



American  
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Association

# Journal of Dental Hygiene

December 2020 • Volume 94 • Number 6

- Honoring Rebecca Wilder, RDH MS
- Dental Hygienists' Knowledge Regarding Dental Implant Maintenance Care: A national survey
- Utilization of Periodontal Risk Assessment Tools in the Clinical Setting: Knowledge, attitudes and practice behaviors of dental hygienists
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## Statement of Purpose

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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### Honoring Rebecca Wilder, RDH, MS



Jennifer L. Brame, EdS, MS, RDH

The *Journal of Dental Hygiene* (*JDH*) is the premier scholarly, peer reviewed, research publication for dental hygiene and plays a key role in advancing the profession. During her fourteen-year tenure as the *JDH* Editor in Chief, Professor Rebecca Wilder has transformed the dissemination of dental hygiene



research and significantly influenced the integrity of dental hygiene in the literature. With the guiding principle of promoting high-impact, evidence-based research, she crafted a platform for dental hygienists to share knowledge and define how we practice, educate, advocate, and grow the dental hygiene discipline. This year marks the conclusion of Rebecca's tenure in this role, as the American Dental Hygienists' Association (ADHA), like so many other professional organizations, has been forced to make significant changes as a result of the financial impact of the COVID-19 pandemic. As we pivot to be nimble in light of these changes, it is important to take a moment to express gratitude for the many contributions Rebecca Wilder has made to the dental hygiene profession in her role as the *JDH* Editor-in-Chief from 2006-2020.

Rebecca's first publication in the *JDH* was in 1982 as a junior author of, "A Comparison of Amalgam Finishing Techniques: A Scanning Electron Microscopic Study." From that starting point, her research contributions have explored a wide range of topics from educational best practices to major research studies on periodontal disease and pregnancy. She has been a prolific researcher and author throughout her

career and continues to support the development of high-impact studies that translate into improved patient outcomes. Through her role as *JDH* Editor-in-Chief, she has been a guardian of truth, quality, and collaboration; influencing the value of information to enhance educational success and improve patient care.

I have had the honor of learning from Rebecca as an undergraduate and graduate dental hygiene student and later on in my career as a junior faculty member. When I entered academia, our professional relationship blossomed effortlessly, and she took me under her wings. It is an honor to call her my colleague, mentor, and friend. Throughout my educational and professional advancements, she has remained a true mentor, always dedicated to helping others reach their potential.

Many in the dental hygiene community know Rebecca Wilder as a brilliant speaker, periodontal expert, leader in education, and *JDH* Editor-in-Chief. However, what many people may not have experienced is her kind and gentle manner, her fierce loyalty, and selfless nature. Her poise and timeless spirit are driven by her desire to always do more and do better. She believes in people and the potential of others. It is rare to have the gift of someone like Rebecca as a both a colleague and a friend. Yet, in her role as Editor-in-Chief, we have all benefitted from her mentorship, this extension of her passion and loyalty. Her role as Editor-in-Chief, afforded her the platform to support the dissemination of high-impact research and timeless manuscripts in support of the profession. We have all experienced her mentoring, the sharing of her knowledge, and her drive to always do better.

Rebecca has dedicated her career to advancing the profession in her role as an educator. At the University of North Carolina at Chapel Hill, Adams School of Dentistry, she has conducted significant research, and made educational, and professional contributions on the national and international level. She is a transformational leader, dedicating efforts to empowering others. She developed the school's faculty mentorship program and subsequently was selected as the first assistant dean for professional development and faculty affairs. She has been passionately loyal to the dental hygiene profession and has carved a pathway for current and future dental hygiene leaders.

Rebecca believes in people; she believes in the benefit of education and the importance of professional integrity. Her character has earned great respect in academic and dental environments. Her collaborative nature and expert communication skills have navigated through challenging environments, yet she always remains unwavering, representing those whom she believes in with great passion, integrity, and dependability. She is a positive representation of our profession and always inspiring us to be the best version of ourselves.

I would like to express my personal gratitude for the many years of dedication that Rebecca has given to the *JDH*. Our profession has been strengthened by her efforts and we have all benefited from her leadership and commitment to scholarship. I hope that you, too, feel her passion and drive, and can recognize the ways her mentoring has reached you. I challenge each of us to be transformational leaders in the dental hygiene profession.

In 2015, Rebecca wrote an editorial titled, "Living to Serve." She detailed a tragic event that forever changed lives, yet also sparked the light of service. She said,

*"You don't have to possess a special talent to make a huge difference in the lives of other human beings. Can you spend a few hours each year or each month to help in your community? What will you do to make a difference?"*

This is the epitome of Rebecca and her compassion for others. In these inspiring words and through her actions, she is mentoring each of us, as modeled through her dedication and passion to serve as an editor, leader in education, and trailblazer in the dental hygiene profession.

Thank you, Rebecca!

***Jennifer L. Brame, EdS, MS, RDH*** is a professor, and the Director of the Dental Hygiene and Graduate Dental Hygiene Education Programs and the Director of Interprofessional Education and Practice in the Division of Comprehensive Oral Health, Adams School of Dentistry, University of North Carolina, Chapel Hill, NC, USA

# Dental Hygienists' Knowledge Regarding Dental Implant Maintenance Care: A national survey

Ivy H. Zellmer, RDH, MS; Elizabeth T. Couch, RDH, MS; Lisa Berens, DDS, MPH; Donald A. Curtis, DMD

### Abstract

**Purpose:** Dental implants are now considered the standard of care for supporting dental restorations in edentulous areas. The purpose of this study was to explore the attitudes and practices of dental hygienists in the United States regarding dental implant assessment and maintenance care.

**Methods:** A 34-item quantitative survey was developed and distributed nationally to a randomly selected sample of 10,000 dental hygienists from the American Dental Hygienists' Association (ADHA) email database. Responses were collected and analyzed via an online software program using frequency distributions for categorical variables.

**Results:** A total of 2,018 dental hygienists participated for a response rate of 21%. The majority of respondents (98%) provided care to patients with dental implants. While the majority of respondents reported routinely assessing patients for bleeding/exudate, mobility, plaque/calculus, and tissue color around implants, 34% rarely/never checked for cement around implants, 31% rarely/never probed, and 54% rarely/never checked the occlusion. Nearly half of the respondents (44%) reported that they were unable to remove plaque as effectively from dental implants as from natural teeth. A majority (60%) reported using plastic/resin scalers, however only 7% of those who use plastic/resin scalers felt they were effective. While only 5% reported using air-polishers, 71% of the users felt they were effective. An oral irrigator was the most commonly recommended self-care hygiene aid for patients with implants and continuing education courses were the primary source of implant-related knowledge among respondents.

**Conclusion:** The wide variation in implant-related assessment and maintenance care practices among dental hygiene respondents indicates a need for greater emphasis on evidence-based practices in dental hygiene curricula and in continuing education to ensure optimal care for patients with dental implants.

**Keywords:** dental hygienists, dental implants, implant assessments, implant maintenance, dental hygiene education, continuing education

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### Introduction

Dental implants were once considered uncommon in the United States (U.S.), however, are now considered customary and the standard of care for supporting dental restorations in edentulous areas. While the field of implant dentistry has demonstrated progress and increasing acceptance in recent decades, complications such as inflammatory peri-implant disease, which can lead to failures, may occur.<sup>1-9</sup> The prevalence of peri-implant diseases is controversial since the definition for peri-implantitis has changed numerous times in the past 10 years.<sup>10-15</sup> Nonetheless, peri-implant disease is a frequently discussed topic of concern among clinicians and

researchers.<sup>10-15</sup> The prevalence of peri-implant inflammatory disease has been reported at 43% to 63.4% for mucositis and 18.8 to 22% for peri-implantitis.<sup>4-6</sup> The variability in disease estimates may be influenced by an inconsistent criteria for diagnosing peri-implant disease, patient risk factors, and maintenance history.<sup>12,15</sup>

Even by conservative estimates, peri-implant disease is a current and future challenge for both the patient and oral health care professional.<sup>10,11,13,14</sup> Existing evidence suggests clinicians will be required to help manage more patients with peri-implant disease, requiring more in-office maintenance related interventions.<sup>7,14,16</sup> How dental professionals approach

maintenance of dental implants becomes relevant to the long-term stability of tissues supporting dental implants.<sup>16-18</sup>

