations. Efforts to do so should include creating working relationships with the medical communities in underserved areas. The lack of knowledge about RDHAP practice from both oral health professionals and the community at large is another issue that could impede economic sustainability. It is necessary for any business/practice to be understood in the professional and public domain in order for it to become a viable endeavor. Close to half of the respondents identified practice challenges involving other providers including the ability to obtain collaborative agreements due to dentists' lack of knowledge of RDHAPs as well as dentists' resistance to the concept of the RDHAP workforce model. The need for professional visibility by those dental hygienists involved with direct access was also addressed in the report by Wides et al.<sup>13</sup> and in the Kansas study by Delinger et al.<sup>6</sup>

Challenges with accessing patients in underserved settings centered on collaborating with a facility's on-site dentist, finding an appropriate person within the agency to contact about accessing patients, insurance related issues including Denti-Cal coverage/billing and obtaining insurance

provider status. This follows the conclusion of the Wides et al. report which stated that in addition to the lack of knowledge of the RDHAP, Denti-Cal funding/regulations had a large impact on the practice.<sup>13</sup> These findings also align with the Scott et al. report which states that, "Denti-Cal's low reimbursement rates is the primary hurdle in obtaining dental services for the underserved."<sup>14</sup>

The economic viability of the RDHAP practice is dependent upon the payer mix (i.e. Denti-Cal public insurance, private pay, indemnity insurance) as well as the number of patients that are seen per day. The more patients per day that are seen at one site, the more economically advantageous it becomes. The Scott et al. report states that the need for good scheduling practices will increase, "efficiency, effectiveness and financial sustainability."<sup>14</sup> However, most of the RDHAP practice sites have patients with medical, physical, and developmental disabilities requiring more time per patient to deliver care. As a group, this population has health concerns that could limit the RDHAPs access due to illness or even death more so than any other population, directly affecting the economic stability of the practice.

In many of the practice settings where the RDHAP provides services, having an assistant can decrease the amount of time it takes to set up and break down, and increase the number of patients seen, but more importantly, help with patient care, especially when dealing with patients with special health care needs. The economic limitations of the RDHAP practice effects the financial justification of having an employee. Meanwhile, it has been shown that the use of a dental assistant increases the productivity of dentists; these data should also hold true for the use of an assistant with the RDHAP.<sup>14</sup> In addition, the use of office staff for scheduling and bookkeeping frees the RDHAP

**Table V. Business Practice Systems**

Type of Practice				
Question		Frequency (%)		
<b>RDHAP practice is?</b>				
Solo portable practice		44 (64%)		
Stand-alone practice (brick and mortar)		11 (16%)		
Group practice		9 (13%)		
Federally qualified Health Center (FQHC)		4 (6%)		
Head Start Programs		1 (1%)		
Sources of Income				
Source (total N=)	Number of responses 0 to 25% of income	Number of responses 26-50% of income	Number of responses 51-75% of income	Number of responses 76-100% of income
Denti-Cal (N=23)	2	3	5	13
Private Insurance (N=25)	23	2	0	0
Fiduciary Representative (N=17)	12	3	1	1
Private Pay by Patient (N=41)	20	4	2	15
Grant Funding (N=2)	1	1	0	0
Tracked Practice Data				
Question		Frequency (%)		
<b>Data you track?</b>				
Gross income per month		29 (21%)		
Total monthly expenses		28 (20%)		
Monthly production		24 (17%)		
Net monthly profit		18 (13%)		
I do/did not track		18 (13%)		
Number of new patients		17 (12%)		
Number of cancellations		3 (2.5%)		
Number of "no-shows"		2 (1.5%)		
Annual Gross and Net Incomes				
	Gross Income (Range) (Mean) (n)	Net Income (Range) (Mean) (n)		
Part-time Practice	\$0 - \$150,000 \$23,454.45 n=31	-\$11,765 - \$90,000 \$11,584.13 n=23		
Full-time Practice	\$0 - \$254,000 \$108,307.69 n=13	\$0 -180,000 \$91,900.00 n=10		

to provide clinical care and also network with agency and health professional personnel. Aligning the correct staffing pattern with the practice can maximize efficiency and economic sustainability.<sup>13</sup>

Although the majority of RDHAPs own their own practices, most felt unprepared to start-up/run their own business. This had been identified in previous California direct access studies and one from Oregon as well.<sup>7,8,9,15</sup> The RDHAP educational programs offer 150 hours of course work divided into several content areas, of which business systems is 25% or less.<sup>11,16,17</sup> Having these programs explore ways to enhance their business systems curriculum is advised. Additionally, professional associations, such as CDHA, might also investigate opportunities to provide continuing education courses in this area.

The largest practice population of the RDHAP is covered by Denti-Cal. California has one of the lowest Medicaid (Denti-Cal) reimbursement rates in the country as well as being noted for changing regulations and coverage parameters.<sup>13,15</sup> This historically has been a large barrier to practice for the RDHAP.<sup>13,15</sup> Indemnity insurances were cited as providing up to 25% of their income however, not all will allow the RDHAP to bill for services. The ability for the RDHAP to become a provider for all indemnity insurances would expand their financial reimbursement prospects. For economic sustainability to be achieved a mix of revenue sources is needed.<sup>7</sup>

Thirty-one respondents stated that they work part-time and earn a mean gross of \$23,454.45. This is slightly higher than the Expanded Practice Dental Hygienist (EPDH) income reported by Coplen and Bell where 85%

**Table VI.** RDHAP Challenges

Greatest Challenges	Frequency (%)
Practice expense (business and equipment)	26 (29%)
Insurance/reimbursement	19 (21%)
Patient flow	17 (19%)
RDHAP visibility	12 (14%)
Issues with DDS	6 (7%)
Ergonomics/physical demands of practice	4 (5%)
Competition	2 (2%)
Challenges with DHCC and CDHA	2 (2%)
Lack of business knowledge	1 (1%)

of the participants indicated their practice income was \$20,000 or less when working a mean of 9.3 hours per week.<sup>7</sup> Of the full-time practices the mean gross income was \$108,307.69.<sup>7</sup> It appears from the data in this study that there are a small number of RDHAPs whose full-time income is lucrative. An in-depth study should be done to examine what these RDHAPs are doing that is contributing to their economic success.

The final questions asked respondents to describe the greatest challenges faced in economically sustaining their practice. The top five were practice expense, insurance reimbursement, patient flow, RDHAP visibility and issues with dentists. Scott et al. identified key factors associated with economic sustainability that included strategic planning and alliances, effective and efficient patient flow, effective business systems and optimal staffing patterns.<sup>14</sup> Of these factors the only issue not addressed by the RDHAPs in response to this question was the need for optimal staffing patterns.

Consideration should be given by the RDHAP to aligning themselves with community-based clinics, Federally Qualified Health Centers and Dental Support Organizations (DSOs) with a commitment to disease prevention in addition to having the financial resources and staff to manage practice business systems.<sup>18</sup> This would allow the RDHAP the ability to focus on providing their clinical services to and building relationships with underserved and vulnerable populations without the challenges of running a business. Working within a team-based clinic/practice or health home would benefit both the practitioner and the patient. Medical practices have been moving in this direction for the past two decades. This model is now gaining traction in dentistry as well.<sup>19</sup>

Even with its challenges, from a national perspective, the RDHAP direct access workforce model has had a positive impact on addressing *Healthy People 2020* goals and objectives. The preventive care the RDHAPs provide to vulnerable and underserved populations address both access to health care and oral health, two of the 12 *Leading Health Indicators*.<sup>20</sup>

There were limitations to this study that should be noted. Although there were 540 RDHAP registered with the DHCC at the time of this study, postal mailing information was only available for 440 and no email information could be legally released by the DHCC. The CDHA, however, was able to email the survey to the 254 CDHA member RDHAPs. In an attempt to reach other RDHAPs

that were not on either of these lists, announcements about the survey and the link were distributed RDHAP only Facebook and Yahoo sites, as well as via flier at the California Dental Hygienists' Association Symposium. Thus, there was no certainty that all 540 RDHAPs received the invitation to participate in the survey. In addition, the respondents may under-represent non-CDHA members. Other limitations include the small sample size, the fact that the information was self-reported, as well as the perceived reluctance of the RDHAP to provide information on either their clinical practice data or business information, including income. Finally, the study was geared to the economic challenges and barriers of RDHAP practice, so it did not capture the benefits respondents may be experiencing.

## Conclusions

The HMPP study and the National Governors Report, *The Role of Dental Hygienists In Providing Access to Care* concluded the RDHAP not only serves the underserved, but also provides clinical care safely, efficiently and non-traditionally.<sup>5,10</sup> The fiscal realities of their practice, however, including the need for strategic planning and alliances, efficient and effective patient flow, optimal staffing patterns, and effective business systems, are major challenges in implementing, providing care, and sustaining this model. Additional research should more fully explore the reasons why RDHAPs either do not stay in practice or never start practicing as well as alternative delivery models beyond solo practice.

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## Impact of State Workforce Policies on Underserved Patients' Access to Dental Care: A longitudinal study

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### Abstract

**Purpose:** Dental diseases are almost entirely preventable, but discrepancies in access to oral healthcare limit the effectiveness of preventive interventions. Dental hygienists are strategically positioned to improve access to preventive dental procedures; however, state workforce policies determine their permitted clinical tasks.

**Methods:** This study cross-referenced oral healthcare service use at Federally Qualified Health Centers (FQHCs) between 2004 and 2012 with the Dental Hygiene Professional Practice Index (DHPPPI), which quantifies the various aspects of state policy environments for the dental hygiene workforce. More specifically, the study used generalized linear mixed-effects models to examine the influence of state policy environment on access to dental care at 958 FQHC grantees.

**Results:** States with "favorable" policy environments consistently reported the highest proportion of FQHC patients accessing dental care services (18%), whereas states with "restrictive" environments reported the lowest proportion (12%).

**Conclusion:** A smaller proportion of FQHC patients' receive dental examinations in states with restrictive state workforce policies; state lawmakers should frame workforce policies to protect public safety without limiting the oral health workforce's ability to provide important oral health services to underserved people.

**Keywords:** Access to care, dental and dental hygiene workforce models, health services research, legislative issues, oral health prevention, public health

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### Introduction

Improving the population's oral health and eliminating oral health disparities is an important public health and health system priority.<sup>1,2</sup> Fifteen years after the Surgeon General's report,<sup>2</sup> oral health disparities persist in the United States (US). Poor oral health may lead to life-long problems; for instance, dental diseases are a leading cause of student absenteeism and predict poorer performance on standardized assessments.<sup>3,4</sup> Adults with poor oral health are less likely to be employed than those with good oral health<sup>5</sup> and are more likely to develop serious health conditions and chronic diseases.<sup>6-8</sup>

Almost all dental diseases are preventable. Dental disease prevention and management is critical in improving oral health and reducing oral healthcare delivery costs in the US.<sup>9</sup> Preventive clinical interventions are effective (e.g., the topical application of fluoride varnish and dental sealants); however, discrepancies in access to these

interventions limit their diffusion and perpetuate oral health disparities.

Numerous factors affect patients' access to care; however, access depends on oral healthcare professionals' service delivery.<sup>2</sup> Dental hygienists are responsible for dental disease prevention, oral health promotion, and periodontal disease management. This workforce may effectively improve access to services that reduce oral health disparities (e.g., preventive dental procedures).<sup>10,11</sup> In a study examining low-income children in a school setting, the number of dental hygienist encounters was inversely correlated with number of children with dental decay and urgent dental needs.<sup>10</sup> Regarding mid-level dental practitioner models, a health care professional with prophylaxis training (e.g., a dental hygienist) may provide most dental care services offered in community-based settings.<sup>11</sup> These findings collectively suggest that dental hygienists may

improve access to oral healthcare services; however, it is important to note that previous findings reflect examination of individual workforce models within particular communities and states. They may not be generalizable due to variations in organizational, local, or state workforce policies.

Dental hygiene education is nationally standardized; however, at the state level, professional licensing boards' statutes and regulations govern professional practice.<sup>12</sup> State policies dictate dental hygienists' permitted clinical tasks, professional supervision requirements, professional governance, and Medicaid reimbursement terms.<sup>13</sup> These policies are documented in the Dental Hygiene Professional Practice Index (DHPPPI), originally developed in 2001 by the Health Resources and Services Administration (HRSA) and updated in 2014. In the DHPPPI, states are assigned numeric values and categorized based on the level of professional independence afforded to the dental hygiene workforce.<sup>13</sup> Professional practice environments vary between states. For example, in states supporting professional independence, dental hygienists may serve as independent oral healthcare access points, whereas in states restricting such independence, dental hygienists may only practice at existing points of care, generally under a licensed dentist's supervision. Claims that such practice restrictions protect public safety are poorly supported.<sup>14</sup> Additionally, state support for professional independence predicts dental care access.<sup>15,16</sup> Moreover, variations in state regulation of the dental hygiene workforce affect the capacity of the dental safety net, which supports the oral healthcare needs of underserved individuals.

State regulation of the dental hygiene workforce is associated with oral health service availability within the dental safety net<sup>17</sup>; this association has been supported regarding Federally Qualified Health Centers (FQHCs; a critical component of the dental safety net).<sup>18,19</sup> Federal funding agreements require all FQHCs to ensure that community members have access to "preventive dental services"<sup>20</sup>; however, the state-level professional practice environments for dental hygienists continue to apply to FQHCs. Thus, federal and state policies intersect at FQHCs, thereby permitting examination of state workforce policies' impact on oral healthcare availability and access. Restriction of professional independence appears to predict reduced delivery of dental services.<sup>17</sup> Empirically supporting this relationship's existence may lead to improved dental care availability in underserved communities; however, demonstrating access requires the examination of service use, rather than resource availability.<sup>21</sup> The purpose of this study was to examine whether state policies regulating the dental hygiene workforce affected FQHC patients' actual access to dental care in order to inform policies aimed towards improving the population's oral health.

## Methods

This study used an adaptation of Aday and Andersen's *Framework for the Study of Access to Medical Care* to study state workforce policies' effect on oral healthcare access.<sup>17</sup> In this framework, FQHCs represent an allocative health policy that aims to affect the volume and distribution of oral health services in underserved communities; however, it should be noted that FQHCs must deliver care that is within the context of their particular state. Therefore, the authors theorized that state workforce policies are likely to influence FQHCs' ability to provide dental services and thereby affect care access.

This study examined longitudinal data on 958 FQHC grantees located in the 50 states and the District of Columbia that received community health center funding from the U.S. Health Center Program from 2004 to 2012. It is important to note that one grantee may operate in multiple locations within their service area. Federal funding agreements require FQHC grantees to report administrative and patient utilization data to the Uniform Data System (UDS) on an annual basis. UDS data for this study were obtained through a Freedom of Information Act (FOIA) request.

## Outcome Measure

Dental care access among FQHC patients was the outcome of interest; this was defined as the proportion of unique FQHC patients that had a dental examination at the FQHC grantee within a reporting year. Dental examinations are generally required before initiation of dental treatment in traditional dental settings. Therefore, the dental examination was considered a reasonable proxy measure for access to oral health care at FQHCs. FQHC grantees report the total number of unique patients as well as the number of unique patients by procedure, using Current Dental Terminology (CDT) codes. The following CDT codes are defined as dental examinations in the UDS: D0120, D0140, D0145, D0150, D0160, D0170, and D0180.<sup>22</sup> FQHC patients are reported as having had a dental examination if they had a visit associated with any of the aforementioned CDT codes during a reporting year. The proportion of FQHC patients accessing dental care was calculated by dividing the total number of unique FQHC patients reported as having a dental examination by the total number of unique patients at the FQHC within a reporting year.

## Primary Independent Measure

The primary independent variable was the Dental Hygiene Professional Practice Index (DHPPPI); this constituted a baseline measure of state policy environments. The DHPPPI was analyzed as a five-level categorical variable (5 = *most supportive policy environment*, 1 = *most restrictive*).

The following limitations were addressed in the DHPPPI before using it in the analysis. First, many

states changed their relevant dental hygiene policies from 2001 to 2012; this was likely to affect state-level professional practice and oral healthcare access. To account for any effects of such changes, all relevant policy changes that occurred between 2002 and 2011 were identified and a subsequent binary, state-level variable was generated and included in the analysis. Additional information regarding the identification of these changes and coding of this variable may be found in the technical appendix. Second, the DHPPI quantifies professional practice environments for dental hygienists based on state policies; this may not accurately represent dental hygienists' practice. Therefore, the DHPPI data was considered to represent state-policy context, rather than dental hygienists' practice. A more detailed description of the DHPPI is provided in Appendix A.

### Covariates

Covariates were FQHC grantee level administrative and aggregate patient characteristics drawn from the UDS for each year included in the study; specifically, the number of clinical sites operated by a given FQHC, the geographic location primarily served by the FQHC, and the proportions of patients who are uninsured, Medicaid recipients, percent in poverty, or members of racial and ethnic minority groups. A variable (time) representing FQHCs' duration of receiving funding was also generated to control for funding duration's effect on care access in the multivariable models: A value of 1 was assigned to each FQHC in the first year it received funding; this value increased by 1 for each subsequent year the FQHC continued to receive funding. A complete list

of study variables with associated definitions and values can be found in Appendix B

### Analysis

Continuous variables are described using means and standard deviations (SDs) and categorical variables are described using frequencies and percentages. Longitudinal profiles of dental care access in FQHCs were modeled using linear mixed-effects models. Random intercepts were adopted at both the state and FQHC levels to account for within-state and within-FQHC correlations. Univariate regressions were conducted to evaluate unadjusted associations between the outcome and predictors. A backward model selection was subsequently adopted to identify the best multivariate model for evaluating the adjusted associations. Two-sided p-values <0.05 were considered statistically significant. All statistical analysis was performed using SAS® version 9.3 (SAS Institute, Cary, NC, USA).

### Results

Table I presents the number of unique FQHC grantees, the number of FQHC observations (total number of FQHC grantees observations across all years), and states by DHPPI category. A total of 6,830 observations were collected dating from 2004 to 2012. The "limiting" DHPPI category (i.e., the second-most restrictive policy environment) contained the largest number of FQHCs grantees, observations, and states.

Table II presents statistics describing FQHC grantees' characteristics and the univariate regression analyses' results, as well as the proportion of patients

**Table I.** Dental Hygiene Professional Practice Index (DHPPI) Categories: Description and Distribution of FQHCs and States

DHPPI Level	Description	Unique FQHC Grantees (n = 958)	Total Grantee Observations (n = 6830)	Number of States Represented	States
1	Restrictive	143	1044	8	NC, AR, GA, AL, KY, VA, MS, WV
2	Limiting	336	2273	21	KS, NH, TN, VT, OH, IN, NJ, IA, IL, MD, AK, MI, MA, WY, FL, RI, DC, DE, HI, ND, OK
3	Satisfactory	191	1348	10	AZ, ID, SC, NE, WI, PA, SD, LA, MT, TX
4	Favorable	122	907	7	CT, MO, NV, MN, ME, NY, UT
5	Excellent	166	1258	5	CO, WA, OR, CA, NM

**Table II.** Descriptive Characteristics of FQHCs Including Results of Univariate Regression Analyses, 2004–2012

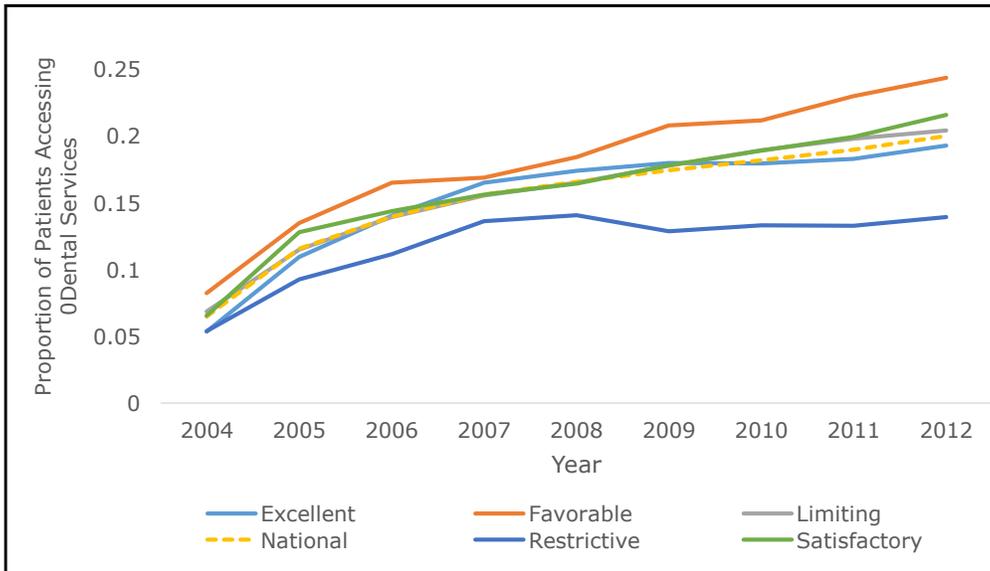
Variable	FQHC Grantee Characteristics (Study Sample)**	Proportion of Patients Accessing Dental Care				
	N(%) or Mean (± SD)	Mean	SD	β	SE	P
<b>DHPPI Range*</b>						
1 (1–30)	1044 (15.3%)	0.12	0.11	-0.05638	0.02824	0.0459
2 (31–40)	2273 (33.3%)	0.16	0.13	-0.01489	0.0248	0.5482
3 (41–49)	1348 (19.7%)	0.16	0.12	-0.00703	0.02742	0.7978
4 (50–80)	907 (13.3%)	0.18	0.13	0.0143	0.02975	0.6307
5 (81–100)	1258 (18.4%)	0.16	0.12	<i>ref</i>	<i>ref</i>	<i>ref</i>
<b>Policy Changes*</b>						
Yes	5528 (80.9%)	0.16	0.12	–	–	–
No	1302 (19.1%)	0.17	0.12	-0.0102	0.01782	0.5671
<b>Urban*</b>						
Yes	3282 (48.1%)	0.16	0.13	–	–	–
No	3548 (51.9%)	0.16	0.12	0.01011	0.006962	0.1464
<b>Clinical Sites</b>	4.91 (± 2.59)			0.007534	0.000783	<.0001
<b>Medicaid</b>	0.29 (± 0.15)			0.3	0.008569	<.0001
<b>200% Poverty</b>	0.66 (± 0.25)			-0.00312	0.006752	0.6435
<b>Minority</b>	0.47 (± 0.32)			-0.04818	0.01245	<0.0001
<b>Uninsured</b>	0.39 (± 0.18)			-0.1014	0.01232	<.0001
<b>Dentist per Capita</b>	5.98 (± 1.33)			0.007685	0.005619	0.1714
<p><b>Note.</b> Estimates and standard error terms were calculated from longitudinal data. Adjustments were made for repeated measures on grantees and clustering at the state level.            *Descriptive characteristics for study sample - FQHC grantees.            **Categorical variables report the number the n (number of observations) within a category.</p>						

accessing dental care by DHPPI category and where appropriate. In general, a greater proportion of FQHC patients accessed dental care in states with more supportive policy environments. States categorized as “favorable” and “restrictive” contained the largest and smallest proportion of patients accessing dental care, respectively (18% and 12%); this finding was consistent for all years. Approximately 6% fewer (-0.056, 0.046) patients access dental care at FQHC grantees located in the most restrictive states as compared to those located in states categorized as excellent (used as reference in descriptive analyses). Dental care access among FQHC patients increased consistently across all DHPPI categories over the study period; consistently, the highest and lowest proportions of FQHC patients accessing dental services

were in favorable and restrictive states, respectively (Figure 1). The gap in proportions between favorable and restrictive states increased over the study period. In 2012, 24.3% and 13.9% of patients in favorable and restrictive states were accessing dental care, respectively. Nationally, 19.9% of FQHC patients accessed dental care at FQHCs in 2012.

In the longitudinal regression analysis, after adjusting for numerous factors, 6% more patients accessed dental services at FQHCs in favorable or “excellent” states than in restrictive states (“excellent” refers to the most supportive policy environment). (Table III) The proportion of Medicaid patients (0.09, P<0.0001) and minority patients (-0.5, P<0.0001) predicted the proportion of patients accessing dental services

**Figure 1.** Proportion of Federally Qualified Health Center (FQHC) Patients Accessing Dental Services by Dental Hygiene Professional Practice Index Rating, 2004–2012 Notes: “national” refers to the national mean proportion of patients accessing care.



**Table III.** Longitudinal Results on the Proportion of Patients Accessing Dental Care from 2004–2012

Variables	Restrictive States as Reference Group		
	Point Estimate	Standard Error	P
DHPPI Range			
1 (1–30)	ref	ref	ref
2 (31–40)	0.03004	0.02131	0.1586
3 (41–49)	0.04724	0.02446	0.0535
4 (50–80)	0.05912	0.02753	0.0318
5 (81–100)	0.05812	0.02871	0.0429
Policy Changes Occur in State	-0.0115	0.01857	0.5357
Number of Clinical Sites	-0.00132	0.000727	0.0684
Proportion Medicaid Patients	0.08748	0.01107	<0.0001
Proportion of Minority Patients	-0.05042	0.0124	<0.0001
Time	0.01264	0.000442	<0.0001

within FQHCs. The proportion of patients accessing dental services increased significantly for each additional year of funding (0.01,  $P < 0.001$ ).

## Discussion

The results of this study suggest that state regulation of the dental hygiene workforce is likely associated with access to dental care among patients of FQHCs. Further, findings suggest that dental hygienists likely facilitate access to dental services at FQHCs; demonstrated in the finding that fewer patients' accessed dental care at FQHCs located in restrictive states.

The results do not indicate whether state policies (as quantified by the DHPPI) independently affect oral healthcare service access or if another factor underlying factor is correlated with DHPPI and affects care access. Nonetheless, the present results support previous research indicating state regulation's effect on dental care access in the general population<sup>15,16</sup> and among underserved individuals.<sup>17</sup> The present results suggest that state policies affect underserved individuals' access to dental care and oral healthcare services' availability in FQHCs.

The study examined the proportion of FQHC patients accessing dental care in 2012 in order to contextualize the present findings. In 2012, approximately 2.1 million people visited FQHCs located in restrictive states; 286,769 of these subsequently received dental care (13.9%). In contrast, in the same year, approximately 2.7 million people visited FQHCs located in favorable states, 663,614 of whom subsequently received dental care (24.3%; a difference of 376,845 people). In 2012, approximately 18.3

million patients received healthcare at FQHCs nationwide, whereas 3.7 million accessed dental care at FQHCs (approximately 20%); the remaining 14.7 million people may lack access to recommended preventive dental care.<sup>23</sup>

FQHC patients in restrictive states may access dental services outside of their local FQHC; however, this is unlikely to be true of all patients. FQHCs are located in urban and rural communities designated as “medically underserved areas” by the federal government;<sup>24</sup> these communities are characterized by recognized and significant shortages in healthcare resources. Individuals in these communities face significant barriers to dental care access (e.g., transportation issues, inability to take time off work, dental care costs).<sup>18, 25-27</sup>

State policies appear associated with underserved individuals’ access to dental care. The present findings do not indicate if this relationship is causal; however, restrictive state policies may limit dental healthcare professionals’ ability to provide dental care. For example, FQHCs located in Mississippi (a restrictive state) cannot provide or bill for preventive dental services delivered by a dental hygienist unless the hygienist is directly supervised by a licensed dentist. In contrast, FQHCs in Maine (a favorable state) may do so without dental oversight. In Colorado (an excellent state), FQHCs may bill for dental services provided by dental hygienists, allowing FQHCs to employ dental hygienists in their primary care clinics and thereby provide preventive dental care and education. This allows patients to access several types of preventive care in one visit and increases patients’ access to care. Conversely, in Kentucky (a restrictive state), FQHCs cannot employ dental hygienists or bill for dental services without concurrently employing a supervising dentist.<sup>28</sup> FQHCs in Kentucky that do not employ dental professionals may refer patients requiring dental services to affiliated dental practices rather than directly providing such services; however, a study conducted at one FQHC found that relatively few referrals led to dental visits and many patients did not receive dental care.<sup>28</sup> Future research should further examine state policy’s effect on delivery of dental services at FQHCs and subsequent affect access to dental care.

### **Limitations**

This study has the following limitations. As mentioned above, some key data could not be obtained and some assumptions were not robustly supported (e.g., that the DHPPI accurately represents state-level professional practice environments for dental hygienists). Additionally, data were not available regarding some potentially confounding state- and FQHC-level factors (e.g., Medicaid policies, patient encounter rates). The authors managed this limitation by adjusting for random effects at the state and FQHC levels; however, future research should

test the present findings using additional FQHC-level data from the U.S. Health Center Program in order to more validly assess state policy’s effect on FQHCs.

Furthermore, FQHC grantee-level information was subject to a number of limitations. The authors could not obtain data indicating the number of healthcare professionals (including dental professionals) practicing in each FQHC using a FOIA request because it is considered proprietary information. Therefore, the analysis could not adjust for variations in dental workforce capacity at the FQHC level. In order to account for, to some extent, dental workforce capacity within a state, state level dentist per capita data were included in exploratory analyses and considered during preliminary model construction. Dentist per capita was ultimately excluded in the final statistical models, as it was not statistically significant or correlated with study outcomes. Appendix B lists all independent variables and covariates included in the final statistical models for this study.

New and innovative workforce models that delivery oral health care in non-traditional settings (i.e. school-based, nursing communities, etc.) are emerging across the country and may contribute to improved access to preventive oral health care. These non-traditional models may or may not operate in similar fashion to more traditional oral health care delivery models. For example, patients receiving school-based oral health care may or may not have a dental examination prior to receiving preventive services such as fluoride varnish or prophylaxis. However, in more traditional settings (i.e. FQHCs or dental offices) dental examinations are typically administered prior to receipt of additional preventive or restorative services. Recognizing these differences, it is important that these findings be considered and interpreted within the context of the research objectives, which as to determine how state scope of practice policies affect FQHC patients’ access to oral health care services as measured by dental examinations. Future studies that both qualitatively and quantitatively evaluate how state scope of practice regulations affect non-traditional models of oral health care delivery as well as various types of preventive oral health services would fill an important gap that currently exists in this area of research.

### **Policy implications**

The present findings make a valuable contribution to public health research and constitute an initial examination of state workforce policies’ relationship with underserved individuals’ access to oral healthcare services. Accordingly, these findings have the following implications. Regarding FQHCs, the findings indicate the necessity of improving FQHC productivity, which is critical to increasing dental safety-net capacity.<sup>29,31</sup> Simultaneously, preventing and managing dental disease may most effectively reduce oral health disparity.<sup>9</sup> Better alignment

between FQHCs' dental service requirements and dental hygienists' professional focus will allow dental hygienists at FQHCs to better increase access to dental services. Numerous FQHCs are pursuing such alignment by embedding dental hygienists in their primary care clinics in order to expand preventive services for patients<sup>29</sup> or by employing dental hygienists in school-based dental programs to expand the reach of particular preventive services (e.g., dental sealant application).<sup>32</sup> Of course, FQHCs may only employ such models if state policies permit dental hygienists to function in these capacities.

Regarding state policy, the present findings may promote discussion between lawmakers and oral healthcare providers regarding optimization of state workforce policies to ensure public safety without impeding underserved populations' oral healthcare access. The study found that 20% of FQHC patients nationwide receive dental care from FQHCs, which indicates the importance of such discussions and may suggest that the use of dental hygienists to address this ongoing public health issue may be promising.

Finally, regarding federal policy, the HRSA might consider collaborating with key researchers to better understand the each state policy's effect on underserved patients' access to oral healthcare and advocate for better access to the FQHC data necessary to further examining this relationship. Federal officials should consider the potential funding issues stemming from the intersection of state workforce policies and federal public health programs. Specifically, the federal government mandates that a health center's funding application shall not be granted unless it shows that "the required primary health services of the center *will be available and accessible* in the catchment area of the center *promptly...*" (emphasis added).<sup>20</sup> Therefore, FQHCs in a restrictive policy environment that cannot promptly provide "preventive dental services" (which comprise one of the required primary health services)<sup>20</sup> to patients in their catchment area via referrals are not productively using their allocated federal funds to deliver dental services to underserved community members. Failure to provide care to underserved individuals increases the cost of emergency and restorative dental procedures to those individuals. In summary, the present results suggest that restrictive state policies impede the implementation of federal health system priorities such as decreasing the cost and increasing the quality and availability of care.<sup>33</sup>

## Conclusion

Improving underserved communities' access to oral healthcare services is a public health priority. Most dental diseases are preventable; however, disparities in access to oral healthcare make it difficult for underserved individuals to benefit from receipt of dental services. Therefore, states should consider supporting the dental hygiene workforce's ability to

improve FQHC patients' access to dental examinations, which generally precede additional dental services. Currently, state workforce policies often limit dental hygienists' ability to efficiently deliver oral health services to the largest possible number of people. Federal and state officials and healthcare professionals should optimize these policies in order to maximize public safety and ensure that the healthcare workforce can provide important dental services such as dental examinations within FQHCs.

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## APPENDIX A: Dental Hygiene Professional Practice Index (DHPPI)

The Dental Hygiene Professional Practice Index (DHPPI) contains values representing the professional practice of dental hygienists in the 50 states and the District of Columbia as of 2001. It was developed by the Center for Health Workforce Studies at the State of New York at Albany (SUNY) for Health Resources Services Administration (HRSA).<sup>1</sup>

DHPPI summarizes and quantifies the four aspects of legal practice environment of dental hygienists: legal and regulatory environment; supervision in various practice settings; tasks permitted under various levels of supervision; and, reimbursement environment. Legal requirements (as of December 31, 2001) for the provision of dental hygiene services across the states are sought to generate values for each of the four aspects. The total index value reflects the sum of values for the four aspects. The influence of each aspect is not distributed equally, as maximum values are assigned for each aspect based on predefined level of importance. Higher values in a category are associated with more supportive environment. The breakdown of these values is as follows: 10 points for legal and regulatory environment; 47 points for supervision; 28 points for tasks permitted; and, 15 points for reimbursement environment. DHPPI values are also grouped into 5 policy categories: restrictive, 0-29; limiting, 30-39; satisfactory 40-49; favorable, 50-79; and, excellent, 80-100. Complete methodology for the DHPPI was published in the final report, *The Professional Practice Environment of Dental Hygienists in the Fifty States and the District of Columbia, 2001*, in April of 2004 and is available to the public through HRSA at: <http://bhpr.hrsa.gov/healthworkforce1/reports/dentalhygiene50statesdc.pdf>.

### Key Legislative Changes Following DHPPI Development

The DHPPI was developed based on legislative data collected in 2001. Thus, the DHPPI reflects a cross-section of the professional practice environment of dental hygienists at the state level. A number of states experienced changes in legislation for dental hygiene supervision, reimbursement, and scope of clinical practice following the development of the DHPPI (Table A I). These changes are likely to alter the DHPPI; however, it is unlikely legislative changes have an immediate impact on oral health service delivery within a HC grantee due to the nature of the legislative processes in most states.

The American Dental Hygienists Association (ADHA) has collected information annually on state level legislative changes since 2002, specifically the data track bills that have been signed into law by state Governors. This includes information on reimbursement policies, supervision requirements,

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and scope of clinical practice. This information was obtained from ADHA's legislative liaison, Daniel Zurawski, on September 16, 2013 for the purpose of this study.

Changes in the legislative environment of a state following the development of the DHPPI may affect the delivery of oral health care services in HC grantees over the study period. In order to control for changes, ADHA legislative data are used to generate legislative change variable. Changes are identified by year for each state. A total of nine legislative change variables are created: 8 variables representing state-level changes for each year of the study and 1 variable representing any legislative changes within a state during the 8-year period. States with legislative changes are coded as 1 and states without change are coded as zero.

Ideally, the DHPPI or another indicator of the political practice environment should be updated on an annual basis. Unfortunately, the DHPPI index has not been routinely updated as it requires a significant amount of resources (time and manpower) which have not been readily available. This study examines DHPPI values as a baseline measurement of state policy environment, controlling for key changes in the policy environment. Updating the DHPPI is outside of the scope of this study; however, the development of an index which could be updated annual may be warranted, if the legislative change variables included this study as covariates have a significant impact.

The following summarize states with key policy (statute or regulatory) changes following the development of the Dental Hygiene Professional Practice Index (DHPPI). This index was developed based on the state level policy environment in 2001. Domains of interest in this study include supervision requirement, scope of clinical practice, and Medicaid reimbursement. These were selected because they 1) are included in the DHPPI (Wing et al., 2005) and 2) have been identified to have direct influence on the dental hygiene labor market and access to oral health care within a state (Wanchek, 2010; Wing et al., 2005).