Peri-implant disease (based on clinical signs of inflammatory disease, such as bleeding on probing and/or suppuration and radiographic bone loss) is established and enhanced by several risk factors/indicators, including periodontal disease, diabetes, smoking, bruxism, residual cement, irregular oral hygiene maintenance programs, and poor plaque control skills (e.g. high plaque levels and microbial dysbiosis).<sup>1,7-9,13,14,17,19-24</sup> Ferreira et al. conducted a longitudinal study of 212 patients followed for 10 years and discovered that those with high plaque levels were 14 times more likely to develop peri-implantitis.<sup>25</sup>

In addition to proper lifelong self-care, patients with implant-borne restorations require professional maintenance to safeguard their investment.<sup>16-20,26-30</sup> According to the American Academy of Periodontology, many of the risk factors for peri-implant disease can be reduced through routine evaluations, early identification and intervention, and adherence to a structured maintenance program.<sup>1,31</sup> In a five-year longitudinal study of over 200 subjects, Costa et al. reported that 44% of participants developed peri-implantitis if not in a maintenance program, while only 18% developed peri-implantitis if they adhered to a maintenance program.<sup>20</sup> Professional implant maintenance programs include assessments such as bleeding upon probing (BOP) and suppuration, which are just two of the important clinical findings in detecting and monitoring peri-implant diseases.<sup>8,9,17,22,26,32</sup> Routine gentle probing, at least once per year, has been identified to be part of the comprehensive oral exam for patients with dental implants.<sup>32</sup> In addition, debridement around the implants includes devices and instruments compatible with implant surfaces.<sup>17,18,26</sup> If scaling is necessary, caution should be used with metal instruments, as they may scratch the titanium implant surfaces.<sup>33-36</sup> A 2012 systematic review evaluated the effects of different instruments on titanium implant surfaces and identified that non-metal instruments, rubber cup and air abrasives caused the least surface alteration to smooth and rough implant surfaces and maintained the implant surface integrity.<sup>33</sup>

Dental hygienists' implant assessment techniques, choice of instrumentation, recall protocols, and self-care recommendations are fundamental in the maintenance and prevention of peri-implant tissue diseases. There are approximately 185,000 licensed dental hygienists in the United States.<sup>37</sup> Presently, dental implant maintenance is not a competency standard from the Committee on Dental Accreditation (CODA), the body that develops and implements education standards for dental hygiene

programs.<sup>38</sup> Although implant curriculum guidelines for dental hygiene programs were developed and released in 1995 by a scientific panel of experts from the International Congress of Oral Implantologists (ICOI), it remains unknown how widely the suggested guidelines have been adopted and implemented in dental hygiene programs and clinical practice.<sup>39</sup> Other implant maintenance care guidelines exist, however if those are widely recognized or utilized is largely unknown.<sup>17,18,26,28,40</sup> Research suggests that dental hygienists may not be adequately prepared to care for patients with dental implants during routine maintenance care appointments.<sup>41</sup> Ward et al. surveyed 213 dental hygienists in the Southeast region of the U.S. and discovered only 12% had received didactic and clinical training on implant care during their dental hygiene education.<sup>41</sup>

Limited information is available on the implant care practices of dental hygienists in the U.S. Given the global concern regarding inflammatory peri-implant disease and the emphasis on patient and provider implant care, the purpose of this study was to explore U.S. dental hygienists' attitudes and practices regarding dental implant assessment and maintenance care, and their sources of implant-related knowledge.

## Methods

This cross-sectional, quantitative, web-based study was approved by the University of California, San Francisco (UCSF) Institutional Review Board (IRB). After a review of survey methodology<sup>42,43</sup> and review of publications on implant assessment and maintenance,<sup>11,16-21,26,28,31,32</sup> a survey instrument was developed by study investigators. The survey was partially based on the framework designed by Ward et al., which was used by permission.<sup>41</sup>

The 34-item survey included topics regarding demographic characteristics, implant assessment practices and attitudes towards maintenance practices. Demographic and practice items included: current clinical dental hygiene status, year of graduation from an entry-level program, degree earned, practice description, years of clinical practice, average hours of patient care per week, percentage of patients with dental implants, and U.S. state of practice. Implant assessment and maintenance practice items included: methods and frequency of implant assessments, commonly used instruments for implant debridement and their relative efficacy, commonly recommended oral hygiene aids, and recall frequency for hypothetical patients with and without risk factors for peri-implant disease. Attitudinal items assessed respondent's perceived ability to remove plaque around implants as compared to natural teeth. One item asked about sources of implant-related knowledge.

Prior to finalizing the survey items, the survey was reviewed by two UCSF subject-matter experts to assess content validity and acceptability. The survey instrument was revised based on the feedback. In addition, the survey was pilot-tested with a convenience sample of 16 participants (eight UCSF Master of Science in Dental Hygiene students and eight UCSF School of Dentistry faculty members) for clarity and feasibility. Modifications to the survey were made based on the comments and results. A second pilot test was conducted with a convenience sample of 10 practicing clinical dental hygienists to assess clarity, feasibility, and accessibility of the items. The final survey was revised based on the feedback from both pilot tests.

### Sample recruitment and data collection

The study population included dental hygienists who were members of the American Dental Hygienists' Association (ADHA). The ADHA Research Department randomly selected 10,000 participants by computer randomization from a database of approximately 35,000 member dental hygienists. The ADHA emailed a link to the web-based survey instrument (Qualtrics; Provo, UT). The survey included a welcome page explaining the study purpose and information to obtain informed consent. Following the initial survey distribution, two follow-up emails were sent approximately one week apart to encourage participation. Data was collected in February and March of 2017.

### Data analysis

Data was gathered and evaluated using Qualtrics software. All responses were reported as frequency distributions. A 5-point Likert ordinal scale, ranging from "not effective at all" to "extremely effective," was used for many questions. Categories of "extremely effective" and "very effective" and the categories of "not effective" and "not effective at all" were dichotomized for analysis purposes to "not effective" and "effective." A 4-point Likert ordinal scale was also selected for some questions and ranged from "never" to "always". Categories of "never" and "rarely" were combined to "never/rarely."

## Results

Of the 10,000 email surveys distributed, 270 emails bounced back, leaving a total of 9,730 in the sample that received a link to the questionnaire. A total of 2,033 dental hygienists opened the survey, however 15 were left blank, leaving 2,018 respondents (n=2,018) for a participation rate of 21%. Due to missing data and rounded values, not all numbers and percentages totaled 2,018 and 100%.

### Demographic and practice characteristics

Most respondents (85%, n=1,708) reported they were currently practicing clinical dental hygiene, 98% of these respondents (n=1,668) reported they provided dental hygiene services to patients with dental implants. Of those practicing clinically, a majority (82%, n=1,213) estimated that between 10-30% of their patients have one or more implants. Over half of respondents (67%) reported working

in a general dental practice setting. There was a balanced representation of respondents from all four geographical regions of the U.S. and similar representation from year of graduation groups (Table I).

### Assessment/evaluation methods

When queried about plaque removal, many respondents (44%) reported difficulty removing plaque around implants compared to natural teeth.