Supervision requirements are defined as the level of professional oversight required for the clinical practice of dental hygiene. Generally, oversight by a licensed dentist is the most common supervision requirement. There is a large range in the level oversight required. For example, in Colorado there are currently no supervision requirements for delivery of basic dental hygiene procedures (with the exception of the administration of local anesthesia). Whereas in Mississippi, direct oversight by a licensed dentist is required for all clinical dental hygiene services. The DHPPI measured level of supervision within a state using discrete values. Changes in the level of supervision are important; however, this study seeks

to identify change in supervision requirement as a two level variable (yes/no). All legislative changes reviewed for this study included provisions that increased professional autonomy for dental hygienists within a state. Thus, policy changes would be associated with an increase in the value of the respective aspects (supervision, tasks, etc.) addressed and the total DHPPI value. This two level variable will be used as a covariate in statistical analyses to control for policy changes in cross-sectional and longitudinal analyses.

The DHPPI includes professional regulation as a fourth domain. The structure of professional governance, state board, is the primary measure for regulation within a state. This is included in the DHPPI as an important measure of the level of professional autonomy within a state; however, it is unlikely changes in the regulatory structure within a state translate directly to changes in delivery of care by dental hygienists. Rather, these changes are likely to be precursory to changes in the other measures (supervision, scope of clinical practice, and Medicaid reimbursement). As changes to governance structures are not considered to have a direct effect on the clinical practice of dental hygiene, they are not included among those changes that are controlled in analyses of this study.

Table A II lists the states in which policy changes occur by aspect (supervision, clinical tasks, reimbursements, any). A total of 36 states had policy changes between 2002 and 2011. The majority, 27 states, had changes to supervision requirements, and 17 states had changes to clinical tasks. Only three states had changes to reimbursement policy. Nine states had changes in more than one of the policy aspects during this time period. Changes included in this study are summarized by year.

### **2003: November 2002 - July 2003**

Among the states with key policy changes in supervision requirements during this time period are Illinois, Kansas, Maryland, Minnesota, Oklahoma, South Carolina, and Virginia. Illinois, Kansas and Minnesota introduced policy specific to public health settings, such as federally qualified health centers. North Dakota and West Virginia had changes in scope of practice policy. New Mexico had changes to reimbursement policy which enabled direct reimbursement to dental hygienists for unsupervised dental hygiene care.

### **2004: August 2003 – September 2004**

Arizona, Idaho, Illinois, and the District of Columbia had changes in supervision requirements during this period. Of these, Arizona's policies were specifically aimed at reducing barriers to dental hygiene practice in public health settings, such as federally qualified health centers. In addition, Michigan and Tennessee had changes within scope of clinical practice policy.

**2005: January –November 2005**

Michigan was the only state to have changes to supervision requirements during this period. These changes were directly focused on reducing supervision requirements in public health settings, such as federally qualified health centers. Connecticut, Massachusetts, Maine, and Minnesota had changes in scope of practice during this period.

**2006: January – June 2006**

Arizona, Florida, and Rhode Island had changes to supervision requirements during this time period. Policy changes in Arizona and Florida were specifically focused on public health settings. In Rhode Island, policy changes were directed toward care for the elderly through reducing supervision requirements in nursing homes. New Hampshire, Ohio and Virginia had changes in scope of clinical practice. Wisconsin policy changes enabled direct reimbursement to dental hygienists for specified services only.

**2007: July 2006 – June 2007**

A number of states had key policy changes during this period. California, Indiana, Kansas, Louisiana, Maryland, Nebraska, North Carolina, North Dakota, Rhode Island, and Washington all had changes to supervision requirements. Among these, Kansas, Louisiana, Nebraska, and North Carolina policy changes specified decreased levels of supervision within public health setting, which included federally qualified health centers. A number of the supervision changes also permitted lower levels of supervision for the provision of care to the elderly in nursing homes and senior centers. In addition, a number of states had policy changes which expanded scope of clinical practice, including Minnesota, Louisiana, Maryland, Oregon, and Virginia. Most notable among these are Oregon and Minnesota which incorporated dental hygiene diagnosis or examination into the scope of clinical practice. Wisconsin had changes in reimbursement policy which enabled direct reimbursement to dental hygienists for the delivery of any dental hygiene service.

**2008: September 2007 - July 2008**

Arkansas, Indiana, Maine, Maryland, Pennsylvania, Vermont had changes to supervision requirement policies. All of these changes included reducing the level of supervision required within public health settings. Although variability in these changes were large; for example, Indiana required examination by a dentist within 45 days of dental hygiene care, while Vermont and Arkansas supervision only required patient chart review or collaborative agreement with a dentist and not a physical oversight examination. In addition, Arkansas and Tennessee had changes to scope of clinical practice.

**2009: July 2008 - June 2009**

During this time period Arkansas, Massachusetts, Texas, Virginia, Washington, and West Virginia had changes to supervision requirements. Massachusetts, Texas and West Virginia specified policy changes reducing the amount of supervision required in federally qualified health centers. Colorado, Kentucky, and Maryland had changes to scope of clinical practice during this period. Of note, Massachusetts policy changes also enabled Medicaid reimbursement direct to dental hygienists practicing in underserved areas.

**2010: July 2009 - June 2010**

Kentucky, Maryland, and Ohio had changes to supervision regulation during this period. Maryland policy changes were focused on long-term care facilities. Louisiana and Missouri had policy changes involving scope of practice.

**2011: July 2010 – June 2011**

Arkansas, Florida, and South Dakota had supervision requirement changes during this time period. Of note, Florida statute included physicians as providing professional oversight for dental hygienists. New Hampshire, Oregon, Indiana, and Ohio had changes to scope of practice statute or rules during this period. Maine had changes to Medicaid reimbursement (MaineCare) enabling direct reimbursement for dental hygiene services.

This study examines DHPPI values as a base-line measurement of state policy environment, controlling for key changes in the policy over the study period. The binary variable for policy change will be used as a covariate in statistical analyses to control for policy changes in cross-sectional and longitudinal analyses.

**Table A 1:** Dental Hygiene Professional Practice Index, 2001  
DHPPI Index Components by State

DHPPI Component							
State	Regulation	Supervision	Tasks	Reimbursement	Total	DHPI Rating	
Maximum Score	10	47	28	15	100		
Colorado	9	47	26	15	97	<b>EXCELLENT</b>	
Washington	10	45	26	15	96		
Oregon	10	41	22	15	88		
California	8	37	26	15	86		
New Mexico	10	37	24	15	86		
Connecticut	9	33	18	15	75	<b>FAVORABLE</b>	
Missouri	8	29	22	15	74		
Nevada	9	36	20	0	65		
Minnesota	8	36	20	0	64		
Maine	8	30	18	0	56		
Utah	7	21	20	5	53		
New York	9	23	18	0	50		
Arizona	6	21	18	0	45		
Idaho	7	18	20	0	45	<b>SATISFACTORY</b>	
South Carolina	8	21	16	0	45		
Nebraska	7	21	16	0	44		
Wisconsin	7	21	16	0	44		
Pennsylvania	8	18	16	0	42		
South Dakota	6	16	20	0	42		
Louisiana	8	15	18	0	41		
Montana	9	16	16	0	41		
Texas	8	23	10	0	41		
Kansas	7	14	18	0	39		<b>LIMITING</b>
New Hampshire	9	16	14	0	39		
Tennessee	7	14	18	0	39		
Vermont	9	16	14	0	39		
Ohio	6	16	16	0	38		
Indiana	8	19	10	0	37		
New Jersey	6	15	16	0	37		
Iowa	8	10	18	0	36		
Illinois	7	11	18	0	36		
Maryland	10	16	10	0	36		
Alaska	9	12	14	0	35		
Michigan	7	18	10	0	35		
Massachusetts	6	16	12	0	34		
Wyoming	4	14	16	0	34		
Florida	6	21	6	0	33		
Rhode Island	7	16	10	0	33		
District of Columbia	6	16	10	0	32		
Delaware	8	16	8	0	32		
Hawaii	5	11	16	0	32		
North Dakota	6	16	10	0	32		
Oklahoma	6	7	18	0	31		
North Carolina	6	9	14	0	29	<b>RESTRICTIVE</b>	
Arkansas	6	5	16	0	27		
Georgia	8	9	6	0	23		
Alabama	6	12	0	0	18		
Kentucky	6	8	4	0	18		
Virginia	7	8	2	0	17		
Mississippi	6	7	2	0	15		
West Virginia	6	2	2	0	10		

Source: Center for Health Workforce Studies, University at Albany, 6/2003

**Table A II:** Summary of States with Policy Changes by Type Change

State Abbreviation	Supervision	Clinical Tasks	Reimbursement	Any
AR	1			1
AZ	1			1
CA	1			1
CO		1		1
CT		1		1
DC	1			1
FL	1			1
ID	1			1
IL	1			1
IN	1			1
KS	1			1
KY	1	1		1
LA	1	1		1
MA	1	1	1	1
MD	1	1		1
ME		1		1
MI	1	1		1
MN	1	1		1
MO		1		1
NC	1			1
ND	1	1		1
NE	1			1
NH		1		1
NM			1	1
OH	1	1		1
OK	1			1
OR		1		1
RI	1			1
SC	1			1
SD	1			1
TN		1		1
TX	1			1
VA	1	1		1
WA	1			1
WI			1	1
WV	1	1		1
Total	27	17	3	36

## APPENDIX B: Study Independent Variables and Covariates

**Table B I:** Study Variable Definitions and Measurements

Variable	Definition	Value
Sites	The number of clinical sites operated by the health center grantee	>0
Geography	The percent urban geographic area served by health center grantee.	0= rural 1= urban
Race	Average proportion of patients from a racial or ethnic minority group for all years of UDS reporting period	>0
Poverty	Percent of patients at or below 200% poverty during reporting period	>0
Uninsured	The percent of uninsured patients served by health center grantee during reporting period	>0
Medicaid	The percent of Medicaid patients served by health center grantee during reporting period	>0
Workforce	State level value indicating the dentists per 10,000 population	>0
Policy change	Key policy changes during the study period and for each year	0= no changes 1= changes
DHPPI Value	Sum of DHPPI index values for 4 aspects of professional practice environment of dental hygienists	>0
DHPPI Rankings	Level 1 = Restrictive, DHPPI range 0-29 Level 2 = Limiting, DHPPI range 31-39 Level 3 = Satisfactory, DHPPI range 40-49 Level 4 = Favorable, DHPPI range 50-79 Level 5 - Excellent, DHPPI range 80-100	1 2 3 4 5

# RESEARCH

## Oral Health Status of Independent Older Adults in Texas: An observational study comparing urban and rural areas

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### Abstract

**Purpose:** The purpose of this study was to assess the oral health needs of community-dwelling older adults participating in congregate meal centers and to determine whether differences exist in the oral health needs of older adult populations residing in urban versus rural communities in the state of Texas.

**Methods:** Study participants were recruited at 6 congregate meal centers located in identified rural and urban communities in the greater metropolitan area of Austin, Texas. (N=78) Participants completed a validated, modified questionnaire containing 20 items on the following topics: self-reported oral health, tooth loss, dental insurance, frequency of dental visits, time since last dental visit, access to dental care, dry mouth, and oral cancer screening. Each participant received an oral health screening based on the Association of State and Territorial Dental Directors Basic Screening Survey for Older Adults. The examiners received hands-on training prior to the study to ensure the validity of their findings and to test for inter-examiner reliability.

The chi-square test of independence was performed to analyze the participants' responses on the Basic Screening Survey to identify any relationships between the variables.

**Results:** There were no significant differences in oral health conditions of older adults residing in urban versus rural communities. Over 50% of the participants (64.9% urban; 56.1% rural) reported incomes below \$15,000 and lacked dental insurance to cover all or a portion of their oral health care needs. Eighty-seven percent of the participants reported tooth loss due to dental caries, 35% required periodontal care, and 37% reported occasional and 43% reported frequent oral pain over the last 12 months.

**Conclusions:** Oral health promotion and disease prevention is an emergent need for older adult populations residing in urban and rural communities of the state of Texas. Analysis revealed that the majority of the older adult populations in both settings to have financial and socioeconomic barriers to access preventative and restorative dental care services.

**Keywords:** oral health, older adult, urban, rural, access to care, oral health disparities

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### Introduction:

The older adult population in Texas is projected to triple by the year 2050, making 65 years and older, the state's population average.<sup>1,2</sup> This rise in the aging population will also include an increased demand for medical and dental care.<sup>3,4</sup> Although Medicaid, Medicare, and the Affordable Care Act have been established to cover the costs of medical care, there is limited insurance coverage for older adults requiring dental care.<sup>5-7</sup> This lack of coverage requires community-dwelling older adults to find their own dental insurance for dental expenses or to pay out-of-pocket.<sup>5,6</sup> Most community-dwelling older adults are retired and live on fixed incomes that do

not accommodate for the rising costs of oral health care in the United States (US).<sup>8,9</sup> Currently, the oral health needs of this population along with the appropriate strategic plan for meeting these needs has not been determined in the state of Texas. While the Texas Department of Health and Human Services has a program in place ensuring that all children and adolescents receive oral health services, similar oral health care programs for older adults do not exist.<sup>10,11</sup> The lack of an oral health care program for older adults may be impacting the management of systemic conditions in this population.<sup>12</sup> Home health and respite services typically do not include oral health services even though research has

determined an association between oral health and the aging process.<sup>13</sup>

The Surgeon General's National Call to Action states that "...no rural inhabitant, no homebound adult, no inner city dweller should experience poor oral health because of barriers to care..."<sup>14</sup> The Administration on Aging released a report revealing the population over the age of 60 years increased by 34% from 2005-2015, and estimated approximately 1 in 7 residents will be considered older adults.<sup>8</sup> At the same time, the US Census Bureau projects that the average age of the adult population is now 60 years and over and will continue to increase.<sup>15</sup> In Texas, this population is projected to increase to 12 million older adults, tripling the population of older adults by the year 2050.<sup>16</sup> The anticipated growth of the aging population will also increase the demand for medical and dental care services.<sup>8</sup>

Oral health promotion and disease prevention has been shown to have a positive impact on the aging process in older adults.<sup>13</sup> Preventive oral health services in the older adult population can slow the aging process and inhibit systemic inflammation by reducing inflammatory cell markers.<sup>17</sup> Oral health promotion also plays a key role in the quality of life for older adults.<sup>18</sup> Individuals with good oral health lead a more active lifestyle and have a more positive outlook regarding the aging process.<sup>13,18</sup> When dental coverage is limited, individuals are less likely to receive preventive care and must seek out emergency room care when dental problems become acute and start to affect other body systems.<sup>19,20</sup>

Geographic and socioeconomic challenges have been identified as two of the main barriers to access to oral health care in older adult populations. Federally qualified community health centers (FQHC) are more likely to be available and utilized in urban areas as compared to rural areas often because of differences in driving distances.<sup>13,21</sup> Despite the availability of community health centers, socioeconomic disparities can also hinder the ability to obtain services for this population.<sup>21</sup> Dental services for older adults dependent on home health care are limited because they are not included as part of the home health and respite care services in the state of Texas.<sup>22</sup>

The purpose of this study was to assess the oral health needs of community-dwelling older adults participating in congregate meal centers and to determine whether differences exist in the oral health needs of older adult populations residing in urban versus rural communities in the greater metropolitan area of Austin, Texas.

## Methods:

This cross-sectional observational study was part of a statewide study conducted in Texas to determine the oral health needs of community-dwelling older adults attending congregate meal centers while also

participating in Medicaid, Medicare, and other state assisted programs for low income adults.

## Setting and Sample

This study was administered in six congregate meal centers in the Austin-metropolitan areas and received the approval of the Meals on Wheels and More organization director and the center events coordinator. Congregate meal centers provide nutritious meals on a daily basis in a variety of group settings such as senior centers and are supported through the Title III Congregate Nutrition Program.<sup>23</sup> Three of the metropolitan Austin congregate meal centers were designated as rural locations, serving populations less than 10,000, while the remaining centers were considered urban with populations exceeding 10,000 as determined by the 2010 US census.<sup>24</sup>

Inclusion criteria were adults aged 65 years and older who participated in the congregate meal center activities. Participants were recruited during an oral health education presentation and were provided with a recruitment letter in English and Spanish. Study participants reviewed and signed informed consent forms prior to receiving the questionnaire and oral screening.

## Survey and Screening Process

The Association of State and Territorial Dental Directors (ASTDD) Basic Screening Survey (BSS) for Older Adults Toolkit was used for the study.<sup>25</sup> The toolkit included examiner training materials (PowerPoint presentation and video), screening form, and participant questionnaire.

The training video and manual was used for hands-on examiner training to ensure the findings were valid and could be replicated between the examiners. Two examiners, a dentist and a dental hygienist, acted as examiners for the study. To maintain ongoing calibration, every tenth participant was screened by the two examiners independently to maintain calibration and validate the findings.

The BSS questionnaire utilized questions from the NHANES (National Health and Nutrition Examination Survey), BRFSS (Behavioral Risk Factor Surveillance System), and NHIS (National Health Interview Survey) surveys. The topics in the BSS questionnaire included: self-reported oral health, tooth loss, dental insurance, frequency of dental visits, time since last dental visit, access to dental care, dry mouth, and oral cancer screening (20 items).<sup>25</sup> The ASTDD recommended addition of demographic questions (5 items).<sup>25</sup> Validation information was not provided in the ASTDD BSS for Older Adults Manual. The participant questionnaire was made available in English and Spanish.

After completing the questionnaire, each participant had an oral health screening performed by calibrated examiners utilizing the ASTDD Basic Screening Survey for Older Adults form. The examiners performed the

following assessments: functional posterior occlusal contacts, substantial oral debris, number of upper and lower teeth, untreated decay, root decay, number of teeth with root decay, root fragments, tooth mobility, need for periodontal care, severe dry mouth, suspicious soft tissue lesions, and treatment urgency.<sup>25</sup>

### Statistical Analysis

Descriptive statistics were used to describe the differences between the demographic characteristics and the oral health conditions of the participants in the study. All statistical analyses were performed in STATA® statistics/data analysis software version 14.0. A chi-squared test of independence was utilized to analyze the questionnaire data and the oral health assessment data for relationships between the following variables; including: oral health conditions, economic, and demographic conditions of the participants.

## Results:

### Population Demographics

A total of 78 volunteers (n=37 urban, n=41 rural) participated in the study. No significant differences were found in demographic characteristics between the urban and rural populations. (Table I) The majority of the survey participants were women and reported family incomes of \$10,000 - \$14,999, making them ineligible for Medicaid.<sup>25</sup> However it is worth noting that these individuals were also unable to afford the out-of-pocket costs of dental services through the Medicare Advantage program.<sup>8</sup> The majority of participants in both the urban and rural communities reported a lack of dental insurance coverage to pay for either all or a portion of their dental care costs (64.9% urban, 56.1% rural).

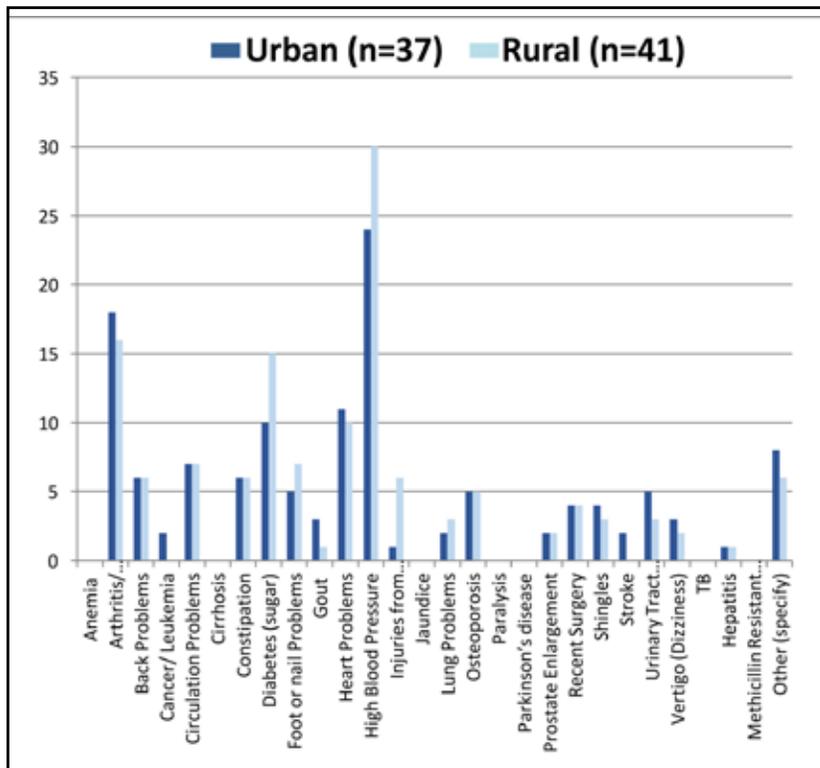
### General and Oral Health Conditions

Common general health conditions reported by the participants from both rural and urban communities were hypertension, arthritis, and type 2 diabetes. (Figure 1) Respondents reporting common chronic health conditions, also reported having ongoing oral disease such as untreated dental caries,

**Table I.** Demographics of Urban and Rural Communities in Austin, TX.

	Urban (n=37)	Rural (n=41)	p-value
<b>Female, n (%)</b>	28 (75.7 %)	27 (65.9 %)	0.342
<b>Age, n (%)</b>			0.355
65 - 69 years	7 (18.9 %)	13 (31.7 %)	
70 - 74 years	10 (27.0 %)	11 (26.8 %)	
75 - 79 years	10 (27.0 %)	8 (19.5 %)	
80 - 84 years	5 (13.5 %)	8 (19.5 %)	
85 - 89 years	2 (5.4 %)	1 (2.4 %)	
90 - 94 years	3 (8.1 %)	0 (0.0 %)	
<b>Race, n (%)</b>			
White	19 (51.4 %)	19 (46.3 %)	
Black	5 (13.5 %)	7 (17.1 %)	
Hispanic	10 (27.0 %)	14 (34.1 %)	
Asian	3 (8.1 %)	1 (2.4 %)	
<b>Highest level of education, n (%)</b>			0.657
8th grade or less	5 (13.5 %)	8 (19.5 %)	
9th - 12th grade	5 (13.5 %)	9 (22.0 %)	
High school graduate	13 (35.1 %)	15 (36.6 %)	
Bachelor's degree	8 (21.6 %)	6 (14.6 %)	
Professional degree	5 (13.5 %)	2 (4.9 %)	
<i>Missing</i>	1 (2.7 %)	1 (2.7 %)	
<b>Family total yearly income, n (%)</b>			0.627
\$3,000 - \$9,999	12 (32.4 %)	8 (21.6 %)	
\$10,000 - \$14,999	7 (18.9 %)	12 (32.4 %)	
\$15,000 - \$19,999	4 (10.8 %)	3 (8.1 %)	
\$20,000 - \$24,999	5 (13.5 %)	8 (21.6 %)	
\$25,000 - \$34,999	3 (8.1 %)	5 (13.5 %)	
\$35,000 - \$49,999	1 (2.7 %)	1 (2.7 %)	
\$50,000 - \$74,999	4 (10.8 %)	1 (2.7 %)	
\$75,000 and above	0 (0.0 %)	1 (2.7 %)	
Unknown	1 (2.7 %)	2 (5.4 %)	

**Figure 1.** Medical Conditions Self-reported by Older Adults Residing in Urban vs. Rural Communities



periodontal disease and lacked dental insurance to assist in the payment of routine dental care. (Table II)

No significance differences were revealed between the oral health conditions reported in the urban versus the rural communities. (Table II) The majority of the participants (86.6%), regardless of the community setting, reported tooth loss due to dental caries and/or periodontal disease. (Table II) Over one third of the participants reported having painful aching in the mouth over the past year, either occasionally (37%) or very often (43%). A total of 53.3% of the urban and rural participants reported frequently avoiding certain foods because of tooth, mouth and denture pain. (Table II)

The oral screening revealed that 48.6% of the urban and 56.1% of the rural communities had untreated dental caries present at the time of the study. Seventy-nine percent of participants had missing teeth and 11-24% of the remaining teeth demonstrated chronic oral infection requiring periodontal therapy. Less than one-third of the participants reported having dental insurance, 28% urban and 32% rural. (Table II) Forty-nine percent urban and 56% rural participants reported over that it had been more than 2 years since their last dental visit. The primary reason reported for a dental visit was oral pain by 34% of the urban and 38% of the rural participants. (Table III) Over 50% of both the urban and rural communities reported having had oral pain during the past 12 months but were unable to seek dental care due to cost of treatment. (Table III)

### Discussion:

Systemic conditions such as hypertension, rheumatoid arthritis and diabetes have been associated with chronic conditions related to poor oral health.<sup>27</sup> In the present study,

the majority of respondents reported being diagnosed with chronic systemic diseases that included hypertension, arthritis, and diabetes. These findings indicate that both rural and urban participants have chronic systemic conditions; research also suggests an association these conditions and oral disease, putting this population at even greater risk.<sup>27</sup> Taking these findings one step further, oral health is also related to healthy aging so it is critical to educate this population on the importance of maintaining good oral health.<sup>13</sup>

The finding that over half (53%) of participants reported often avoiding certain foods because of tooth, mouth and denture pain may lead to compromises in nutrition status. Research has shown that tooth loss and the ability to chew food may lead to decreased consumption of nutrient-rich fruits and vegetables which may further result in malnutrition for sustaining energy and immunity to systemic infections.<sup>28,29</sup>

Although there were no significant differences in the oral health needs between the urban and rural communities, there were similarities based upon the need for improvements of access to oral health care and education for this specific population. Over half of the participants in both types of communities revealed an urgency for immediate oral health care but also lacked access to oral health care services due to the rising costs of dental care and a limited understanding of the important relationship between oral and systemic health.<sup>5,6,13</sup> Texas Medicaid coverage limits dental services to dental extractions and emergency care.<sup>12</sup> Eligible Medicare Advantage members were unable to pay the co-payments of the rising costs of dental services due to their fixed incomes.<sup>58</sup> As the older adult population increases, the demand for oral health services will also increase the need for medical care.<sup>1,9</sup> With the older adult population's limited access to oral health services in Texas, an increased number of exacerbated systemic illnesses and emergency room visits may result, leading to higher demands for emergency room and other hospital services as well as workforce expansions of oral health professionals.<sup>19,30,31</sup> A plausible solution to these increased demands on the health care system could include the implementation of a mid-level oral health provider, capable of assisting in the triage and care in medical centers and other community settings.<sup>30</sup>

**Table II:** Oral Health Conditions of Urban and Rural Communities in Austin, TX.

	Urban (n=37)	Rural (n=41)	p-value
<b>Participant Self-Report Metrics</b>			
<b>Permanent teeth removed due to dental caries or periodontal disease, n (%)</b>			0.62
0-5 teeth	15 (40.5 %)	14 (34.1 %)	
≥6 teeth	14 (37.8 %)	20 (48.8 %)	
all teeth	8 (21.6 %)	7 (17.1 %)	
<b>Condition of mouth including replacement teeth &amp; dentures, n (%)</b>			0.763
Poor	7 (18.9 %)	10 (24.4 %)	
Fair	13 (35.1 %)	17 (41.5 %)	
Good	10 (27.0 %)	8 (19.5 %)	
Very good	7 (18.9 %)	6 (14.6 %)	
Excellent	0 (0.0 %)	0 (0.0 %)	
<b>Frequency of painful aching in the mouth over the last year including teeth and gingiva) n (%)</b>			0.908
Never	11 (29.7 %)	15 (36.6 %)	
Hardly ever	10 (27.0 %)	11 (26.8 %)	
Occasionally	10 (27.0 %)	10 (24.4 %)	
Very often	6 (16.2 %)	5 (12.2 %)	
<b>Frequency of particular food avoidance because of condition of teeth, mouth, or dentures, n (%)</b>			0.788
Never	12 (32.4 %)	12 (29.3 %)	
Hardly ever	8 (21.6 %)	7 (17.1 %)	
Occasionally	9 (24.3 %)	9 (22.0 %)	
Very often	8 (21.6 %)	13 (31.7 %)	
<b>Oral Health Exam Metrics</b>			
Number of Natural Maxillary Teeth, mean (SD)			
Number of Natural Mandibular Teeth, mean (SD)	7.30 (5.47)	7.24 (5.33)	0.892
Untreated Caries Lesions, n (%)	7.97 (5.25)	8.29 (5.09)	0.916
Yes			0.721
Edentulous	18 (48.6 %)	23 (56.1 %)	
Root Caries Lesions, n (%)	7 (18.9 %)	8 (19.5 %)	
Yes			0.824
Edentulous	15 (40.5 %)	18 (43.9 %)	
Obvious Tooth Mobility, n (%)	6 (16.2 %)	8 (19.5 %)	
Yes			0.977
Edentulous	4 (10.8 %)	5 (12.2 %)	
Need for Periodontal Therapy, n (%)	7 (18.9 %)	8 (19.5 %)	
Yes			0.269
Edentulous	4 (10.8 %)	10 (24.4 %)	
Severe Dry Mouth, n (%)	6 (16.2 %)	7 (17.1 %)	
Suspicious Soft Tissue Lesion, n (%)	2 (5.4 %)	0 (0.0 %)	0.132
	2 (5.4 %)	0 (0.0 %)	0.132

**Table III.** Oral Health Services in Urban and Rural Communities in Austin, TX

	Urban (n=37)	Rural (n=41)	p-value
<b>Participant Self-Reported Metrics</b>			
<b>Have insurance that pays for some or all of routine dental care, n (%)</b>			0.58
No	24 (64.9 %)	23 (56.1 %)	
Yes	11 (29.7 %)	13 (31.7 %)	
Subject did not know	2 (5.4 %)	5 (12.2 %)	
<b>Have insurance that pays for routine dental services such as cleaning, x-rays, and examinations, n (%)</b>			0.40
No	28 (75.7 %)	25 (61.0 %)	
Yes	7 (18.9 %)	12 (29.3 %)	
Subject did not know	2 (5.4 %)	4 (9.8 %)	
<b>Time since last dental visit for any reason, n (%)</b>			0.98
never	2 (5.4 %)	3 (7.3 %)	
> 5 years	12 (32.4 %)	15 (36.6 %)	
2 - 5 years	4 (10.8 %)	5 (12.2 %)	
1-2 years	3 (8.1 %)	3 (7.3 %)	
< 1 year	16 (43.2 %)	15 (36.6 %)	
<b>Main Reason for last dentist visit, n (%)</b>			0.89
Never been to the dentist	2 (5.4 %)	3 (7.3 %)	
Voluntarily went check-up, examination, or cleaning	16 (43.2 %)	17 (41.5 %)	
Contacted by dentist for check-up, examination, or cleaning	0 (0.0 %)	1 (2.4 %)	
Medical oral issue; oral pain	14 (37.8 %)	14 (34.1 %)	
Other	5 (13.5 %)	6 (14.6 %)	
<b>Is there a particular dentist or dental home usually attended, n (%)</b>			0.67
No	19 (51.4 %)	26 (63.4 %)	
Yes	17 (45.9 %)	41 (100.0 %)	
Subject did not know	1 (2.7 %)	1 (2.4 %)	
<b>Dental care needed in the last 12 months, but did not seek care due to cost issues, n (%)</b>			0.99
No	15 (40.5 %)	16 (39.0 %)	
Yes	20 (54.1 %)	21 (51.2 %)	
Subject did not know	2 (5.4 %)	4 (9.8 %)	

Limitations of this study include the potential for the inaccurate recall of the study participants influencing the responses to the self-reported survey questions related to demographics, oral health history, and general health. Future studies should focus on examining the multiple issues related to access to oral health care for community-dwelling older adults throughout the state of Texas as well as other states.

### Conclusions:

Oral health promotion and disease prevention is an emergent need for older adult populations residing both urban and rural communities in the state of Texas. More research is needed in these populations to assess the impact of the lack of access to routine dental services on oral as well as systemic health. As the older adult population continues to increase, oral health care will play a crucial role in the overall

management of systemic diseases accompanying this age demographic. Demand for oral health care services will increase as more older adults choose to live independently within their communities. With limited coverage of Medicaid and Medicare for preventive and restorative dental services, the expansion of services provided by oral health care professionals may assist in supporting overall health and wellness.

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## Measuring the Impact of Cultural Competence Training for Dental Hygiene Students

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### Abstract

**Purpose:** The purpose of this study was to measure the change in levels of knowledge of providing culturally competent care and self-assessed cultural competence of senior level dental hygiene students after the implementation of an online cultural competence training module.

**Methods:** Twenty-eight members of the senior class of 31 dental hygiene students (N=28) volunteered to participate in this IRB approved study at the Ohio State University School of Dentistry. The students took the online Inventory for Assessing the Process of Cultural Competence- Student Version (IAPCC-SV), to assess their self-perceived cultural competence. Upon completion of the pre-test, students then completed the United States Department of Health and Human Services (HHS) Office of Minority Health (OMH) Cultural Competency Program for Oral Health Professionals; a three-module online training program designed to measure increased knowledge of cultural competence. Three weeks following the initial pre-test and upon completion of the Cultural Competency Program for Oral Health Professionals online learning modules, students re-took the IAPCC-SV.

**Results:** Twenty-eight senior dental hygiene students completed the IAPCC-SV pre-test, the OMH e-learning modules and the IAPCC-SV post-test. The average score on the pre-test was  $55.14 \pm 7.54$  and the average score on the post-test was  $61.33 \pm 7.86$ . There was a significant difference in pre-test and post-test scores ( $p < 0.001$ ). There were also significant differences in the constructs of knowledge of cultural competence ( $p < 0.001$ ) and skill ( $p < 0.001$ ).

**Conclusion:** The HHS OMH Cultural Competency Program for Oral Health Professionals was effective for increasing dental hygiene students' levels of knowledge of cultural competence.

**Keywords:** cultural competence, cultural competency assessments, cultural knowledge, curriculum development, dental hygiene education

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### Introduction

According to the 2010 United States (US) census, the US continues to be more culturally diverse which subsequently creates an increasingly diverse population of patients for oral healthcare providers.<sup>1</sup> In order to treat, counsel and communicate with diverse patient populations, oral healthcare providers must be culturally competent.<sup>2</sup> As oral healthcare providers, dental hygiene students must have knowledge, understanding and appreciation for a wide variety of cultures, beliefs and customs in order to provide quality oral care for diverse populations.<sup>3</sup>

Dental hygiene, according to the US Bureau of Labor and Statistics, is one of the fastest growing professions in the US and the number of dental hygienists is projected to increase by approximately 38% between the years 2010-2020.<sup>4</sup> In spite of this projected growth of the profession

within an increasingly diverse general population, demographics on the current workforce indicate that dental hygiene is the least culturally diverse of all healthcare providers. According to data from the U.S. Department of Health and Human Services, 85% of dental hygienists are Caucasian and 97.2% are female; leaving the profession severely lacking in diversity.<sup>5</sup> If this lack of diversity continues, the profession may be ill-prepared to treat patients of differing cultures.<sup>3</sup> A more culturally diverse dental hygiene workforce has the potential of being both beneficial to the profession as well as the increasingly diverse population at large. While increasing the cultural diversity of the workforce may be part of a solution, promoting cultural competence within the dental hygiene workforce is essential. Failure to develop culturally competent oral healthcare providers may compromise the quality of and access

to care, limit patient resources, threaten patient safety and perpetuate oral health disparities.<sup>2,3</sup>

### **Cultural Competence**

Betancourt and colleagues define cultural competence as, "understanding the importance of social and cultural influences on patients' health beliefs and behaviors; considering how these factors interact at multiple levels of the health care delivery system (e.g., at the level of structural processes of care or clinical decision-making); and, finally, devising interventions that take these issues into account to assure quality health care delivery to diverse patient populations."<sup>2</sup>

The dental hygiene profession has not ignored the growing need for cultural competence. A set of core competencies for graduate level dental hygiene programs established collaboratively by the American Dental Hygienists' Association (ADHA) and the American Dental Education Association (ADEA) addresses ability of graduate dental hygiene students to engage and interact with individuals and groups across and within diverse communities and cultures in an effective and respectful manner.<sup>6</sup> Entry level education also includes a cultural competence knowledge base. The Commission on Dental Accreditation Standards for dental hygiene addresses the student's ability to treat diverse populations in Standard 2-15: "Dental hygienists should recognize the cultural influences impacting the delivery of health services to individuals and communities (i.e. health status, health services and health beliefs)."<sup>7</sup> Dental hygiene education must include effective communication and treatment of patients of various cultures and backgrounds in their curriculum.