**Table I. Demographic characteristics of study population**

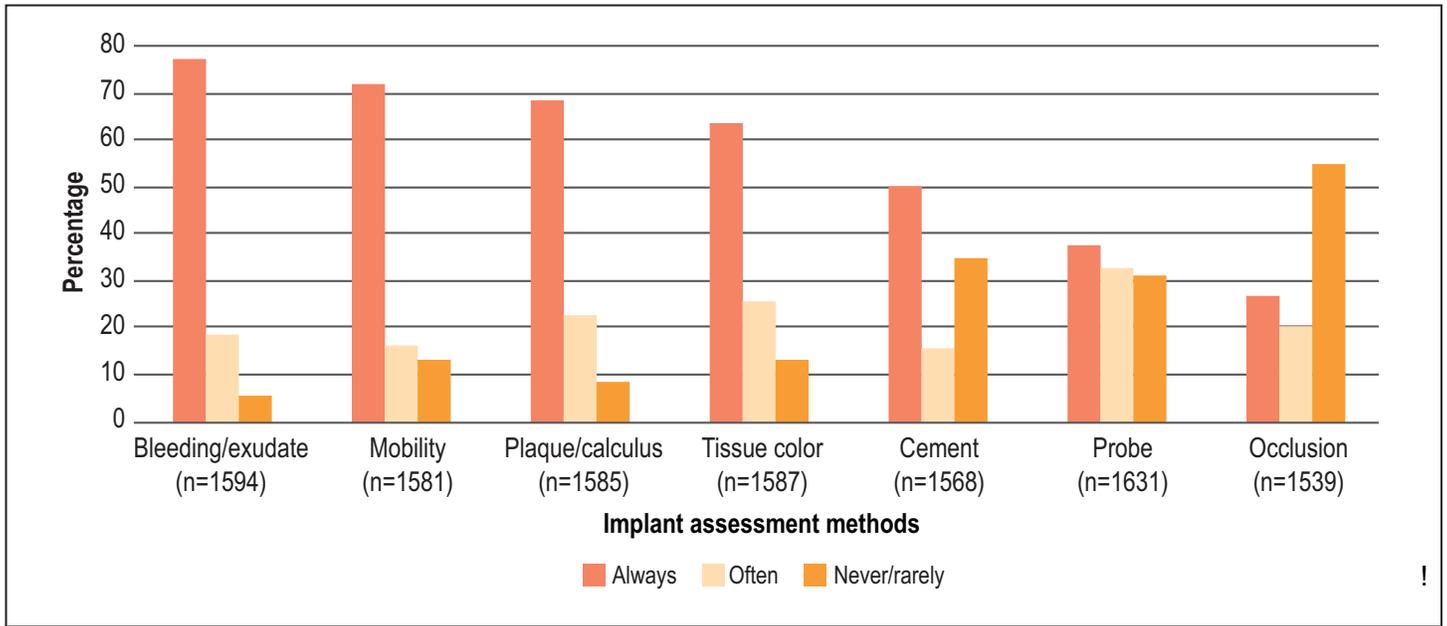
Characteristic	n (%)*
<b>Year of graduation (n=1894)</b>	
1958-1977	260 (14)
1978-1987	442 (23)
1988-1997	329 (17)
1998-2007	390 (21)
2008-2017	473 (25)
<b>Entry level degree earned (n=1915)</b>	
Certificate	99 (5)
Associate	1213 (63)
Bachelor	603 (32)
<b>Primary place of employment (n=1914)**</b>	
General dentistry	1276 (67)
Educational institution	376 (20)
Periodontics/Prosthodontics	245 (13)
Other (e.g. Pediatric, Oral industry)	203 (11)
Community clinic/Public health	166 (9)
<b>Hours patient/client care per week (n=1916)</b>	
1-16 hours	405 (21)
17-32	714 (37)
33+	584 (31)
Not applicable to respondent	213 (11)
<b>U.S. region of practice (n=1901)***</b>	
Midwest	456 (24)
Northeast	437 (23)
South	514 (27)
West	494 (26)

\* Due to rounding and missing data, not all numbers and percentages equal 2,018 and 100%.

\*\*Respondent allowed to select more than one item.

\*\*\*Data was merged into four regions according to U.S. Census Bureau guidelines

**Figure 1. Frequency of assessment methods during routine dental implant maintenance appointments (n=1668)**



When queried about the presence of bleeding and exudate, the majority of respondents (77%) reported that they always assess the gingiva and record bleeding and exudate. When queried about residual cement and probing, 34% reported never/rarely checking for residual cement, 31% never/rarely probed around implants, and 52% never/rarely checked for occlusion (Figure 1).

**Instrumentation and perceived effectiveness**

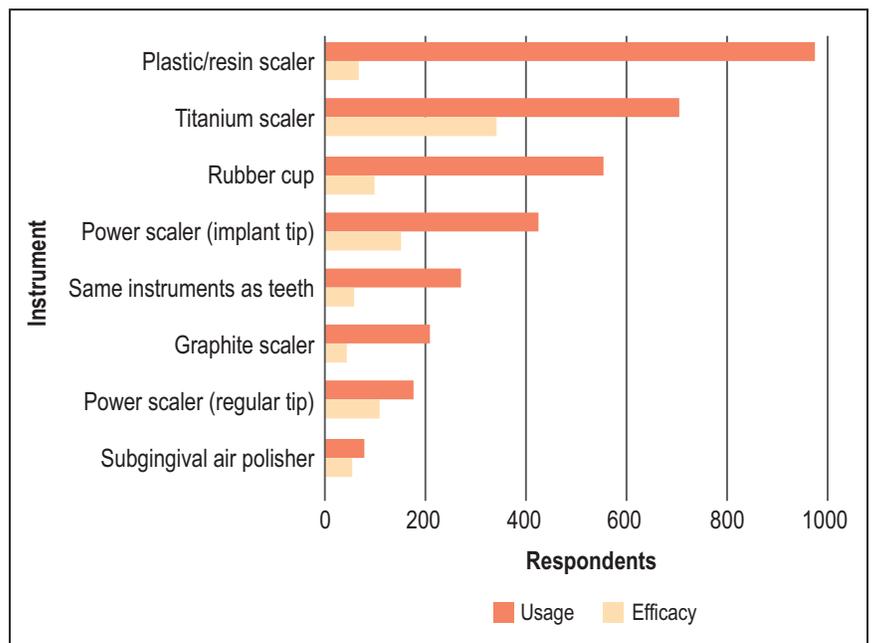
Plastic/resin scalers were the most commonly reported instrument used for debridement during routine implant care, selected by 60% of respondents. However, of those respondents, only 7% felt plastic/resin scalers were effective in implant debridement. Less than 5% of respondents reported using an air-polisher device for implant debridement; however, a majority (71%) of those who used air-polishers felt they were effective. Sixteen percent of respondents reported using the same instruments around implants as natural teeth (Figure 2). Five percent of respondents (n=70) indicated that they did not use any type of scaling instrument to debride around dental implants.

**Maintenance recall**

Items regarding recall frequency were asked using hypothetical patients with and without

risk factors for peri-implant disease. For the patient with no risk factors for peri-implant disease, 58% of respondents (n=929) reported a six-month maintenance recall frequency in their practice, while 24% (n=392) indicated that recall frequency should be based on the individual patient needs. For the patient with risk factors of peri-implantitis (e.g. smoking, diabetes, history of periodontitis), 58% of respondents (n=937) reported that the best maintenance recall frequency is every three months, while 21% (n=334)

**Figure 2. Commonly used instruments for implant debridement from a 5-point Likert scale ranging from “not effective at all” to “extremely effective” (n=1646)**



indicated that maintenance recall frequency should be based on individual need.

### **Recommended self-care aids for implants**

When respondents were asked what type of oral hygiene aids they primarily recommend to patients for self-care for dental implants, responses included: oral irrigators (75%, n=1,208); floss products including monofilament or waxed (65%, n=1,044); tufted floss (59%,n=943); interdental/proxy brushes (55%, n=890); dental picks with synthetic rubber or silicone bristles (52%, n=837); specialty brushes such as a sulca-brush or end-tuft (41%, n=661); rubber tips (35%, n=557); wooden picks (12%, n=193); and air-floss devices (11%, n=174).

### **Sources of implant-related knowledge**

The majority of respondents reported that their primary source of implant-related knowledge was continuing education courses, followed by professional interest magazines, and their employer/dentist (Table II).

**Table II. Sources of implant-related knowledge (n=2018)**

Sources of knowledge	n (%)
Continuing education courses	1708 (91)
Magazine	1412 (83)
Employer/dentist	1125 (70)
Dental hygiene school	1126 (66)
Dental hygiene colleague	1014 (65)
Database (e.g. PubMed, journals)	883 (59)
Textbook	875 (58)
Sales representative	423 (30)
Social media	216 (16)
Other	98 (22)

## **Discussion**

The aim of this study was to assess U.S. dental hygienists' practices and attitudes regarding implant assessment and maintenance care, as well as their sources of implant-related knowledge. Nearly all respondents currently practicing clinical dental hygiene provide care to patients with dental implants. Most respondents reported that 10-30% of the patients in their practice have one or more dental implants, which confirms the widespread acceptance of implant therapy in the U.S, and establishes the importance of dental hygienists' education and knowledge on this topic.