A recent survey of dental hygiene program directors showed that 92% of dental hygiene program respondents reported incorporating some form of cultural competency education into their curriculum; the most common form was via lectures. It is also noteworthy that while cultural competency is part of the curriculum, measurements of cultural competence outcome indicators are rarely evaluated.<sup>8</sup> There are examples of cultural competency education in the literature. Doucette et al found that implementing a tobacco dependence education (TDE) curriculum with a cultural competence component increased dental hygiene students' cultural knowledge. However, while the study results indicated an increase in the student's knowledge of the culture of First Nations and Inuit peoples, it is unclear whether the students felt better prepared to provide TDE to this population and the authors acknowledged the need to implement additional learning experiences with cultural competence components to better facilitate student levels of preparedness.<sup>9</sup> Dewald and Solomon assessed the cross-cultural adaptability of dental hygiene students by administering the Cross-Cultural Adaptability Inventory (CCAI) at the beginning and

at the end of the 2- year dental hygiene curriculum and found no significant differences in the four skill areas assessed in the CCAI. Students did not receive any specific cultural competency training module intervention nor did they receive their CCAI results until after completing the dental hygiene program which may indicate that clinical experiences alone are not enough to increase cultural competence in students.<sup>10</sup>

Looking beyond examining the cultural competence of students, Behar-Horenstein et al, surveyed cultural competence of allied dental educators in Florida by administering the Knowledge, Efficacy and Practices Instrument (KEPI), a validated measure of cultural competence. Survey results demonstrated that while allied dental faculty have a greater awareness of sociocultural and linguistically diverse dental patients' oral health needs than that of dental faculty members, their scores in several areas of cultural competence indicated need of moderate to more intense training.<sup>11</sup> Current literature indicates that further research in the areas of training and evaluation of cultural competence is warranted.

### **Assessing Cultural Knowledge and Competence**

In April of 2014, the US Department of Health and Human Services (HHS), Office of Minority Health (OMH) launched a three-module online training program specifically for oral health professionals: The Think Cultural Health Initiative; a component of the Cultural Competency Program for Oral Health Professionals.<sup>12</sup> The purpose of the free, self-paced online program is to provide oral health professionals with basic knowledge and skills related to cultural and linguistic competencies based on the HHS Office of Minority Health National Standards for culturally and linguistically appropriate services in health and health care (CLAS Standards). This training tool serves to inform oral health professionals about the variety of cultures, traditions, beliefs, and customs of the diverse population that they will encounter in practice and provide a respectful appreciation for all individuals regardless of culture.<sup>12</sup> The program is broken down into three online modules consisting of a pretest, an information component and video followed by a post test. The three modules are as follows: Fundamentals of Culturally and Linguistically Appropriate Oral Health Care; Providing Culturally and Linguistically Appropriate Oral Health Care; Culturally and Linguistically Appropriate Communication and Messaging.<sup>12</sup> The training modules have added features to enhance the learning experience including additional resources, questions, culturally specific information, and video vignettes. Participants achieving scores of 70% or higher on all three post-tests receive a certificate serving as proof of successful completion of the course which also provides the oral health professional with six hours of continuing education.<sup>12</sup>

Studies addressing cultural competence assessment in health care providers often use self-administered tools and with inconsistent measurements lacking validation.<sup>13</sup> A systematic review of the literature documents over 45 variations of such instruments.<sup>13,14</sup> The Inventory for Assessing the Process of Cultural Competency among Health Professionals- Student Version (IAPCC-SV) as developed and copyrighted by Campinha-Bacote is a 20-item pencil/paper validated self-assessment tool for measuring the healthcare student's self-perceived levels of cultural competence in five constructs.<sup>15,16</sup> Cultural awareness as defined by Campinha-Bacote is the process of conducting self-examination of one's own biases towards other cultures and an in-depth exploration of one's own cultural and professional background and one's own biases towards other cultures.<sup>15,16</sup> Campinha-Bacote describes cultural knowledge as the process in which the healthcare professional seeks out a sound knowledge base about culturally diverse groups while integrating the following as defined by Lavizzo-Mourey and Mackenzie: health related beliefs, practices and cultural values, disease incidence and prevalence of disease.<sup>15-17</sup> Cultural skill, according to Campinha-Bacote is the ability to conduct an assessment in order to collect relevant cultural data regarding the client's presenting problem in addition to conducting an accurate culturally-based physical assessment.<sup>15,17</sup> Cultural encounters, are defined as the process by which the healthcare professional engages in face-to-face cultural interactions as well as other encounters with clients from culturally diverse backgrounds in an effort to modify any existing beliefs about a cultural group and to prevent stereotyping.<sup>15,17</sup> The survey identifies cultural encounters as the pivotal construct of cultural competence.<sup>15,17</sup> Lastly the fifth construct, cultural desire, is defined as the healthcare professional's desire to become freely engaged in the process of becoming culturally aware, knowledgeable and skillful in seeking cultural encounters.<sup>15,17</sup>

Oral health care providers must possess knowledge of cultural competence in order to meet the needs of diverse groups of patients and provide services in a culturally and linguistically appropriate manner. There is potential for HHS Think Cultural Health Initiative online course modules and the IAPCC-SV measurement tool to be used in dental hygiene education programs as parts of their cultural competence curriculum. Currently there are no published studies on the effectiveness of the HHS OMH modules for oral health care providers and knowledge of cultural competence. The purpose of this study was to measure the change in scores of self-perceived levels of cultural competence of senior level dental hygiene students after the implementation of an online training module designed to increase knowledge of cultural competence.

## Methods

This study used a pre-test, post-test design with a prospective cohort. Participants were recruited

from the 31 senior dental hygiene students at Ohio State University, School of Dentistry. The study received an exempt status from the University's Institutional Review Board. The students attended an informational session explaining the study. Following the informational session, students were invited to participate and informed consent was obtained from 28 out of 31 of the senior dental hygiene students. Students took the Inventory for Assessing the Process of Cultural Competency among Health Professionals- Student Version (IAPCC-SV), a 20-item, copyrighted, fee-based, survey instrument as a pre-test. The IAPCC-SV as developed by Campinha-Bacote is specifically designed to assess students' perceived cultural competence levels in five specific areas or constructs: Cultural Awareness, Cultural Knowledge, Cultural Skill, Cultural Encounter and Cultural Desire. Specific questions on the survey are related to each construct. The validity and reliability of this instrument has been established previously in the literature.<sup>15,16</sup>

The IAPCC-SV is designed so that specific questions are designed to assess the level of each of the specific constructs. Each response is given a point value. For questions 1-13 and 15-20 the values are as follows: strongly agree=4 Points, agree=3 Points, disagree=2 Points, strongly disagree=1 Point. Question 14 uses a reverse coding system and the point values are as follows: strongly disagree=4 Points, disagree=3 points, agree=2 Points, strongly agree=1 Point. Once a number value has been assessed for a student's responses, a level of cultural competence can be established. Culturally proficient is defined as a total score of 75-80, culturally competent 60-74, culturally aware 41-59 and culturally incompetent 20-40. The pre-test survey established a baseline level of knowledge and a level of cultural competence for each student.

Upon completion of the pre-test, students were instructed to complete the US Department of Health and Human Services (HHS) Office of Minority Health (OMH) Cultural Competency Program for Oral Health Professionals.<sup>13</sup> Students were given two full weeks to complete the online training modules. Following the completion of the three modules and post-test, students received an email from the Office of Minority Health Cultural Competency Program confirming completion of the three-course program. To verify completion of the online training modules, the students sent their course confirmation email to the program director. Three weeks following the pre-test, the students completed the IAPCC-SV post-test survey, which was used to establish the level of knowledge of cultural competence following the completion of the HHS OMH online modules. Data was analyzed using JMP 10 (SAS Institute, Cary, NC). The IAPCC-SV pre-test and post-test results were analyzed using descriptive statistics, a paired t-test and Wilcoxon Signed-rank test.

## Results

Twenty-eight (N=28) out of 31 senior dental hygiene students agreed to participate in the study. Individual demographic information was not asked of each participant but the class as a whole from which the sample was drawn had a mean age of 22 years with a range of 20-49 years. Ninety percent of the class was female and 87% of the class was Caucasian. Ninety-four percent of the class were domestic students (US citizens) and 6% indicated international citizenship. Twenty-eight surveys were distributed and completed for both the pre-test and the post-test. One participant's survey was missing a response on both the pre-test and the post-test. Therefore, for the specific constructs of Cultural Encounters and Cultural Knowledge, only 27 surveys were utilized.

The average score on the pre-test was 55.41(±7.54) while the average score on the post-test was 61.33(± 7.86) (Table I). No students fell into the culturally incompetent category on either the pre-test or the post-test (Table II).

**Table I.** Mean Scores on the IAPCC-SV

IAPCC-SV construct	Pre-test mean score	Post-test mean score
Overall Score	55.41± 7.54	61.33± 7.86
Awareness	3.17±0.37	3.35±0.38
Desire	3.18±0.52	3.30±0.57
Encounters	2.96±0.45	3.09±0.46
Knowledge	2.32±0.59	2.83±0.43
Skills	2.37±0.55	2.93±0.56

The mean change in overall score from pre-test to post-test was 5.79. Two students had post-test scores that were lower than pre-test scores, but both stayed within the same level of cultural competency from pre-test to post-test despite the lower scores. There were also two students who scored equally on the pre- and post-tests. The greatest overall score increase was 17 points. Scores were also evaluated by construct (Table I).

After assessing normality of the data, the paired t-test and the Wilcoxon signed rank tests were used to determine if there were differences in the level of knowledge of cultural competence before and after the modules were completed. There was a statistically significant difference in the pre-test to post-test scores in the constructs of knowledge ( $p<0.001$ ), skill ( $p<0.001$ ) and overall sum ( $p<0.001$ ) (Table III).

**Table II.** Total number of students in levels of cultural competence

IAPCC-SV Level	Pre-test (n)	Post-test (n)
Culturally Proficient	0	1
Culturally Competent	7	15
Culturally Aware	21	12
Culturally Incompetent	0	0

## Discussion

According to the results from the IAPCC-SV survey, the pre-test results indicated that the majority of the senior dental hygiene students started at the self-perceived level of being culturally aware. After completing the online HHS OMH training modules and then taking the post-test the students increased their self-perceived levels of cultural competency on the IAPCC-SV survey, with the majority of the students at the scoring level of culturally competent. One student's score was rated at the highest level of cultural competency: culturally proficient.

The dental hygiene students' mean score for the pre-test was 55.14, which falls within the level of culturally aware according to the scaling of the IAPCC-SV. This finding was not surprising as senior dental hygiene students have received some instruction in cultural competence at various points in the curriculum and have likely experienced interactions with patients from different cultural backgrounds than their own.

In a study by Hawala-Druy et al, health professions students including nursing, pharmacy and allied health were enrolled in an interdisciplinary course designed to provide the necessary knowledge and skills through transformative learning experiences to provide culturally appropriate team-based patient care to diverse

**Table III.** Differences Between Pre-test and Post-test Scores

IAPCC-SV construct	Median	Mean	P-value (Wilcoxon Signed Rank Test)	Paired t-test
Awareness	0.3333	0.1786	0.0543	0.0572
Desire	0.0	0.125	0.1184	0.0947
Encounters	0.2	0.156	0.0827	0.0544
Knowledge	0.4	0.4963	<0.0001*	<0.0001*
Skill	0.6667	0.5595	<0.0001*	<0.0001*
Overall Sum Change	4.5	5.786	<0.0001*	<0.0001*

\*indicates statistically significant

populations.<sup>18</sup> Student's levels of cultural awareness, competency and proficiency were measured with the IAPSS-SV both prior to and following the educational intervention. Additional evaluation measures included course evaluations, student feedback and portfolio reflections. Results from the pre and post IAPSS-SV surveys indicated a significant increase in the mean scores from the pre-test mean of 60.8 to the post test mean of 70.6.<sup>18</sup> While Hawala-Druy et al and this study both used the IAPSS-SV instrument and demonstrated an increase in the mean scores of cultural competence, the change in the scores for the dental hygiene students was 5.79 as compared to a change of 10.8 points with health professions students.<sup>18</sup> It is important to note that the single intervention for the dental hygiene students was the online HHS OMH training program administered over a two-week time period while the Hawala-Druy et al studied the effects of a semester-long, interprofessional education course.

In this study, the constructs of knowledge and skill showed the most significant increases in the comparison of the IAPSS-SV pre- and post-test mean scores, 0.496 and 0.560 respectively. Significant increases in these categories may be due to the focus of the HHS OMH online training modules on increasing the knowledge and skills of cultural competency with videos, information along with ways to communicate to achieve culturally and linguistically appropriate oral health care and services (CLAS).

Additional studies cite the challenges of measuring cultural competency within the curriculum.<sup>19-21</sup> Palombaro et al used the IAPSS-SV to measure the development of cultural competence in physical therapy students over a three-year curriculum with students participating in both mandatory and voluntary experiential learning opportunities that included experiences in a student-run pro bono clinic. Required didactic classroom presentations and activities were also integrated throughout the curriculum. Palombaro et al found that there was an overall improvement in self-assessed cultural competence as a result of a combination of curricular activities with a special emphasis on service learning and cultural encounters. These findings support the construct that the cultural encounters provide that foundation for each individual healthcare provider's journey towards cultural competence.<sup>19</sup>

Measuring and comparing cultural competence, even when similar instruments are used can be challenging. Studies conducted on the curricular integration and measurement of the development of cultural competency in physical therapy students do not differentiate between the various constructs and the changes in the pre- and post-test scores for each construct.<sup>19,20</sup> Only the overall mean change is examined and reported.<sup>19-21</sup> This limits the ability to compare previous study results with this study.

Limitations to this study include the sample was only comprised of 28 senior level dental hygiene students at one institution. This was a small, homogenous group and it is difficult to generalize the results as applicable to all dental hygiene programs. This study should be repeated in other dental hygiene programs to further validate the tool in improving cultural competence in the dental hygiene student population.

This pre-test, post-test design within one cohort of students did not allow for a control group. It is unclear whether the HHS OMH training modules or if time, experiences or other external factors over the two-week period influenced the levels of change in cultural competence. Future work should include a control group that does not complete the HHS OMH modules. While some cultural competency studies have tracked the longitudinal effects of specific interventions,<sup>21</sup> this study only looked at the measurement of cultural competence changes over a two-week period of time. Tracking the students' levels of cultural competence over longer periods of time may show how the levels change with ongoing training and experience.

Another limitation was that there was no way to measure the amount of time the students spent on the HHS OMS website. The students were instructed to work on the online training modules independently outside of the classroom and submitted an email indicating completion of the training modules. If the students did not work through the information completely and just completed the post-test at the end of each module, the full impact of the training modules may not have been reflected in their overall scores. Using the training modules within the context of a course would help to ensure more complete participation in all aspects of the modules.

The authors of this study recognize that cultural competence is a multi-faceted construct and one online training program is not adequate to meet the needs of a very diverse patient population. Clinical and community experiences that students have throughout their curriculum also contribute to their levels of cultural competence and patient feedback and health outcomes are critical components of culturally competent oral health care. This study aimed to examine one novel program's effects and it is not suggested that this be the sole content for cultural competence in the dental hygiene curriculum. The HHS OMH training modules can serve as an ideal starting point for the topic are an excellent resource for dental and allied dental educators to address cultural competence in an oral health context.

Future research would include a larger, more diverse sample size, a control group and the ability to track the amount of time spent on the training modules possibly by incorporating the training modules into the dental hygiene curriculum.

## Conclusion

Culturally competent dental hygiene care is becoming increasingly more important as the population of the United States becomes more diverse. Dental hygiene accreditation (CODA) standards required that students recognize cultural influences that impact the delivery of healthcare. This study examined the effects of knowledge acquired via the online HHS OMH Cultural Competency Program for Oral Health Professionals as compared to pre- and post-tests of self-perceived levels of cultural competence as measured by the Inventory for Assessing the Process of Cultural Competency among Health Professionals-Student Version (IAPCC-SV). While this single HHS OMH training program and IAPCC-SV student post-tests do not serve as sole indicators of cultural competency, the results of this study demonstrate that the HHS OMH Cultural Competency Program for Oral Health Professionals was effective for increasing dental hygiene students' levels of knowledge of cultural competence.

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# RESEARCH

## Association Between Social Anxiety with Oral Hygiene Status and Tongue Coating among Patients with Subjective Halitosis

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### Abstract

**Purpose:** Halitosis is a universal affliction suffered by many individuals irrespective of age, sex and social status. Concern about oral malodor can significantly impede an individual's personal, professional and public life which can lead to the development of social anxiety. The present study was undertaken to assess the association between social anxiety with oral hygiene status and tongue coating among patients with subjective halitosis.

**Methods:** A total of 321(n=321) subjects were self-recruited to participate in this IRB approved study. A 24- item Liebowitz Social Anxiety Scale, Self-Report version (LSAS-SR) was distributed and completed by the participants; followed by oral examination using Simplified Oral Hygiene Index and Tongue Coating Record (TCR). ANOVA, t-test and Mann Whitney U test was used for comparison among variables. Correlation was performed using Karl Pearson's correlation coefficient method. The level of significance was set as  $p < 0.05$ .

**Results:** The total LSAS for the study population of 321 was  $61.41 \pm 24.09$ ; with females having significantly higher scores ( $64.64 \pm 24.95$ ;  $p = 0.01^*$ ). Comparison of clinical oral parameters between the genders revealed that poor oral hygiene ( $2.45 \pm 1.06$ ) with a higher tongue coating score ( $71.38 \pm 18.24$ ) was observed among male participants. However, these scores were statistically insignificant. A significant correlation between total LSAS, majority of its subscales and the oral parameters among females and subjects with high school education was also reported.

**Conclusion:** This study revealed that social anxiety, poor oral hygiene and tongue coating were associated with subjective halitosis. Hence, maintenance of good oral health along with the use of appropriate tongue cleaning methods is of critical importance in reducing oral malodor. In some cases, comprehensive treatment of halitosis may require a multidisciplinary approach including dental, psychology and counselling professionals.