A majority of respondents routinely assess bleeding/exudate, mobility, plaque/calculus, and tissue color around dental implants. However, fewer respondents routinely check for residual cement, probe around an implant, or check

occlusion. In this study, only 37% reported probing around implants during routine implant maintenance visits. This result differs with a study by Ward et al., in which 76% of respondents reported probing.<sup>41</sup> A possible explanation for the differences in the study findings may have been a result of how the question was asked; Ward et al. asked a dichotomous yes/no question regarding probing around implants while this study assessed frequency of probing, "how often," at routine maintenance care appointments.

The difference in probing practices among dental hygienists may also stem from the controversy that exists among dental professionals, as probing may be thought to damage the peri-implant tissue, seal, and/or implant surface. However, to address that concern, Etter et al. concluded in their 2002 canine study that tissue trauma from clinical probing around implants is reversible, requiring four to five days for the epithelium to heal.<sup>44</sup> Furthermore, Thierbach and Eger concluded that the presence of suppuration around an implant is a significant clinical parameter in determining the outcome of peri-implantitis treatment and reported that implants with suppuration frequently require surgical intervention for improved outcomes.<sup>45</sup> A 10-year follow-up cohort study of 4,591 implants showed that suppuration and profuse bleeding was a meaningful observation in explaining marginal bone loss.<sup>46</sup> Additionally, Salvi et al. suggests that tissue destruction around implants can be faster and more aggressive than around natural teeth,<sup>13</sup> therefore frequent monitoring is advised. Although BOP around dental implants results in a higher rate of false-positive BOP rates than around teeth,<sup>46</sup> diagnosing peri-implant disease and marginal bone loss solely by radiographic interpretation is problematic.<sup>1,47</sup> Gentle probing around dental implants is a recommended clinical evaluation method by both the American Academy of Periodontology and the European Federation of Periodontology.<sup>1,8,9,31,32</sup> Therefore, it is fundamental practice that dental professionals routinely monitor peri-implant soft tissues using a variety of techniques, including gentle probing, to detect early signs of biological complications for early clinical management, similar to natural teeth.

More than half of survey respondents never/rarely checked for residual cement around an implant. Assessment of residual cement is advisable, as residual cement may be associated with biologic complications.<sup>3,24</sup> Given the popularity of cement-retained implant restorations and the high likelihood that a dental hygienist will encounter these restorations,<sup>48</sup> evaluation of excess cement is recommended to reduce the associated inflammatory response and risk for peri-implantitis.<sup>3,24</sup> These results suggest a necessity to further educate and reinforce the need to evaluate for residual cement

during dental hygiene care appointments. In addition, it was found that more than half of the respondents never check implant occlusion, a similar finding to a previous implant survey study.<sup>41</sup> Checking occlusal contacts can be helpful since implants are ankylosed and occlusal contacts can change. Compliance in the use of an occlusal guard, if the guard had been recommended, is advised. Additionally, evaluating the proximal contacts between implants and adjacent natural teeth is important since proximal contacts can open, resulting in food impaction and tissue irritation.<sup>49</sup>

The majority of respondents indicated using plastic/resin scalers for implant debridement. Similar results were reported from a previous survey of hygienists conducted in the U.S.<sup>41</sup> Non-metal instruments have been identified as safe for implant debridement in the literature.<sup>33</sup> Louropoulou et al., conducted a systematic review and evaluated the effects of different instruments on titanium implant surfaces and found that non-metal instruments, in addition to rubber cup and air abrasives, were most effective at maintaining implant surface integrity.<sup>33</sup> This may explain why plastic scalers were reported by dental hygienists as the most commonly used instrument. However, almost all respondents (93%) who reported using plastic/resin scalers also indicated they are not effective instruments for implant debridement. An explanation for their perceived ineffectiveness may be the size of plastic scalers, as the bulky design of non-metal instruments may impose a significant challenge to access the submucosal regions around an implant.<sup>50</sup>

Very few respondents (5%) reported using air polishers for implant debridement, a finding consistent with Ward et al., where one-fifth of the participants reported air polishing use.<sup>41</sup> The majority of the air polisher users (71%) in this study found the device to be very effective. The literature recommends the use of powered instruments such as air polishing devices in combination with low abrasive powders such as glycine or erythritol.<sup>18,33,51,52</sup> While powered instruments should be considered as effective debridement methods for smooth and rough implant surfaces, there may be barriers to their implementation. The authors speculate two practical barriers to air polishing usage include cost, since dental hygienists may not be key decision makers in practice equipment purchases, and lack of access to knowledge and/or training of air polishing technology.

Removal of plaque biofilm and other hard deposits are basic principles to ensure implant longevity. In daily clinical practice, plaque may be the more frequent biological occurrence than calculus in routine implant maintenance. The traditional approach to scaling first, as with natural teeth, may not be the

logical sequence for implant debridement. Air polishing or use of a rubber cup are suggested as preferred methods for biofilm management.<sup>33</sup> If scaling is required, instruments that are effective and safe should be used. Additionally, emerging research shows that scratching as a result of instrumentation causes disruption of the titanium structure and oxide layer, which may lead to future inflammatory complications.<sup>53-55</sup> Results from this study indicate that further studies on dental hygienists' perceived barriers and education related to implant debridement and instrumentation are needed.

Oral irrigation devices, followed by floss and tufted floss were the most common oral hygiene aids recommended to patients with dental implants. In some studies however, floss has shown to be a possible risk factor to supporting implant tissues, as flossing fibers may get trapped on the roughened implant surfaces.<sup>56-57</sup> Despite the importance of effective plaque control for implant health, there is a lack of published research on the effects or benefits of powered oral irrigators, floss, and interdental brushes specifically around implants. Louropoulou et al. completed a systematic review on various self-performed mechanical oral hygiene aids and found that, while powered toothbrushes are beneficial for plaque removal, there is limited evidence demonstrating that powered toothbrushes are superior to manual toothbrushes.<sup>58</sup> In addition, robust studies indicating the benefits of one interproximal cleaning device over another, was also lacking.<sup>58</sup> Bidra et al. published clinical practice guidelines for implant-borne restorations including at-home maintenance specifications, however the strength of these recommendations was low due to the limited evidence available.<sup>18</sup> Given the importance of daily mechanical plaque control on implant longevity, further research is recommended to identify optimal self-care oral hygiene aids for patients with dental implants.

The majority of respondents recommend a six-month recall frequency for individuals with no risk factors for developing peri-implant disease, which is similar to other published recommendations for patients at minimal risk.<sup>16,18,31</sup> Many respondents indicated that a three-month recall frequency was recommended for those with risk factors, which is also consistent with recall frequencies recommended in the literature.<sup>17,31</sup> Evidence-based recall frequency guidelines for patients with implants are not definitive; however, during supportive periodontal therapy, it is recommended that peri-implant tissues should be re-evaluated at each visit and recall frequencies should be tailored to the individual need of the patient.<sup>17,31</sup> Dental hygienists should use a combination of knowledge, clinical judgment, experience, and patient's individual risks when considering recall frequency for patients with dental implants.<sup>59</sup>

Continuing education was the primary source of implant-related knowledge, followed by professional interest magazines, and their employer/dentist. Since one-third of respondents reported that they did not receive or had limited information about dental implants in their educational program, it was not surprising that continuing education was the most common source of implant-related knowledge. With regards to professional interest or industry magazines as the second most frequent source of dental implant knowledge cited, it should be noted that these publications may not be as scholarly or evidence-based as peer-reviewed journals. Results from this study showed a wide-range of practice patterns among dental hygienists. It is recommended that dental hygienists seek courses and publications that emphasize current scientific evidence to guide clinical practice decision making for patients with dental implants. Respondents reported both their employer/dentist and dental hygiene program as sources of implant knowledge. Future studies are needed to investigate implant-related knowledge, attitudes, and practices of U.S. dentists, and assess the dental implant curricula of dental hygiene educational programs in the U.S.

This study had limitations. Although there were over 2,000 respondents, the response rate was 21% from the random sample of 10,000. One explanation could be that ADHA members are inundated with requests to participate in online surveys and therefore fatigued to email survey requests. Results could also be affected by sampling bias, as all respondents are members of the ADHA and may be fundamentally different in their clinical practice behaviors than non-members. The findings could also be affected by response bias, as those who responded may have a greater interest in the topic than non-respondents. In addition, despite rigorous pilot testing, there were limitations to the survey items. The choices of instruments for debridement was not exhaustive. Furthermore, items regarding frequency and methods for taking radiographs was not assessed, which could have provided additional information on hygienists' practices. However, to the best of the authors' knowledge, this was the first study to explore implant care trends of dental hygienists throughout the U.S. and can serve as a resource for future studies of a larger population to validate the reported findings.

## Conclusion

Early detection and prevention of peri-implant diseases are critical for dental implant health and longevity. While a majority of dental hygienists in clinical practice provide care to patients with dental implants, they demonstrate a wide range of assessment and maintenance practices. As the science of implantology advances, dental hygienists need to

have current and comprehensive knowledge of evidence-based recommendations related to implant maintenance. Findings from this study highlight the need for implementing an evidence-based dental implant care curriculum in dental hygiene programs and continuing education settings as a means to increase the consistency and effectiveness of dental implant care and potentially decrease the prevalence of peri-implant diseases.

## Disclosure

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# Utilization of Periodontal Risk Assessment Tools in the Clinical Setting: Knowledge, attitudes and practice behaviors of dental hygienists

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### Abstract

**Purpose:** Identifying individuals at risk for developing periodontal disease helps to prevent, treat, and manage this condition. The purpose of this study was to explore the knowledge, attitudes, and practice behaviors of dental hygienists regarding the use of periodontal risk assessment tools.

**Methods:** This cross-sectional survey study used a convenience sample of dental hygienists recruited through social media and snowball sampling. The validated electronic survey included items related to demographics, knowledge, attitude, and practice behaviors regarding the use of periodontal risk assessment tools in the clinical setting. Descriptive statistics were used to analyze the data and outcomes were represented through frequencies and percentiles.

**Results:** Two-hundred eighty-two of the respondents ( $n=282$ ) ( $n=530$ ) met the inclusion criteria, for a participation rate of 53%. A majority (88%) “agreed” or “strongly agreed” that periodontal risk assessment tools improve communication and increase educational opportunities with patients and 50% reported completing periodontal risk assessments during a patient’s scheduled appointment. Significant relationships existed between “frequently” or “always” reviewing periodontal risk assessment outcomes and the participants age, place of employment and number of continuing education (CE) hours completed ( $p=0.004$ ). Participants who were members of the American Dental Hygienists’ Association (ADHA) were more likely to correctly answer three or more knowledge questions ( $p=0.01$ ), and more likely to measure and record pocket depths in a periodontal risk assessment tool ( $p=0.005$ ).

**Conclusion:** Although dental hygienists reported periodontal risk assessment tools were helpful for patient communication and education, only 50% reported regular completion while providing patient care. Continuing education on the value of periodontal risk assessment tools and better understanding of the barriers to routine implementation, could expand their use.

**Keywords:** dental hygienists, clinical practice, periodontal risk assessment, periodontal risk assessment tools, periodontal disease, periodontal probing

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### Introduction

Periodontal disease is a significant oral health problem in the United States (U.S.), affecting approximately 46% of all adults.<sup>1,2</sup> Periodontal disease plays an important role in an individual’s oral health, systemic health, and overall quality of life.<sup>3,4</sup> Risk factors associated with periodontal disease include, but are not limited to, tobacco use, diabetes, medications, age, heredity, and stress.<sup>1,2</sup> Accurate diagnosis and identifying at risk patients helps to prevent, properly treat, and manage periodontal disease.<sup>3,5</sup>

Periodontal disease susceptibility varies greatly and is now regarded as a multifaceted interaction between an individual’s

inflammatory and immune responses.<sup>3,6</sup> Risk factors for periodontal disease are influenced by individual modifiable and non-modifiable factors.<sup>7,8</sup> While these risk factors have been associated with the development of or progression of periodontal disease; at risk patients may not be informed of their disease status during routine dental care.<sup>5,7</sup> Recognizing a patient’s periodontal risk level is essential in dentistry and should be assessed at every comprehensive and periodontal evaluation.<sup>9</sup>

To help assess a patient’s level of periodontal risk, there are a variety of assessment tools available. Mathematical algorithms have been used in computerized periodontal risk assessment

tools to enable prognosis accuracy and limit subjectivity.<sup>7,10,11</sup> Computerized periodontal risk assessment tools have the potential to better identify individuals at high risk before the disease has progressed, allowing for early intervention with the goal of reducing the need for more complex periodontal therapy.<sup>7,11</sup> These tools can also support patient education regarding the risk factors that can be modified to prevent, treat, and manage periodontitis.<sup>10,11</sup> Additionally, periodontal risk assessment tools can provide clinicians' with a framework for planning individualized periodontal treatment and the management of modifiable risk factors.<sup>10,11</sup>

The efficacy of periodontal risk assessment tools is an important consideration in patient care. Prediction of clinical periodontal outcomes are key factors for risk assessment in periodontal disease.<sup>12</sup> Research studies on computerized periodontal risk assessment tools have shown that these tools were able to predict tooth loss and recognize the progression of periodontitis.<sup>13,14</sup> These risk assessment tools have been shown to provide more uniform guidance in predicting disease progression, leading to an increase in early interventions, and reducing the need for more complex interventions.<sup>13,14</sup> In spite of what is known regarding the benefits of periodontal risk assessment tools, clinicians have underestimated their value.<sup>8</sup>

Currently, there is limited research on the use of periodontal risk assessment tools in the dental setting.<sup>5,15</sup> However, Thyvalikath et al. demonstrated that periodontal risk assessment tools could help improve patients' overall health, provide patient education, and improve business.<sup>5</sup> In addition to considering providers' perception of using periodontal risk assessment tools, it is also important to consider patient's reactions to their risk factors. The use of these tools has been shown to provide patients with a higher degree of understanding regarding the severity of their disease.<sup>5,16-19</sup> In addition, patients expressed a greater intent to follow periodontal treatment recommendations.<sup>5,16-19</sup> More research is needed to more fully explore the impact of periodontal risk assessment tools.<sup>8</sup> The purpose of this study was to identify the knowledge, attitudes, and practice behaviors among dental hygienists in clinical practice regarding the use of periodontal risk assessment tools.

## Methods

This study was approved by the MCPHS University Institutional Review Board (IRB), protocol number IRB080919B. A descriptive, cross-sectional survey research design was chosen, using a convenience sample of dental hygienists recruited via dental hygiene social media sites. Dental hygienists with an active license and six months or more experience providing patient care in a clinical setting

a minimum of 1 day/week, fluency in reading and speaking English, and the ability to access and complete a web-based survey were included in the sample population.

### *Statistical analysis*

A statistical power analysis and effect size (medium effect size;  $w=0.03$ ) was performed. The projected sample size needed for an  $\alpha=.05$ , power=0.80, and a medium effect size (G\*Power 3.1), was approximately  $n=143$ . A proposed sample size of  $n=204$  was considered more than adequate and allowed for an expected attrition of 30%.

Chi-square tests of independence were used to assess the relationship between categorical demographic variables and survey responses. To improve interpretation and decrease alpha inflation, age was recoded into three separate groups 18-34, 35-54, and 55+. Knowledge was recoded into either the pass group (three or more correctly answered questions), attitudes were recoded into 1=strongly disagree or disagree, 2=neutral, and 3=strongly agree or agree. Clinical practice questions were further collapsed into 1=sometimes or never and 2=frequently or always. Age, education level, years in practice, continuing education (CE) hours, and membership in the American Dental Hygienists' Association (ADHA) were tested for association with knowledge (pass/fail), attitudes, and practices.

### *Survey Instrument*

The survey included outcome and predictor variables. The instrument was developed based on the literature and included: demographic and professional characteristics (7 items), knowledge (5 items), attitudes (9 items), and practice behavior (10 items). The knowledge questions were selected from information found in the current literature on the subject of periodontal risk assessment tools.<sup>5,3,8,9,18-22</sup> Several response scales were used, including multiple choice, 4-point Likert scale (1=never, 2=sometimes, 3=frequently, and 4=always), and a 5-point Likert scale (1=strongly disagree, 2=disagree, 3=undecided, 4=agree, 5=strongly agree).