**Keywords:** behavioral research, social anxiety, oral hygiene, halitosis, tongue coating

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### Introduction:

Halitosis is a universal affliction suffered by many individuals irrespective of age, sex and social status. Halitosis, or oral malodor, is a common term used to define an unpleasant or an offensive odor in expired air<sup>1</sup>. Clinically, some individuals may present with self-perceived halitosis (described as halitosis complaint lacking objective confirmation with diagnostic methods such as a halimeter)<sup>2</sup> while others may seek treatment as a result of a complaint from their spouse, relatives or friends. The prevalence of halitosis is highly variable within the general population; ranging from 22% to

more than 50%.<sup>3</sup> An estimated 8 to 50% of the developed world's population report the perception of persistent episodes of oral malodor<sup>4</sup>. Ashwath et al found that among Indian dental students reporting self-perceived halitosis, that females self-reported at 35.5% versus 21.7% for males.<sup>5</sup> Multiple studies report higher percentages of subjective halitosis among those aged 30 years and older.<sup>1,6-11</sup>

Halitosis has a multi-factorial etiology including extra-oral, intra-oral and psychological factors<sup>5,11</sup>. In approximately 80-90% of cases, oral malodor originates intraorally and includes the following factors: bacterial reservoirs on the dorsum of

the tongue, plaque biofilm, periodontal pockets, xerostomia and extensive carious lesions with exposed dental pulps. Other oral causes identified in the literature include pericoronitis, mucosal ulcerations, food impaction, debris accumulation, unclean dentures and habitual mouth breathing<sup>12-17</sup>. Of the aforementioned factors, tongue coating has been identified as having a significant role in the etiology of halitosis. According to Quirynen et al, tongue coating was the predominant cause of halitosis either alone (43.3%) or in combination with gingivitis and periodontitis (18.2%).<sup>17</sup> The irregular texture of the dorsum of the tongue is an ideal niche for oral anaerobic bacteria to putrefy the debris, producing volatile sulphur compounds (VSCs), hydrogen sulphide and methyl mercaptan, all reported to be responsible for oral malodor.<sup>13, 16-21</sup>

Concern about oral malodor can significantly impede an individual's personal, professional and public life which can lead to the development of social anxiety.<sup>22</sup> Social anxiety is the extreme fear of being scrutinized and negatively judged by others in social or performance situations. Individuals with social anxiety are typically shy when meeting new people, quiet in groups and withdrawn in unfamiliar social settings. They avoid speaking in public, expressing opinions or even fraternizing with peers.<sup>22-24</sup> Also, it is suggested that anxiety influences the production of VSCs by stimulating autonomic nervous system (ANS).<sup>6,7,25-27</sup> As a consequence to ANS stimulation, adrenalin and noradrenalin secretion is enhanced, similar to fight or flight response thereby, reducing the salivary flow. This decrease in salivary flow further impairs the self-cleansing properties of the mouth, thus enabling tongue coating and potential malodor to develop.<sup>28,29</sup> Therefore, social anxiety plays a pivotal role leading to halitosis. Against this background, the present study was conducted to assess the association between social anxiety with oral hygiene and tongue coating among patients with subjective halitosis

## Methods

A cross-sectional study was carried out to assess the association between social anxiety with oral hygiene status and tongue coating among patients with subjective halitosis. The study was conducted in the outpatient department, Panineeya Institute of Dental Sciences and Research Centre, Department of Oral Medicine and Radiology during the 5 month period from January 2016 to May 2016. Approval for the study was obtained from the Institutional Review Board at Panineeya Institute of Dental Sciences and Research Centre.

Subjects aged 18 years or older presenting in the outpatient department with the complaint of halitosis were invited to participate in the study. Individuals with the following conditions: history of antibiotic usage over the last month; systemic

medical conditions including pregnancy, diabetes mellitus, renal disease, and immunosuppression; oral infections such as dental abscess; respiratory infections; history of tobacco use; and complete or partial denture wearers, were excluded from the study. Interested participants received an explanation of the study procedure and completed an informed consent form. Participation was voluntary and anonymity and confidentiality was maintained.

Social anxiety was assessed with the 24-item Liebowitz Social Anxiety Scale-Self Report version (LSAS-SR) developed in 1987 by Michael Liebowitz. The assessment instrument was available in both English and local vernacular language (Telugu).<sup>30,31</sup> LSAS-SR measures social interaction (S) (11 items) and performance (P) (13 items) in terms of fear and avoidance. Both fear and avoidance were rated on a 4-point Likert scale (Fear: 0- none, 1-mild, 2-moderate and 3- severe; Avoidance: 0-none, 1-occasionally, 2-usually and 3-often) in the last week. The LSAS-SR also provides six subscale scores: social-interaction fear, social-interaction avoidance, total fear, performance fear, performance avoidance, total avoidance along with total LSAS-SR score. Individual total scores ranged from 0-144 with the total fear/total avoidance varying from 0-72. Sociodemographic details were also collected including age, gender and level of education.

## Oral Examination

The clinical examination included an assessment of the oral hygiene status using the Simplified Oral Hygiene Index (OHI-S) by Greene and Vermillion.<sup>32</sup> Tongue coating was evaluated using Tongue Coating Record (TCR) by Shimizu et al.<sup>33</sup>

Data analyses were performed using the Statistical Package for Social Sciences Software (SPSS Version 21.0). Descriptive statistics were computed for the demographic variables. Mean score was calculated for each item, sub-scales and the total LSAS-SR. Likewise, the mean Debris Index simplified (DI-S), Calculus Index- Simplified (CI-S) and Simplified Oral Hygiene Index (OHI-S) scores were calculated. The Tongue Coating Record (TCR) was used to calculate mean percentage of tongue coating affecting the study population. Comparison of variables (gender) was carried out by t-test and Mann Whitney U test. ANOVA was used for comparison of 3 or more groups (educational levels). Correlation of social anxiety, oral hygiene status and tongue coating was assessed using Pearson's correlation coefficient method. The level of significance (p value) was set at  $p < 0.05$ . The validity and reliability of the questionnaire was tested using Cronbach's alpha.

## Results

A total of 321 adults with self-reported halitosis presenting to the outpatient department, Panineeya Institute of Dental Sciences and Research Centre, Department of Oral Medicine and Radiology, were

included in the study. A total of 159 males (49.5%) and 162 females (50.5%) participated. The majority of the study participants (n=189) were aged 30 years or younger (58.9%) and the majority of the participants (n=194) had completed a university education (60.4%). (Table I)

**Table I.** Demographic distribution of the study population.

Variables		n (%)		Total
		Males	Females	
Age	≤30 years	90 (47.6)	99 (52.4)	189 (58.9)
	31-40 years	55 (51.4)	52 (48.6)	107 (33.3)
	≥41 years	14 (56.0)	11 (44.0)	25 (7.8)
Education	Primary	9 (26.5)	25 (73.5)	34 (10.6)
	High school	43 (46.2)	50 (53.8)	93 (29.0)
	University	107 (55.2)	87 (44.9)	194 (60.4)
Total		159 (49.5)	162 (50.5)	321 (100)

\*p<0.05 statistically significant

Gender-wise comparisons of questionnaire items revealed that, in the fear subscale females had higher mean scores as compared to males for all the items except "Trying to pick up someone" (I<sub>21</sub>). However statistical significance was observed only for "Using a telephone in public" (I<sub>1</sub>) (p=0.03\*), "Talking to someone in authority" (p=0.01\*) (I<sub>5</sub>), "Going to a party" (I<sub>7</sub>) (p=0.006\*), "Calling someone you don't know very well" (I<sub>10</sub>) (p=0.004\*), "Talking face to face with someone you don't know very well" (I<sub>11</sub>) (p=0.006\*). Overall, for the fear subscale, the highest mean was noted for "Acting, performing or speaking in front of an audience" (I<sub>6</sub>) (1.83). A similar tendency was identified for the avoidance subscale, with females demonstrating statistically significant higher scores only for "Going to party" (I<sub>7</sub>) (p=0.02\*), "Meeting strangers" I<sub>12</sub> (p=0.03\*), "Urinating in public bathroom" (I<sub>13</sub>) (p=0.03\*) and "Giving party" (I<sub>23</sub>) (p=0.04\*). (Table II)

The total Liebowitz Social Anxiety Scale (LSAS) for the study population was 61.41±24.09 with females having a significantly higher score (64.64±24.95; p=0.01\*). Likewise, for the subscales: social interaction fear (13.57±7.20; p=0.001\*), performance fear (16.35±7.97; p=0.02\*) and social interaction avoidance (16.22±6.69; p=0.04\*), females had significantly higher scores compared to males. When subscales total fear and total avoidance were compared, a significant difference was found regarding gender only for total fear (p=0.004\*) with females having higher scores (32.15±14.32). (Table III)

When educational levels were taken into consideration, higher mean scores for all the subscales were noted for those with lower levels of education i.e., primary school. Moreover, with the exception of performance avoidance (p=0.17), all other subscales and total scores were significantly higher for those with lower (primary school) educational qualifications. (Table III)

Gender-wise comparison of clinical oral parameters revealed that poor oral hygiene (2.45±1.06) with more tongue coating score

(71.38±18.24) was observed among males. However, the scores were statistically insignificant. With regard to education levels, significantly higher scores were recorded for CI-S (0.004\*) and OHI-S (p=0.007\*) among subjects with lower (primary school) levels of education. (Table IV)

The OHI-S and TCR% revealed a significant and positive correlation with total LSAS and its subscales except for performance avoidance and total avoidance subscales. Wherein, subjects with high anxiety had high OHI-S score and high TCR percentage indicating poor oral hygiene status (Tables V and VI)

Based on gender, OHI-S and TCR percentage showed a significant positive correlation among females for total LSAS and its subscale scores. However, insignificant correlations were found between OHI-S and performance avoidance (p=0.7) and total avoidance subscales (p=0.1)S. Furthermore, gender wise correlation between TCR percentage and social anxiety and its subscales revealed an insignificant correlation among females for only the performance avoidance subscale (p=0.09). (Tables V and VI)

Likewise, based on levels of education, OHI-S and TCR percentage showed positive correlation with the social anxiety scale and its subscale scores, significant correlations were observed only for the social interaction fear (p=0.01\*), performance fear (p=0.003\*), total fear (p=0.003\*), performance avoidance (p=0.001\*) and total avoidance (p=0.01\*) subscales, and total LSAS score (p=0.0003\*) with TCR percentage only among subjects who had high school qualification. (Tables V and VI)

## Discussion

Oral odors are essential clues in the creation and conservation of social bonds. Halitosis as a medical term, was first coined in 1921 by the Listerine Company to describe unpleasant breath, regardless of its sources.<sup>11</sup> There are several agents

**Table II.** Itemwise comparison of the Liebowitz Social Anxiety Scale (LSAS) mean scores based on gender.

S. No.	QUESTIONS**	FEAR				AVOIDANCE			
		Males	Females	p-value	Total	Males	Females	p-value	Total
I <sub>1</sub>	Telephone in public (P)	0.66	0.90	<b>0.03*</b>	0.78	0.82	0.89	0.67	0.85
I <sub>2</sub>	Participating in a small group (P)	0.99	1.10	0.44	1.04	1.11	1.09	0.82	1.10
I <sub>3</sub>	Eating in public places (P)	0.50	0.62	0.08	0.56	0.92	1.02	0.20	0.97
I <sub>4</sub>	Drinking with others in public places (P)	0.55	0.65	0.16	0.60	1.04	0.90	0.36	0.97
I <sub>5</sub>	Talking to people in authority (S)	1.12	1.41	<b>0.01*</b>	1.26	1.36	1.33	0.76	1.35
I <sub>6</sub>	Acting, performing or giving a talk in front of an audience (P)	1.75	1.90	0.25	1.83	1.74	1.79	0.76	1.76
I <sub>7</sub>	Going to a party (S)	0.55	0.82	<b>0.006*</b>	0.69	0.84	1.09	<b>0.02*</b>	0.97
I <sub>8</sub>	Working while being observed (P)	0.82	1.02	0.12	0.92	1.04	0.96	0.45	1.00
I <sub>9</sub>	Writing while being observed (P)	0.84	1.01	0.16	0.92	1.06	0.93	0.23	1.00
I <sub>10</sub>	Calling someone you don't know very well (S)	1.21	1.56	<b>0.004*</b>	1.38	1.28	1.56	0.01*	1.42
I <sub>11</sub>	Talking with people you don't know very well (S)	1.26	1.59	<b>0.006*</b>	1.43	1.35	1.55	0.09	1.45
I <sub>12</sub>	Meeting strangers (S)	1.32	1.61	<b>0.021*</b>	1.47	1.40	1.65	<b>0.03*</b>	1.52
I <sub>13</sub>	Urinating in a public bathroom (P)	1.51	1.86	<b>0.014*</b>	1.69	1.87	2.19	<b>0.03*</b>	2.03
I <sub>14</sub>	Entering room when others are already seated (P)	1.48	1.62	0.25	1.55	1.53	1.64	0.38	1.58
I <sub>15</sub>	Being the centre of attention (S)	1.53	1.64	0.43	1.59	1.58	1.71	0.27	1.64
I <sub>16</sub>	Speaking up at a meeting (P)	1.70	1.81	0.34	1.76	1.67	1.68	0.95	1.68
I <sub>17</sub>	Taking a test (P)	1.44	1.72	<b>0.02*</b>	1.58	1.45	1.60	0.21	1.53
I <sub>18</sub>	Expressing disagreement or disapproval to people you don't know very well (S)	1.16	1.26	0.41	1.21	1.40	1.42	0.90	1.41
I <sub>19</sub>	Looking at people you don't know very well in the eyes (S)	1.27	1.49	0.06	1.38	1.62	1.60	0.92	1.61
I <sub>20</sub>	Giving a report to a group (P)	1.72	1.79	0.64	1.76	1.62	1.79	0.14	1.70
I <sub>21</sub>	Trying to pick up someone (P)	1.42	1.30	0.37	1.36	1.59	1.53	0.55	1.56
I <sub>22</sub>	Returning goods to a store (S)	1.00	1.11	0.33	1.06	1.16	1.39	0.06	1.27
I <sub>23</sub>	Giving a party (S)	0.71	1.09	<b>0.001*</b>	0.90	1.13	1.37	<b>0.04*</b>	1.25
I <sub>24</sub>	Resisting a high pressure sales person (S)	1.13	1.28	0.20	1.21	1.57	1.54	0.78	1.55

\*\*S= Social interaction, P=Performance

\*p<0.05 statistically significant

**Table III.** Comparison of mean Liebowitz Social Anxiety Scale and its sub-scales scores based on gender and educational qualification.

Variables		Mean±S.D.						
		<i>Social interaction fear</i>	<i>Performance fear</i>	<b>Total fear</b>	<i>Social interaction avoidance</i>	<i>Performance avoidance</i>	<b>Total avoidance</b>	<b>Total LSAS (Liebowitz social anxiety scale)</b>
<b>Gender</b>	<b>Males</b>	12.27±6.90	15.37±7.84	27.64±13.74	14.76±6.00	15.72±6.32	30.48±11.19	58.13±22.79
	<b>Females</b>	14.84±7.28	17.31±8.00	32.15±14.32	16.22±6.69	16.27±6.69	32.49±12.20	64.64±24.95
	<b>p-value</b>	<b>0.001*</b>	<b>0.02*</b>	<b>0.004*</b>	<b>0.04*</b>	0.44	0.12	<b>0.01*</b>
<b>Education</b>	<b>Primary school</b>	19.09±7.67	21.76±7.58	40.85±14.40	18.15±6.31	17.85±5.98	36.00±11.33	76.85±24.41
	<b>High school</b>	13.76±7.52	16.99±9.19	30.75±15.70	15.74±6.56	16.13±7.18	31.87±12.53	62.62±26.38
	<b>University</b>	12.51±6.51	15.09±6.94	27.60±12.43	14.91±6.22	15.61±6.17	30.53±11.27	58.12±1.79
	<b>p-value</b>	<b>0.0001*</b>	<b>0.0001*</b>	<b>0.0001*</b>	<b>0.02*</b>	0.17	<b>0.03*</b>	<b>0.0001*</b>
<b>Total</b>		13.57±7.20	16.35±7.97	29.92±14.20	15.50±6.39	16.00±6.48	31.50±11.73	61.41±24.09

\*p<0.05 statistically significant

**Table IV.** Comparison of mean scores of clinical oral parameters based on gender and educational qualification.

Variables		Mean ± S.D.			
		<b>DI-S (Debris Index-Simplified)</b>	<b>CI-S (Calculus Index-Simplified)</b>	<b>Total OHI-S (Simplified Oral Hygiene Index)</b>	<b>TCR% (Tongue Coating Record in %)</b>
<b>Gender</b>	<b>Males</b>	1.05±1.20	1.51±0.76	2.45±1.06	71.38±18.24
	<b>Females</b>	0.98±1.21	1.44±0.85	2.30±1.13	69.21±17.28
	<b>p-value</b>	0.61	0.44	0.21	0.27
	<b>Total</b>	1.01±1.20	1.47±0.81	2.37±1.10	70.29±17.77
<b>Educational qualification</b>	<b>Primary school</b>	0.95±0.45	1.69±0.76	2.64±1.11	74.14±17.07
	<b>High school</b>	1.10±1.53	1.64±0.74	2.60±1.08	70.41±16.55
	<b>University</b>	0.98±1.12	1.35±0.83	2.22±1.08	69.55±18.44
	<b>p-value</b>	0.67	<b>0.004*</b>	<b>0.007*</b>	0.38
	<b>Total</b>	1.01±1.20	1.47±0.81	2.37±1.10	70.29±17.77

\*p<0.05 statistically significant

**Table V.** Correlation of Liebowitz Social Anxiety Scale (LSAS) and its subscale scores with Simplified Oral Hygiene Index(OHI-S) based on gender and educational qualification.

Variables		p-value					Total
		Gender		Educational Qualification			
		Males	Females	Primary	High School	University	
Simplified Oral Hygiene Index (OHI-S)	Social interaction fear	0.5	<b>0.01*</b>	0.1	0.09	0.9	<b>0.13*</b>
	Performance fear	0.4	<b>0.007*</b>	0.3	0.4	0.2	<b>0.03*</b>
	<b>Total fear</b>	0.4	<b>0.005*</b>	0.2	0.2	0.4	<b>0.01*</b>
	Social interaction avoidance	0.06	<b>0.02*</b>	0.7	<b>0.006*</b>	0.2	0.2
	Performance avoidance	0.4	0.7	0.5	0.32	0.7	<b>0.04*</b>
	<b>Total avoidance</b>	0.1	0.1	0.5	<b>0.04*</b>	0.6	0.08
	<b>Total LSAS (Liebowitz social anxiety scale)</b>	0.2	<b>0.02*</b>	0.3	0.09	0.5	<b>0.02*</b>

\*p<0.05 statistically significant

**Table VI.** Correlation of Liebowitz Social Anxiety Scale (LSAS) and its subscale scores with Tongue Coating Record (TCR%) based on gender and educational qualification.

Variables		p-value					Total
		Gender		Educational Qualification			
		Males	Females	Primary	High School	University	
Tongue Coating Record (TCR%)	Social interaction fear	0.3	<b>0.004*</b>	0.58	<b>0.01*</b>	0.4	<b>0.13*</b>
	Performance fear	0.5	<b>0.006*</b>	0.51	<b>0.003*</b>	0.9	<b>0.03*</b>
	<b>Total fear</b>	0.4	<b>0.003*</b>	0.52	<b>0.003*</b>	0.6	0.01*
	Social interaction avoidance	0.6	<b>0.03*</b>	0.58	0.16	0.9	0.2
	Performance avoidance	0.2	0.09	0.14	<b>0.001*</b>	0.7	<b>0.04*</b>
	<b>Total avoidance</b>	0.6	<b>0.03*</b>	0.28	<b>0.01*</b>	0.8	0.08
	<b>Total LSAS (Liebowitz social anxiety scale)</b>	0.4	<b>0.006*</b>	0.38	<b>0.003*</b>	0.9	<b>0.02*</b>

\*p<0.05 statistically significant

that can temporarily mask the malodor such as mouth rinses, chewing gum, etc., which in turn may prevent the individual from seeking definitive treatment from an oral health professional. While halitosis is most often associated with oral causes, its presence may have serious medical implications as there are numerous medical conditions that predispose one to oral malodor. Halitosis is a common condition with serious social stigmas that may lead to individuals to becoming anxious and stressed in their daily lives. Therefore, identifying a need to enhance knowledge regarding the relationship of self-perceived halitosis, social anxiety and clinical diagnostic factors.<sup>5</sup> Halitosis, whether real or perceived, is a cause of concern, embarrassment and frustration on the part of the both sufferer and the general public, and has been shown to lead to social isolation, divorce proceedings, and even contemplation of suicide<sup>11</sup>.

There are very few studies evaluating subjective halitosis and its social impact. Therefore, the present study was undertaken to explore the association between social anxiety with oral hygiene and tongue coating among patients with subjective halitosis. To evaluate the social impact of halitosis on the study population, Liebowitz Social Anxiety Scale-Self Report version (LSAS-SR) was used.<sup>30,31</sup> The LSAS is recognized by the International Consensus Group on Depression and Anxiety as the gold standard for evaluating the clinical impact of social anxiety in an individual.<sup>26</sup> The merit of LSAS scale compared to other social anxiety measures- [Social Interaction Anxiety Scale (SIAS), Social Phobia Scale (SPS), Social Avoidance and Distress Scale (SADS) and Fear of negative Evaluation Scale (FNE)] is that, LSAS assesses both anxiety and avoidance in specific situations, rather than assessing specific symptoms. Also, the psychometric properties of the self-report version were found to be as satisfactory as the clinician administered format, with added advantage of being easier and faster.<sup>32</sup> In the present study, the validity of the questionnaire was 0.81.

In a study by Miyazaki et al wherein the correlation between volatile sulphur compounds and certain oral health measurements in the general Japanese population was estimated, it was reported that tongue coating was the main cause of halitosis among the young female subjects.<sup>10</sup> Another study by Delanghe et al revealed that of the intraoral causes of halitosis, 51% was associated with tongue coating, 17% due to gingivitis, 15% as a result of periodontitis and 17% was the result of the combination of the previous conditions. In order to objectively measure tongue coating and correlate it with the self-reported complaint of halitosis, the Tongue Coating Record (TCR) was employed in this study. Apart from its reliability and reproducibility, the index had good inter-observer agreement (0.66) and intra-observer agreement (0.80).<sup>33</sup>

In comparison to an Italian study by Settineri et al, where a higher number of female participants (59.2%) presented with subjective halitosis<sup>6</sup>, the present study had comparable numbers of male (49.5%) and female (50.5%) participants.

The majority of the participants had a university education (60.4%) demonstrating a higher concern among educated subjects with respect to their self-image, which might be lowered due to bad breath. Similar findings were observed in a study among Kuwaiti patients with a university education (66.2%).<sup>35</sup> Contrary findings come from a study conducted by Youngnak- Piboonratanakit et al, among Thai dental patients from Chulalongkorn Dental Hospital. Subjects with lower education levels (77.7%) dominated the study population as compared to those with a university education (66.2%).<sup>7</sup>

When individual items of LSAS were taken into consideration, such as the fear subscale, females reported higher mean scores for all the items except for Item-21 (Trying to pick someone up). This could be due to the fact that women may be more phobic and less willing to interact in a strange/unknown situation due to their bad breath. On the other hand, avoidance subscale showed comparable mean scores between males and females. The overall LSAS and its subscale mean scores were significantly lower for males, indicating that males were less anxious when compared to females. Less anxiety among men could be attributed to the fact that, they have higher self-esteem and less introverted tendencies as compared to women and they may seldom avoid social situations. Similar findings were also reported among Japanese<sup>26</sup> and American<sup>36</sup> populations where females posed a greater risk of having social anxiety as compared to males.

However, significantly lower mean scores for LSAS and its subscale (except the performance avoidance subscale), was noted among subjects with a higher level of education in this study. This could be because subjects with higher or university education, indulge in good oral hygiene practices as evidenced with the overall good oral hygiene score ( $2.22 \pm 1.08$ ) and Tongue Coating Record ( $69.55 \pm 18.44$ ) when compared to subjects with a lower education in the current study.

In a study by Liu et al among Chinese individuals, it was found that a significant correlation existed between volatile sulphur compounds (VSCs) and oral hygiene status (plaque index and calculus index) among various age groups wherein females outnumbered males.<sup>13</sup> Whereas, in the present study, poor oral hygiene scores based on OHI-S and TCR index were found among males, which may be attributed to the fact that females are invariably more concerned about oral hygiene and appearance and may be spending more time on oral hygiene maintenance as compared to males. This was further supported by this study's

finding of a positive correlation between total LSAS, its subscale and the oral clinical parameters among females, thus signalling a higher level of concern about their oral hygiene.

The present study acknowledges certain limitations; such as the cross-sectional nature of the study which was confined to a single institution, therefore, the results cannot be generalized beyond the study population. The effects of age, gender and education in regards to the etiology and self-perception of halitosis could not be clearly established. Lastly, there was a lack of correlation between subjective halitosis and clinical or laboratory-based evaluations made using halimeter, gas chromatography and organoleptic methods.

## Conclusion

The current study revealed that social anxiety, poor oral hygiene and tongue coating were associated with subjective halitosis. Also, it may be concluded that halitosis may pose a serious oral health problem with an extensive social impact on its sufferers. Maintenance of good oral health along with the use of appropriate tongue cleaning methods is of utmost importance in reducing oral malodor. In some cases, however, a comprehensive treatment of halitosis may require a multidisciplinary approach by a team of dental, psychology and counselling professionals.

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# RESEARCH

## A Comparison of Efficiency and Material Wear of Diamond-Plated versus Ceramic Sharpening Stones

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### Abstract

**Purpose:** The purpose of this study was to compare sharpening efficiency and metal (carbon steel) removal from scalers using two types of synthetic sharpening stones: ceramic and diamond-plated. Previous research used scanning electron microscopy alone to measure instrument sharpness. Additionally, no research has been reported on the use of diamond-plated sharpening stones.

**Methods:** Fifteen threaded, double-ended H6/H7 scalers were randomly divided into three groups of ten: control, ceramic stone, and diamond-plated stone. All cutting edges were dulled by scaling the surfaces of extracted molars. The cutting edges were then sharpened by a blinded examiner with the assigned stone until optimal sharpness was achieved using a test stick between sharpening strokes. The number of strokes needed to reach sharpness for each cutting edge was recorded. Four hundred sharpening strokes were then applied on each end using the assigned stone. The scaler ends were weighed before and after sharpening to determine amount of material loss in milligrams. Statistical analysis was performed using ANOVA followed by a Tukey-Kramer post-hoc test.

**Results:** The diamond-plated sharpening stone removed significantly more metal (7.62 mg +/-0.38) than the ceramic stone (0.69 mg +/-0.06) ( $p < 0.001$ ), while there was no significant difference between the ceramic sharpening stone and the control. There was no significant difference between diamond-plated and ceramic stones in the number of strokes needed to sharpen scalers.

**Conclusion:** While a similar number of strokes was needed to sharpen scalers with the diamond-plated or ceramic stone, the diamond-plated stone removed nearly 7 mg more metal than the ceramic stone using a standardized number of sharpening strokes, suggesting greater scaler longevity when using a ceramic sharpening stone.

**Keywords:** instrument wear, ceramic sharpening stones, diamond plated sharpening stones, periodontal instrumentation

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### Introduction

The use of a sharp scaler is crucial for adequate calculus removal during periodontal instrumentation. Dull scalers can result in fatigue, less control, need for excessive lateral pressure, and failure to remove deposits entirely. After repeated use, a scaler's cutting edges begin to dull. This requires sharpening of the instrument in order to regain its optimal cutting edge. Sharpening entails the removal of small increments of metal from the cutting edge. The final goal of sharpening is to restore the instrument's cutting edge to its original shape while removing as little metal as possible.<sup>1</sup> No research has been reported in the literature to date, comparing the amount of metal removal during instrument sharpening with various sharpening stones.

Sharpening stone selection is crucial to obtaining an optimally sharp cutting edge while retaining the instrument's original shape. There are two categories of stones: natural abrasive stones and synthetic stones. Natural abrasive stones are derived from natural sources such as the Arkansas stone and India stone. Synthetic stones are artificially constructed stones, which include ceramic, carborundum, ruby, and diamond stones. Sharpening stones range in abrasive levels from extra fine to coarse grit. The coarser the stone, the quicker the metal is removed from the instrument. When using a coarse stone, it is important to follow up with a fine grit stone in order to produce a smooth, uniform surface along the cutting edge.<sup>2</sup> In 2015, a new diamond-plated synthetic sharpening stone came onto the market in

medium, fine, and extra fine grit. Research needs to be conducted to determine if this new sharpening stone is superior or equivalent to other synthetic stone options.

Most previous research studies evaluating the sharpening of dental instruments have utilized Scanning Electron Microscopy (SEM).<sup>3-10</sup> While irregularities and the presence of a dull, beveled cutting edge can be examined under SEM magnification, this method is not as clinically relevant when assessing instrument sharpness especially in clinical settings. The use of a hard, acrylic test stick is considered the optimal method for evaluating cutting edge sharpness in a traditional clinical setting. When determining sharpness with a test stick, a sharp instrument will cut into the acrylic whereas a dull instrument will slide across the surface.<sup>1</sup>

Diamond-plated stones are new to the market and research is currently lacking on this synthetic stone. More specifically, there is a lack of research on how the diamond-plated stone compares to a ceramic stone in its ability to provide a sharp cutting edge while removing the least amount of metal from a scaler. The purpose of this study was to compare the sharpening efficiency and the amount of metal (carbon steel) removal from scalers using two types of synthetic sharpening stones: ceramic and diamond-plated.

## Methods

Fifteen, double-ended carbon steel scalers (H6/H7; G. Hartzell and Son, Concord, CA) with threaded tips were used for this study. Activation strokes were performed in increments of 50, on five scalers on extracted molars to determine the number of strokes required to achieve appropriate dullness. Dullness was determined by an experienced dental hygienist (principal investigator, HH). A minimum of 300 activation strokes were performed on each of the 60 cutting edges until dullness was achieved. An experienced dental hygienist (HH) used an acrylic test stick to assess the level of dullness for each cutting edge.

The thirty scaler ends were labeled, submitted into an electronic randomizer, and divided into three groups of ten: control, fine ceramic stone, and fine diamond-plated stone. The control group did not receive any sharpening treatment but was weighed at the same intervals as the experimental groups in order to evaluate variation in the measurement technique. Each cutting edge in the two treatment groups was sharpened with the assigned stone using a sharpening guide (PDT-Gleason Guide™; Paradise Dental Technology, Missoula, MT) to standardize the stone angulation. For the initial sharpening of the scaler, a dental hygiene student researcher (LS) used five strokes for each cutting edge. A blinded, experienced dental hygienist (HH) tested each cutting edge for sharpness with an acrylic test stick. Additional strokes were assigned and performed

until sharpness was attained as determined by the same experienced dental hygienist (HH). Sharpening efficiency for each end of the instrument was calculated by adding together the number of strokes to sharpen each of the two cutting edges.

In order to assess metal removal comparing the three groups, a second dental hygiene student researcher (ES) detached each end and determined initial weight with an analytical laboratory digital balance scale (Mettler Toledo AG285; Columbus, OH), sensitivity of 0.1 mg. A pilot study was performed using two scalers to determine how many sharpening strokes were required to remove at least one mg (threshold to represent ten times the sensitivity of the balance) of carbon steel. Researcher (LS) performed sharpening in increments of 50 strokes and continued until 1 mg of metal was lost using the ceramic stone, resulting in 650 strokes per instrument end. The same researcher (LS) attempted 650 strokes using the diamond-plated stone; prior to reaching this threshold, a significant amount of metal was lost. Thus, the researchers chose 400 strokes as the threshold for evaluating both ceramic and diamond-plated stones. Researcher (LS) sharpened each end with its assigned stone using 400 strokes. A final weight was determined for each end by researcher (ES).

## Statistical Analysis

A one-way analysis of variance (ANOVA) was used to determine whether the control, ceramic sharpening stone, and diamond-plated sharpening stone differed with respect to the number of strokes needed to sharpen the scalers and the amount of metal removed as a result of instrument sharpening. A Tukey-Kramer Post-hoc Test was performed to evaluate all pairwise comparisons among the three groups. Statistical significance was set at  $p < 0.05$ .

## Results

There was no statistically significant difference between the diamond-plated and ceramic stones with respect to the number of strokes needed to sharpen the scalers (Table I); however, there was a statistically significant difference between the diamond-plated and ceramic stones versus the control group ( $p < 0.001$ ).

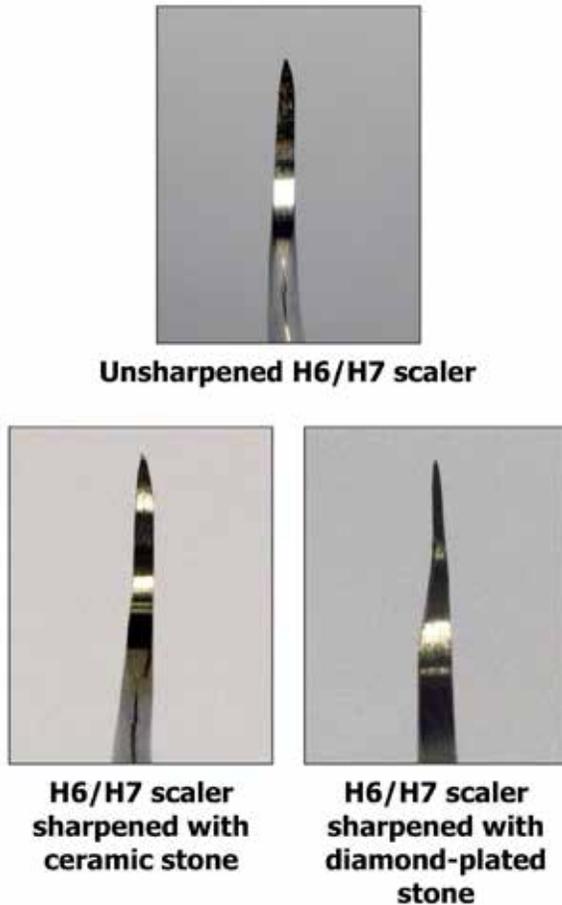
**Table I.** Number of Strokes Needed to Sharpen Scalers\*

Sharpening Stone	n	Number of Sharpening Strokes (mean ± SEM)
Control	10	0 ± 0 <sup>a</sup>
Ceramic	10	17.6 ± 1.73 <sup>b</sup>
Diamond-plated	10	15.6 ± 1.05 <sup>b</sup>

\*Group means with same superscript letters are not significantly different at the  $\alpha = 0.05$  level of confidence. Group means with different superscript letters are significantly different at the  $p < 0.001$  confidence level. Results from ANOVA/Tukey.

After 400 sharpening strokes, the diamond-plated stone removed significantly more metal from the scalers than the ceramic stone ( $p < 0.001$ ; Table II; Figure 1). There was no statistically significant difference in weight change of the scalers between the ceramic stone and control groups.

**Figure 1.** Scaler Cross-sections



**Table II.** Weight Difference After 400 Sharpening Strokes\*

Sharpening Stone	n	Weight Change in mg (mean $\pm$ SEM)
Control	10	0.0 $\pm$ 0.03 <sup>a</sup>
Ceramic	10	0.7 $\pm$ 0.06 <sup>a</sup>
Diamond-plated	10	7.6 $\pm$ 0.38 <sup>b</sup>

\*Group means with same superscript letters are not significantly different at the  $\alpha = 0.05$  level of confidence. Group means with different superscript letters are significantly different at the  $p < 0.001$  confidence level. Results from ANOVA/Tukey.

## Discussion

It was hypothesized that the diamond-plated stone would produce a sharp cutting edge using fewer sharpening strokes when compared to the ceramic stone; however, this study showed both stones produced a sharp cutting edge using a similar number of strokes. This study also evaluated the amount of metal lost following 400 strokes per instrument end for each stone. It was hypothesized that the diamond-plated stone would remove more of the instrument material. The control group did not receive any strokes, but was weighed before and after to evaluate variation in the measurement technique. The minimal weight change in the control group demonstrated that the weighing technique was reliable. When comparing the three groups, it was found that there was no statistically significant difference in weight change between the ceramic stone and the control, suggesting that the ceramic stone does not remove a significant amount of material during sharpening. However, the diamond-plated stone removed nearly 7 mg more metal than the ceramic stone. This finding confirms the hypothesis that when using a diamond-plated stone, more material is lost after multiple sharpening sessions compared to the ceramic stone.

Previous studies have evaluated sharpening with synthetic versus natural stones<sup>3-4,6-7,9-10</sup> as well as various grits.<sup>6,9</sup> In the literature, a fine grit stone produced a sharper cutting edge with fewer wire edges, which provided support for selecting a fine grit stone for each group in this study.<sup>9</sup> Also, as supported by the literature, a sharpening guide, which standardized the angle for sharpening, was used in this study.<sup>5</sup>

While irregularities and the presence of a dull, beveled cutting edge can be examined under SEM magnification, the use of a hard, acrylic test stick is the optimal method for evaluating cutting edge sharpness in a traditional clinical setting. The majority of the historical sharpening research has been conducted with SEM technology, yet the acrylic test stick has been shown to have comparable results according to a 1989 study by Hoffman, et al.