The survey instrument was validated using a content validity index (CVI), resulting in a S-CVI score of 0.97. A panel of experts ( $n=7$ ) rated each question according to its relevance. The expert panel consisted of dental professionals experienced with periodontal risk assessment tools, researchers of periodontal risk assessment, and educators on the use of periodontal risk assessment tools. Revisions were made based on the expert panel feedback. Pilot testing was performed by dental hygienists who met inclusion criteria ( $n=9$ ); no further changes were required after testing.

## Recruitment

Administrators of dental hygiene Facebook groups, LinkedIn, and Instagram were asked for approval to post the survey invitation. Upon approval, the invitation was posted with a link to the survey instrument hosted through SurveyMonkey™ (San Mateo, CA). Members of the social media sites were encouraged to share the survey with other dental hygienists who met the inclusion criteria. Informed consent was obtained before proceeding to the survey. Data collection was carried out over a four-week period (August to September 2019).

## Data analysis

The Statistical Package for the Social Sciences 23 (IBM, Armonk, NY) software was used for data analysis. Responses were summarized and reposed with measures of central tendency (e.g. mean (average) and variance (e.g. standard deviation). All variables were analyzed for statistical assumptions including normalcy and co-linearity. Outliers were identified and removed. Data were analyzed for missing items and any participant with less than 80% of responses completed was removed from analysis.

Statistical testing by cross tabulation, including chi square test of independence or appropriate correlations (Pearson or Spearman), were used to explore the relationship between variables. A t-test or ANOVAs for categorical demographics and linear regression for continuous predictors as fixed effects, were used to determine the effect of demographic or independent variables on the primary outcome variables. The acceptable alpha level was set at .05 for hypothesis testing. Measures of effect size (medium effect size;  $w=0.03$ , e.g. 95% Confidence Interval,  $R^2$ , Phi Coefficient) was determined and reported.

## Results

A total of 530 respondents opened the link to the survey; 248 respondents were removed due to lack of starting the survey. An additional 20 respondents were removed from the sample due to completing less than 80% of the survey, yielding a participation rate of 53% ( $n=282$ ). One-third of the participants were between 45 to 54 years of age ( $n=92$ , 33%), and over one-half ( $n=155$ , 55%) had been practicing dental hygiene for over 15 years. Participant demographics are shown in Table I.

## Knowledge

Knowledge responses were calculated by scoring each of the five knowledge questions as either correct=1 or incorrect=0. The largest number of correct responses was three questions

**Table I. Respondent demographics (n=282)**

	n	%
<b>Age</b>		
18 to 24	11	3.9%
25 to 34	51	18.1%
35 to 44	53	18.8%
45 to 54	92	32.6%
55 to 64	64	22.7%
>65 to 74 or older	11	3.9%
<b>Gender</b>		
Female	281	99.6%
Male	1	0.4%
Transgender Female	0	0.0%
Transgender Male	0	0.0%
Gender Variant/Non-Confirming	0	0.0%
Prefer Not to Answer	0	0.0%
<b>Highest level of education completed.</b>		
Associate degree	146	51.8%
Bachelor's degree	111	39.4%
Master's degree	25	8.9%
Doctoral degree	0	0.0%
<b>Years of dental hygiene practice</b>		
Less than 1 year	2	0.7%
1-5 years	47	16.7%
6-10 years	42	14.9%
11-15 years	35	12.4%
More than 15 years	156	55.3%
<b>Hours of periodontal risk assessment continuing education in past 5 years</b>		
0 hours	34	12.1%
1-4 hours	108	38.3%
5-8 hours	66	23.4%
9+ hours	74	26.2%
<b>American Dental Hygienists' Association Member</b>		
Yes	94	33.3%
No	188	66.7%
<b>Current employment Setting</b>		
Clinical Practice	244	86.5%
Public Health	19	6.7%
Education	13	4.6%
Research	1	0.4%
Other	5	1.8%

with 34% of the respondents. Only respondent (0.1%) answered all five questions correctly. Response distributions for the sample are shown in Table II. Members of the ADHA were more likely (50%) to have three or more correctly answered knowledge questions than non-members ( $\chi^2(1)=6.53$ ,  $p=0.01$ ,  $\phi=-0.15$ ). All other comparisons of demographic variables to knowledge questions were not statistically significant ( $p>0.05$ ).

**Table II. Knowledge items (n=282)**

		n	%
Which of the items listed below is a non-modifiable periodontal risk factor?	Incorrect	29	10.3%
	Correct	253	89.7%
The American Academy of Periodontology recommends periodontal risk assessments be completed at which evaluation?	Incorrect	153	54.3%
	Correct	129	45.7%
Which of the following is not a benefit of using periodontal risk assessment tools to determine a patient's periodontal disease risk in the clinical setting?	Incorrect	255	90.4%
	Correct	27	9.6%
Which item listed below is not a common risk variable used in periodontal risk assessment tools?	Incorrect	187	66.3%
	Correct	95	33.7%
According to recent studies, clinicians expressed which of the following as a major barrier for using periodontal risk assessment tools in the clinical setting?	Incorrect	151	53.5%
	Correct	131	46.5%

### Attitudes

Attitude and belief questions had a five-point Likert Scale (strongly disagree=1, disagree=2, undecided=3, agree=4, and strongly agree=5). Across the nine attitude/belief items, participants largely responded with positive beliefs and attitudes towards periodontal risk assessment. Most (84%) agreed or strongly agreed that periodontal risk assessment tools were an integral part of dental hygiene practice and 88%, agreed or strongly agreed that periodontal risk assessment tools improved communication and increased educational opportunities with patients. Attitude and belief response distributions are shown in Table III.

Participants with no CE hours were the least likely (65%) to agree or strongly agree with the statement, "I am confident in my ability to identify and classify periodontal disease without the use of a periodontal risk assessment tool" as compared to participants with 1-4 hours (81%), 5-8 (89%), or 9+ hours (89%) of CE ( $\chi^2(6)=14.77$ ,  $p=0.02$ ,  $\phi=0.23$ ). Nearly one quarter of the participants with no CE hours (24%) were also least likely to agree or strongly agree with the statement, "I believe that periodontal risk assessment tools decrease clinician subjectivity in assessing a patient's periodontal risk of future disease," compared to respondents with 1-4 hours (38%), 5-8 (42%), or 9+ hours (39%), ( $\chi^2(6)=16.74$ ,  $p=0.01$ ,  $\phi=0.24$ ). A majority of the participants (84%) reported using a periodontal risk assessment tool is an integral part of dental hygiene practice and felt using a periodontal risk assessment tool improves communication and increases

educational opportunities with patients (88%). All other comparisons of demographic variables to attitude questions were not statistically significant ( $p>0.05$ ).

### Practice

Practice related items were coded on a four-point Likert scale (1=never, 2=sometimes, 3=frequently, 4=always). Most clinical practice items were identified as frequently or always regarding the occurrence of periodontal risk assessment practices in clinical practice. A majority of respondents (85%) agreed with the statement "The dentist or dental hygienist measures patients' pockets depths and records required findings into periodontal risk assessment tool." Nearly three-fourths of the participants (72.7%) indicated that they always or frequently completed a periodontal risk assessment tool during the patient care appointment in an effort to collect patient's current health and behavior data for accurate periodontal risk level findings. Over one-half (62.0%) indicated always or frequently completing periodontal risk assessments outcomes or that they reviewed these reports with the patient. Clinical practices of the respondents are shown in Table IV.

Participants aged 55 years and older were most likely (87%) to be employed in a dental practice that frequently or always reviewed risk assessment outcomes with patients as compared to respondents aged 35-54 years (68%), and 18-34 years (65%), ( $\chi^2(2)=11.12$ ,  $p=0.004$ ,  $\phi=0.20$ ). Participants aged 55 years and older were also more likely (77%) to be employed in a practice setting where the dental hygienist frequently or always recorded the bleeding on probing (BOP) as compared to those aged 35-54 years (54%) and 18-34 years (63%). Dental hygienists holding a master's degree were less likely (52%) to be employed in a dental practice allowing for the use of periodontal risk assessment tools, as compared to respondents holding a bachelor's degree (n=80, 72%) or associate degree (n=112, 77%) who reported that their practice setting frequently or always allowed for the use of a periodontal risk assessment tool ( $\chi^2(2)=6.60$ ,  $p=0.04$ ,  $\phi=0.15$ ).

**Table III. Attitude Questions (n=282)**

	Strongly Disagree		Disagree		Undecided		Agree		Strongly Agree	
	n Count	%	n Count	%	n Count	%	n Count	%	n Count	%
I feel using periodontal risk assessment tools, to determine a patient's periodontal risk level, is an integral part of dental hygiene practice	21	7.4%	2	0.7%	23	8.2%	102	36.2%	134	47.5%
I feel using periodontal risk assessment tools improves communication and increases educational opportunities with patients	15	5.3%	5	1.8%	13	4.6%	115	40.8%	134	47.5%
I feel I have enough time to perform periodontal risk assessment on each patient	42	14.9%	112	39.7%	41	14.5%	72	25.5%	15	5.3%
I am confident in my ability to explain periodontal risk assessment results with the patient	5	1.8%	20	7.1%	48	17.0%	135	47.9%	74	26.2%
I am confident in my ability to identify and classify periodontal disease without the use of a periodontal risk assessment tool	4	1.4%	6	2.1%	38	13.5%	142	50.4%	92	32.6%
I feel using periodontal risk assessment tools improves communication between myself and the dentist	37	13.1%	112	39.7%	73	25.9%	46	16.3%	14	5.0%
I feel periodontal risk assessment tools improve treatment processes and patient outcomes	20	7.1%	75	26.6%	68	24.1%	87	30.9%	32	11.3%
I feel I can assess periodontal risk based on my personal knowledge, expertise and practice experience, and do not feel a risk assessment tool is of value	6	2.1%	14	5.0%	19	6.7%	144	51.1%	99	35.1%
I believe that periodontal risk assessment tools decrease clinician subjectivity in assessing a patient's periodontal risk of future disease	12	4.3%	81	28.7%	83	29.4%	87	30.9%	19	6.7%

Current members of the ADHA were more likely to frequently or always (73%) measure patient's pocket depths and record into a periodontal risk assessment tool than non-members (56%), ( $\chi^2(1)=7.71$ ,  $p=0.005$ ,  $\phi=0.17$ ). Several practice items were dependent on the number of CE hours a participant had completed in the last five years. Relationships between practice items and CE hours in periodontal risk assessment are shown in Table V.

### Discussion

As preventative specialists, dental hygienists are in a unique position to use periodontal risk assessment tools to

educate patients regarding their level of periodontal disease risk.<sup>20</sup> While most participants were knowledgeable about the identification of modifiable and non-modifiable risk factors for periodontal disease, the majority lacked sufficient knowledge regarding the benefits of risk assessment tools, common risk variables, and when to complete a periodontal risk assessment evaluation. Thyvalikakath et al. conducted qualitative research with focus groups to explore use of periodontal risk assessment tools and identified the need to educate all oral health care providers on performing risk assessments.<sup>5</sup> The study findings suggested these tools could enable clinicians to play a bigger role in patient care as well as

**Table IV. Clinical practice related items (n=282)**

	Never		Sometimes		Frequently		Always	
	n	%	n	%	n	%	n	%
DH* completes periodontal risk assessment tool during patients scheduled appointment in an effort to collect patient's current health and behavior data for accurate periodontal risk level findings, i.e., smoking history	16	5.7%	61	21.6%	85	30.1%	120	42.6%
Dentist or DH measures patients' pocket depths and records required findings into periodontal risk assessment tool	15	5.3%	27	9.6%	94	33.3%	146	51.8%
DH records BOP on patients and records required findings into periodontal risk assessment tool	17	6.0%	62	22.0%	89	31.6%	114	40.4%
DH evaluates patients' current and historical radiographs and records required information into periodontal risk assessment tool	20	7.1%	45	16.0%	77	27.3%	140	49.6%
DH inquires about HbA1c levels for diabetic patients, and discuss the relationship between periodontal disease and diabetes	34	12.1%	73	25.9%	63	22.3%	112	39.7%
Periodontal risk assessment outcomes or reports are printed for each patient	182	64.5%	67	23.8%	19	6.7%	14	5.0%
Periodontal risk assessments outcomes or reports are reviewed with the patient	54	19.1%	53	18.8%	65	23.0%	110	39.0%
My dental practice or place of employment allows for the use of periodontal risk assessment tools to assess a patient's level of risk	71	25.2%	63	22.3%	57	20.2%	91	32.3%
My dental practice or place of employment implements periodontal risk assessment tools as an evidence-based approach to individualized dental care	74	26.2%	62	22.0%	70	24.8%	76	27.0%
My dental practice or place of employment encourages continuing education classes on the benefits of using periodontal risk assessment tools	87	30.9%	65	23.0%	54	19.1%	76	27.0%

\* Dental hygienist

educate patients regarding their periodontal risk to improve oral health outcomes.<sup>5</sup> Increasing dental providers education on the various periodontal risk assessment tools could in turn expand knowledge of the benefits of these tools. Participants who held membership in the ADHA were 50% more likely to have three or more correct responses in the knowledge section demonstrating a possible relationship between belonging to a professional association and increased knowledge level relating to periodontal risk assessment tools. This relationship may be due to increased exposure to these assessment tools as a result of professional programs or education opportunities for association members.

Study findings demonstrated a positive relationship between dental hygienists who considered a periodontal risk assessment tool an integral component of dental hygiene practice (84%) and improving communication and educational opportunities with patients (88%). There was also a strong relationship between participants who reported not having any CE hours on periodontal risk assessment tools and a lack of confidence and ability to identify and classify periodontal disease without the use of a risk assessment tool demonstrating a need for more education on the benefits of using periodontal risk assessment tools for both the clinician and the patient. Research conducted by Asimakopoulou et al. identified that practitioner - patient

**Table V. Clinical practice item relationships by CE hours in periodontal risk assessment in the past 5 years (n=282)**

0 hours			1-4 hours			5-8 hours			9+ hours			Chi square Test		
Sometimes or never	Frequently or always		Sometimes or never	Frequently or always		Sometimes or never	Frequently or always		Sometimes or never	Frequently or always		x <sup>2</sup>	Phi	
	(n)	%		(n)	%		(n)	%		(n)	%			(n)
21	61.8%	38.2%	31	28.7%	77	71.3%	17	25.8%	8	10.8%	66	89.2%	30.7**	0.33
13	38.2%	61.8%	17	15.7%	91	84.3%	8	12.1%	58	87.9%	70	94.6%	20.3**	0.27
19	55.9%	44.1%	38	35.2%	70	64.8%	14	21.2%	52	78.8%	66	89.2%	28.2**	0.32
18	52.9%	47.1%	26	24.1%	82	75.9%	12	18.2%	54	81.8%	65	87.8%	23.0**	0.29
20	58.8%	41.2%	51	47.2%	57	52.8%	25	37.9%	41	62.1%	63	85.1%	27.0**	0.31
32	94.1%	5.9%	98	90.7%	10	9.3%	60	90.9%	6	9.1%	15	20.3%	7.4	0.16
21	61.8%	38.2%	50	46.3%	58	53.7%	22	33.3%	44	66.7%	60	81.1%	23.4**	0.29
26	76.5%	23.5%	56	51.9%	52	48.1%	30	45.5%	36	54.5%	52	70.3%	21.7**	0.2
26	76.5%	23.5%	57	52.8%	51	47.2%	31	47.0%	35	53.0%	52	70.3%	21.9**	0.28
29	85.3%	14.7%	67	62.0%	41	38.0%	30	45.5%	36	54.5%	48	64.9%	28.8**	0.32

\* See Table IV \*\*=p<0.001. Df for all tests = 3

encounters focused on individualized risk communication increased the patient's awareness of disease risk and increased intentions to adhere to periodontal treatment which was consistent with our findings.<sup>16</sup>

Participants employed in practices or other employment settings that allowed for the use of periodontal risk assessment tools indicated that they had adequate time to perform periodontal risk assessments. These findings were similar to those of Francisco et al. who studied dental hygienists performing caries risk assessments during the dental hygiene care appointment.<sup>23</sup> Findings from this study were unexpected since the additional time needed to complete and use and a periodontal risk assessment tool has been suggested as a barrier to implementation in previous research.<sup>5,23</sup> Reasons for this difference in findings is unknown, but may be impacted by the self-selection of participants, a limitation of non-probability sampling.