Testing for sharpness is not a quantifiable measure and this study approached evaluation from the approach of applications to clinical practice and relevance. While this is a limitation due to operator variability and subjectivity in measuring sharpness, operator variance would exist with SEM as a means of measurement as well. Future research should utilize both methods for further comparison. Another limitation of the study was the inability to ensure all instruments were equally dulled at the start of the study. Strokes were taken in increments of 50 and performed without the use of a calibrated machine to maintain consistency in angulation, adaptation, and pressure. However, the same experienced clinician (HH) determined the

initial dullness for each cutting edge used. Intra-rater reliability was also established by practicing the study protocol prior to actual data collection.

It is in the clinician's best interest to select a stone that provides both time efficiency and preservation of material. The ceramic stone is shown to offer both of these advantages, suggesting that the ceramic stone may be a better choice compared to the diamond-plated stone. Scaling instruments have reduced longevity when more metal is removed. Using the calculated means, it is estimated that a clinician would be able to utilize a scaler sharpened with a ceramic stone approximately ten times longer than one sharpened with a diamond-plated stone.

## Conclusions

This study established a protocol for determining metal loss during sharpening. Previous studies have not utilized weight loss as a means of determining removal of material. This protocol can now be used in future studies to examine different types of scalers and curettes of various materials as well as different types of sharpening stones.

Based on the results of this study, the ceramic stone is preferable to the diamond-plated stone because significantly less metal is removed and sharpening efficiency is comparable. This study suggests that the use of a ceramic stone as compared to the diamond-plated stone, would result in greater scaler longevity because significantly less metal is removed in the sharpening process.

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# DENTSPLY SIRONA/ADHA GRADUATE STUDENT CLINICIAN RESEARCH ABSTRACTS

The following abstracts are from the participants of the 2017 Annual Dentsply Sirona/ADHA Graduate Student Clinician's Research Program. The purpose of the program, generously supported by Dentsply Sirona since 2007, is to promote dental hygiene research at the graduate level. Dental hygiene post-graduate programs may nominate one student to participate in the program and present their research at ADHA's annual conference.

\*Indicates poster presenter

## Theory Based Development and Beta Testing of a Smartphone Prototype App Developed as an Oral Health Promotion Tool to Influence Early Childhood Caries

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**Purpose:** The aim of this study was to develop and test a smartphone prototype app, ToothSense as an oral health promotion tool for the prevention of Early Childhood Caries (ECC).

**Methods:** The app development process used quantitative and qualitative design included the following steps: Phase 1 application design and development based on the Theory of Planned Behavior to document the design of applications features accounting for Doshi's Intervention Strategies for the TPB; Phase 2 beta-testing of the application using quantitative and qualitative measures utilizing an online software UserTesting® to host beta testing with a series of tasks and prompts followed by a 5-point Likert-scale questionnaire that quantitatively measured perceptions of ToothSense's interaction design based on Jakob Nielsen's principles and behavioral strategies. A Net Promotor Score was calculated to determine likelihood to recommend ToothSense. Using a template approach, audio and video were qualitatively measured.

**Results:** Beta testers agreed the app met the majority of the five usability statements. The Net Promotor score indicated a likelihood to recommend ToothSense. The thematic analysis revealed the following themes: Interface Design, Navigation, Terminology, Information, and Oral Health Promotion.

**Conclusion:** This research provided health promotion project design information and highlighted the importance of health promotion application usability.

## Relationships of Somali Mother-Child Caries Experience

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**Purpose:** Dental caries experience among immigrants upon migration is often lower than that of a comparative United States-born population (US); this advantage is quickly reversed with US residency. Growing evidence indicates maternal oral health is a predictor of child caries. This has not been confirmed among immigrant populations. This study was designed to explore the correlation between caries experience of Somali immigrant mothers and their children. The study further investigated the association of oral health perceptions and caries experience of Somali mothers.

**Methods:** A community-engaged approach was used enroll 75 mother-child dyads at 9 urban day care centers. Clinical data was collected utilizing decayed, missing and filled surfaces for the mother-child dyads. A survey compiled from previously validated instruments designed specifically for this study was completed by each mother. Descriptive statistics, Spearman's correlation and linear regression modeling were used to analyze the data.

**Results:** The mean age of mothers and children was 33.8 and 8.2 years, respectively. Mothers had lived in the US an average of 9.6 years. Almost all mothers and children were insured, and 68.6% of children reported having had a dental visit within the past year. No correlation was found between Somali mother-child caries experience. There was a statistically significant positive association between mother oral health perception and caries experience.

**Conclusions:** The oral health of a Somali child is not similar to their mother's. Somali mothers' self-perception of oral health reflects their own caries experience. Practical applications include designing an intervention using a community-engaged process to prevent caries in children's primary teeth.

## A Study of Visible Tattoos in Entry –Level Dental Hygiene Education Programs

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## Developing an observational method for assessing dental hygienists' injury risk

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**Purpose:** The purpose of this study was to survey entry-level dental hygiene program directors in the United States (US) to assess their perceptions of dental hygienists with visible tattoos as well as to determine current policies related to dress codes in US dental hygiene programs.

**Methods:** Data was collected with an online survey emailed to 340 dental hygiene program directors from March to April 2016, yielding a 43% (n=141) response rate. Participants indicated their opinions of visible tattoos on the basis of professionalism and school policy requirements.

**Results:** Eighty percent of respondents reported their program had dress code policies on visible tattoos, with the majority (97%) requiring visible tattoos to be covered.

Results revealed that both students (M=5.57,  $p<.0005$ ) and faculty (M=5.76,  $p<.0005$ ) with visible tattoos were perceived as being significantly less professional. Most participants agreed that faculty should discuss the impact of visible tattoos on future employment opportunities, and that the surrounding community would view the school as less professional if students had visible tattoos ( $p<0.0005$ ). Tolerance toward tattoos in general ( $p<0.001$ ), but not age, ( $p=0.50$ ), was significantly associated with satisfaction concerning the dental hygiene program's tattoo policies. A lower tolerance towards visible tattoos ( $p<0.001$ ) was associated with an increased likelihood that there was a program dress code policy on visible tattoos.

**Conclusion:** Results showed that visible tattoos were not perceived favorably in general, and that the dental hygiene program director's personal perceptions may have influenced existing school dress code policies. These findings provide evidenced based information for hygienists, students, faculty, administrators and hiring managers as they formulate institution policies relating to body art.

**Problem:** Dental hygienists have a high prevalence of work-related musculoskeletal disorders (WMSDs) due to repetitive motions and sustained postures. No standardized method exists for evaluating risk factors in the clinic. The purpose of this study was to evaluate risk for WMSDs in dental hygienists using video observations.

**Methods:** Videos of five volunteer student dental hygienists were obtained during patient care for this IRB approved study. Two stationary cameras captured a wide-angle view of body positions and a close-up view of the hand and wrist during scaling. Videos were coded by activity, time spent in each clock-position (CP) and area of the mouth (AOM). Sustained postures (i.e., >45-sec in one CP/AOM) were evaluated using the rapid upper limb assessment (RULA).

**Results:** Average appointment time was 178 minutes (2.9 hours). Instrumentation took 57% of appointment, 82% of which was spent performing hand scaling. Students worked most frequently in the 9-CP (40% of the time), with equal time in each AOM. Sustained postures were noted in 71 video segments. Overall RULA scores were distributed around modes of 4 and 6, and the most frequent poor postures were wrist flexion and neck flexion. 18% of video segments were unable to be assessed due to a blocked view.

**Conclusions:** RULA scores of 4-6 indicate moderate risk for these students. The observational method was found to be feasible; however, adding a third view may improve analysis of sustained postures. Additionally, assessing hand strain during scaling may assist in evaluating risk for WMSDs.

## Faculty Calibration with Instructional Videos for Head and Neck Examinations

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**Purpose:** Calibrating faculty for clinical teaching is essential to providing a high-quality education for students in dental hygiene education. However, academicians have struggled to determine effective methods to increase faculty consistency in teaching. The primary objective of this pilot study was to evaluate the effect of an online head, neck, and oral-cancer examination instructional technique video for dental hygiene faculty knowledge. Additional objectives were to assess if years of teaching and/or clinical experience or type of faculty position affected test performance.

**Methods:** Using a repeated measures design after receiving IRB exemption, the primary investigator invited 24 dental hygiene (DH) clinical faculty to participate by completing an online pre-test, viewing an instructional technique video and immediate post-test, and four-month follow up retention test. Statistical analysis was completed with SPSS using Spearman Correlation Coefficient and t-tests.

**Results:** Pre-test response rate was 79% (N=19) with 95% (N=18) completing all four components of the study. Results demonstrated mean pre-test scores of 68%, post-test score of 76%, and retention test score of 80%. Mean scores increased 15.7% from pre-test to post-test, decreasing 2.8% from post-test to retention test. There was no significance between years of clinical experience with either test score or faculty grouping. There was significance between years of teaching experience and lower pre-test scores.

**Conclusions:** The use of an instructional technique video increased the knowledge level of DH clinical faculty for head, neck and oral-cancer examinations. Future research should investigate methods measuring if student performance of the examination is calibrated in other settings with larger numbers of faculty.

## General Dentists' Perceptions of Dental Hygienists' Professional Role: A Survey

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**Purpose:** Changes in dental hygienists' scope of practice in the United States (US) are not independent of general dentists' attitudes and behavior related to professional roles of dental hygienists. The purpose of this study was to assess general dentists' perceptions of what dental hygienists can legally perform in their state vs. what is performed in their practice; the level of importance of dental hygienists' contributions to their individual practice; and how well dental hygienists interacted with dentists and patients. Additionally, the relationships between dentists' attitudes, and dental hygienist/employee actual behavior, dentists' age and number of hygienists and assistants were also explored.

**Methods:** Survey data were collected from 292 general dentists in Michigan concerning their attitudes and behavior related to dental hygienists' scope of practice and contributions to their dental practices.

**Results:** The average numbers of services hygienists provided in their professional practice were lower than the average number of services they were legally permitted to provide in the state of Michigan. The more importance dentists placed on their dental hygienists' clinical contributions, contributions to their practice and their patient management skills, the more diagnostic services and therapies their dental hygienists performed. The older dentists were, the more important they rated their dental hygienists' clinical contributions and their hygienists' importance for patient care, and the more diagnostic and other procedures their hygienists performed.

**Conclusions:** While dentists did not utilize their dental hygienists optimally, they had a very high appreciation of their hygienists' contributions to their practice. There was a positive correlation between the perceived value of hygienists' contributions and the number of diagnostic and other services with which they entrusted their hygienists.

## Oral Manifestations of Menopause: An Inter-professional Intervention for Dental Hygiene and Physician Assistant Students

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## Perceptions of Dental and Dental Hygiene Students Regarding Intraprofessional Education

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**Purpose:** Interprofessional education (IPE) is a means of fostering integration and collaboration between health care professions. This study evaluated the effect of an IPE educational module on the oral manifestations of menopause.

**Methods:** This mixed-method study used a convenience sample of dental hygiene (DH) and physician assistants (PA) students. Pre- and post- tests collected quantitative data using a modified Readiness for Interprofessional Learning Survey (RIPLS), and a principle investigator (PI)-designed knowledge of menopause test to determine students' attitudes and learning. Students participated in a one-time workshop that included an educational presentation and a case study exercise using a pseudo-standardized patient. Students worked in preselected groups, representing both disciplines, to create a patient care plan addressing oral manifestations of menopause. Qualitative data was collected from student comments.

**Results:** Study results indicate an increase in participants' knowledge of oral manifestations of menopause ( $p < 0.05$ ). Additionally, results suggest improved attitudes toward interprofessional teamwork and collaboration ( $p < 0.05$ ), positive professional identity ( $p < 0.05$ ), roles and responsibilities ( $p < 0.05$  for IPEC core competencies RR1, RR2, RR3, RR4), interprofessional communication ( $p < 0.05$  for IPEC core competencies CC3, CC4, CC). Qualitative data from IP care plan formulation and debriefing demonstrated facilitation of gained confidence in applying new skills related to oral manifestations of menopause.

**Conclusion:** Implementation of an IPE intervention demonstrated correlation between an IPE experience and participants' attitudes, learning, and confidence. Patients experiencing menopause are prone to oral manifestations. Therefore, preparing health care students interprofessionally to meet the needs of menopausal women may ultimately decrease oral discomfort and improve the quality of life.

**Purpose:** Dental and dental hygiene students are expected to work together to provide patient care following graduation from their respective education programs. In general, pre-doctoral (DDS) students and dental hygiene (DH) students receive separate education and training which prevents the full understanding and appreciation of each other's roles as part of the dental team. Recent focus has been on evaluating education between the various health care professions but limited attention has addressed intraprofessional education. The purpose of this study was to determine the perceptions of DDS and DH students regarding intraprofessional education.

**Methods:** A 29-question survey was sent via Qualtrics, to 24 institutions that educate both DDS and DH students. The survey was sent to DH program directors and DDS academic deans, who in turn forwarded the survey to their respective students. A total of 151 students ( $n = 151$ ) representing programs from 16 states completed the survey.

**Results:** Results showed 45% of the respondents stated DDS and DH students took didactic courses together and 70.9% stated their clinics are integrated with both disciplines. 97.8% strongly agreed or agreed that learning with other DDS and DH students would help them become more effective members of an oral health care team; 97.7% strongly agreed or agreed patients would ultimately benefit if DDS and DH students worked together to solve problems; 98.5% strongly agreed or agreed that learning together prior to graduation would improve future professional relationships in the workforce; and 94% strongly agreed or agreed they wanted to have time learning together.

**Conclusion:** Overall, DDS and DH students believe they would be able to become better members of the oral health care team if their education and training was integrated together and institutions should look for opportunities where intraprofessional education can be utilized.

## Perceptions of Oral Cancer Screenings Compared to Other Cancer Screenings: A Pilot Study

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## Perceptions of Registered Dental Hygienists in Alternative Practice Regarding the Use of Silver Diamine Fluoride

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**Purpose:** The purpose of this pilot study was to compare public perceptions of Idaho adults regarding oral cancer (OC) screening with other common cancer screenings including breast cancer (BC), prostate cancer (PC), and colon cancer (CC) screenings.

**Methods:** This study utilized a convenience sample (N=100) of Idaho residents. A self-designed, validated interview-administered questionnaire was administered by a data collection service using computer-assisted telephone interview software to assess consumer perceptions about cancer screenings. Data were analyzed using descriptive statistics, frequencies, and Pearson's Chi-Square tests.

**Results:** Participants were predominantly white (90%) with a mean age of 52.7 years and some post-high school education (80%). The majority had received OC screenings (54%), perceived benefits of each cancer screening as very helpful: (a) OC screening (60%), (b) BC screening (79.2% females), (c) PC screening (63.8% males), and (d) CC screening (84%), and reported perceiving no risks regarding OC (80%), BC (60.4%), PC (66%) screening. Only 11% reported fear of finding cancer with OC screening. The findings supported significant associations ( $p < 0.05$ ) between consumer perceptions of cost and time as barriers to all of the selected cancer screenings.

**Conclusion:** This study identified associations between consumer perceptions of OC screening when compared with BC, PC, and CC. Concerns about cost and time for cancer screenings may reflect low consumer awareness regarding differences between OC and other cancer screenings. Future studies including larger samples representing more diverse populations are recommended to further explore the basis of participants' perceptions and to identify ways to minimize barriers to cancer screening.

**Purpose:** Silver diamine fluoride (SDF) is an inexpensive, non-invasive, antimicrobial liquid used to treat carious lesions and decrease sensitivity. The purpose of this study was to assess the perceptions of registered dental hygienists in alternative practice (RDHAP) regarding the use of SDF to treat dental caries.

**Methods:** A 16-item survey to evaluate RDHAP's familiarity and perceptions of SDF was electronically distributed to 222 RDHAPs in the state of California. A survey research software program collected and tabulated responses, calculated response frequencies for each survey item, and determined statistical relationships among variables, using cross tabulation analysis.

**Results:** The response rate was 46%. Over half the respondents were unfamiliar with SDF. After describing SDF's properties and uses, 78% of respondents agreed that applying SDF to treat dental caries would be within the RDHAP scope of practice. Respondents agreed that patients or their parents would be interested in using SDF because it is an alternative to removing tooth structure with a dental drill to place restorative material (82%), less expensive than restorative treatment (82%), applied like a varnish and time efficient (86%), and utilized without local anesthesia (91%). Over half (56%) of the respondents agreed that many patients or parents of patients would object to the permanent black staining of the carious lesion. Respondents' employment/practice settings were related to their agreement that SDF is within the RDHAP scope of practice ( $p < 0.01$ ) and their disagreement that patients would not accept SDF treatment due to the black staining ( $p = 0.03$ ). According to 88% of respondents, the advantages of SDF outweigh the disadvantages for their patient populations.

**Conclusion:** SDF would be a useful caries therapeutic agent in RDHAP practices of the underserved populations.

## **The Use of Technology in Academic Dishonesty with Dental Hygiene Programs**

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**Purpose:** Cheating behaviors have been common in academia for decades. With the evolution of technology, information is more readily available than ever. The purpose of this study was to investigate the self-reported habits of dental hygiene students regarding the use of technology and academic dishonesty at seven accredited dental hygiene programs in the state of Missouri.

**Methods:** A total of 274 dental hygiene students were contacted to take an online survey. Thirty-nine students responded to complete the survey (n=39) for a response rate of 14%. An original survey instrument developed by Muhney, et al (2008) was utilized along with the additions of questions relating to technology. The instrument contained 31 questions that included open-ended, yes/no, and Likert scale type questions. This IRB approved study included a confidential survey obtained through REDcap. Data were analyzed using SPSS with frequencies and chi-square tests.

**Results:** Findings revealed that 37.9% of the respondents had participated in some form of cheating behavior during the time spent in their dental hygiene program. Of the total respondents, 51.3% felt that technology increases the likelihood that others have or will cheat. Of the 62.1% of students reporting that they had never cheated, 33% reported allowing other students to copy their work; 16.6% reported copying an assignment from another student and another 16.6% reported that they had falsely recorded vital signs.

**Conclusion:** Dental hygiene students have used technology to engage in academic dishonesty and many feel that technology is a catalyst to cheating behaviors. While the dental hygiene students surveyed, indicated that cheating is unfair, many expressed uncertainty as to what constitutes cheating.