Continuing education hour content on periodontal risk assessment tools was shown to be a strong predictor of clinical practice behaviors. Significant relationships were identified between CE hours in the last five years and hygienists utilizing periodontal risk assessment tools at patients scheduled appointments, inquiring about HbA1c levels for patients with diabetes, reviewing periodontal risk assessment outcomes with patients, and employment in clinical settings allowing for the use of periodontal risk assessment tools. These clinical settings implemented periodontal risk assessment tools as an evidence-based approach to individualized dental care and encouraged CE on utilizing periodontal risk assessment tools.

Research indicates there are barriers to using periodontal risk assessment tools in clinical practice. The validity of the science, cost of implementation, and lack of reimbursement have been cited as major barriers.<sup>5,17</sup> There is also a gap in the literature regarding the long-term success of periodontal risk assessment tools.<sup>10</sup> In addition, recently developed Periodontal Classifications now includes grading, which

addresses some of the major modifiers of periodontal disease progression, such as diabetes and tobacco use. However, web-based periodontal risk assessment tools have the added benefit of using complex algorithms to improve accuracy of assessing risk, which is not possible with other approaches.<sup>16</sup> It is yet to be demonstrated how the new classification system could be used together with a periodontal risk assessment tool to identify the modifiable risk factors that clinicians and patients can address to modify long term disease progression of disease.

This study had limitations. The non-probability convenience sample and self-selection bias limiting generalization of the findings. Access to social media and technology was also a limitation and may have introduced bias by individuals who use social media versus those who do not. Other limitations included self-report and recall bias. Close-ended questions, although quick and less costly to analyze, may have limited the accuracy of the respondents. There were also inconsistencies in responses related to items in the clinical practice section of the survey. Approximately 50% of the respondents indicated using a periodontal risk assessment tool, however 85% reported recording periodontal probing depths in a periodontal risk assessment tool. This inconsistency may be due to a misinterpretation of the survey item. Future studies should examine the impact of periodontal risk assessment tool use on long-term patient outcomes and continue to explore barriers to implementation of periodontal risk assessment tools in clinical practice as well as patient perceptions of their use. Comparisons between periodontal risk assessment tools and the 2017 Periodontal Classification system should also be studied.

## Conclusion

Periodontal disease requires prevention and management strategies for oral health care professionals and patients. Periodontal disease risk identification also plays a key role in patient education. Results from this study demonstrated a need to improve dental hygienists' knowledge, attitudes, and practice behaviors regarding the use of periodontal risk assessment tools. Continuing education in periodontal risk and disease management should be implemented to increase dental hygienists' knowledge and utilization of these evidence-based tools.

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# Efficacy of a Prototype Solution to Facilitate the Removal of Supragingival Dental Calculus: A proof of concept study

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## Abstract

**Purpose:** The purpose of this study was to determine whether the adjunctive use of an experimental calculus disruption solution (EXP-955), combined with the exclusive use of hand instruments, decreases the amount of time required to remove supragingival dental calculus deposits.

**Methods:** A single-site, randomized, split-mouth clinical trial was conducted to compare the time needed to remove supragingival dental calculus on deposits pretreated with an experimental calculus disruption solution vs. calculus deposits that were not pretreated. Quadrants were randomized to either the treatment or control group and the principal investigator (PI) was timed while using hand instruments to remove the calculus. At the end of each session, both the subjects and the PI completed a questionnaire assessing their perceptions regarding the various aspects of the appointment and the solution. Descriptive statistics were used to analyze the data. Recurring themes from the questionnaire were examined.

**Results:** Twenty-five healthy subjects, each having two quadrants matched for number of teeth and level of calculus deposits, completed the study (n=25). A statistically significant difference was found in the supragingival calculus removal times between the control, (M=12.5 minutes; SD=6.0), and the treatment, (M=9.7; SD=4.6), quadrants; Mean difference (95% CI) = 2.8 (1.8-3.7),  $p < 0.0001$ . Thematic analysis of the questionnaire responses showed that the perceptions of the principal investigator and subjects were positive towards the use of the solution with less pain being a common participant comment. The experimental calculus disruption solution was well tolerated by all subjects.

**Conclusions:** Results from this proof of concept study provide preliminary evidence that use of an experimental calculus disruption solution (EXP-955) reduced the time needed to remove supragingival calculus while using hand instrumentation.

**Keywords:** dental calculus, calculus disruption, calculus removal, hand instrumentation

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## Introduction

Dental calculus is a contributing factor to periodontal disease, as it provides a nidus for biofilm attachment which can subsequently lead to inflammation.<sup>1-3</sup> The gold standard for calculus removal has been hand instrumentation with adjunct use of the ultrasonic scaler. This combination of techniques may be time consuming, fatiguing for the clinician, and uncomfortable for the patient.<sup>1-5</sup> Multiple factors may extenuate the removal of dental calculus, including but not limited to: tightness of gingival tissues, tooth positioning, depth of periodontal pocket, along with the amount, duration, and tenacity of the calculus deposits.<sup>1</sup>

Comfort is an essential component of patient centered care.<sup>6</sup> little is quantitatively known concerning the effects

of instruments, technique and treatments on debridement (scaling). Dental anxiety has been associated with needles, the sound of drills, and the discomfort of hand instrumentation.<sup>7,8</sup> For some patients the very sight of dental instruments and/or sound of hand instrumentation creates anxiety.<sup>7</sup> Dental providers may use local anesthesia to increase patient comfort during scaling of deposit, however some patients may decline the use of local anesthesia due to the fear/anxiety of needles and/or the lingering numbness extending long past the appointment time.<sup>9</sup>

The amount of pressure required to remove heavy calculus deposits during hand instrumentation has been linked to patient discomfort, provider fatigue, and musculoskeletal

problems.<sup>6,10-15</sup> A wide variety of hand instrument designs including larger diameter and light weight handles have been developed to relieve operator fatigue and reduce muscle tension.<sup>14-18</sup> In addition to hand instruments, a wide range of ultrasonic scalers and dental handpieces have been designed with operator comfort and musculoskeletal health in mind. Instrumentation techniques, such as sequencing of quadrants, ergonomic postures, stretching, and breaks between patients have also been recommended as strategies to reduce musculoskeletal disorders.<sup>19-25</sup> Additionally, calculus disruption products have been developed in an effort to relieve muscle tension and minimize the effort needed to remove deposits.<sup>1-5</sup> Research indicates that no technique or product has been shown to be superior, and musculoskeletal disorders and provider fatigue remain a significant issue for dental hygienists.<sup>26-29</sup> In addition to provider fatigue, effective hand instrumentation may be time consuming, impacting overall productivity. Dental hygiene professionals devote a significant amount of patient appointment time to the removal of calculus deposits.<sup>10,11,15,20</sup> It has been suggested that one way to increase productivity is to increase the efficiency of deposit removal.<sup>30</sup>

Patient comfort, provider fatigue, and productivity explain the interest in developing products to ease the removal of calculus.<sup>3</sup> SofScale™ (Dentsply Sirona; Charlotte, NC, USA), first became available in the mid 1990's as a pre-scaling gel for calculus removal. Active ingredients in this product include disodium EDTA and sodium laurel sulfate.<sup>1</sup> Reviews in the literature regarding the efficacy of this particular calculus softening gel have been mixed.<sup>1-5,31</sup> Wiggs et al., and Jabro et al. found that the product eased calculus removal and/or reduced calculus removal time.<sup>2,31</sup> In contrast, Miller et al., Maynor et al., Smith et al., and Nagy et al. found no significant difference in scaling time between the experimental and control sides and/or did not consider this adjunct to be beneficial for calculus removal.<sup>1,3-5</sup>

A new product has been developed to soften and loosen dental calculus. In vitro test results conducted on extracted teeth with visible calculus deposits, demonstrated a reduction in the time required to thoroughly remove deposits from the solution-treated vs. untreated teeth. Biological safety testing conducted on the prototype resulted in the solution being deemed safe for human use. The next step in the development process called for in-vivo testing in a clinical study. In developing the study design for the next stage of product development, it was decided to limit the testing to supragingival calculus, on a small number of subjects due to ease of assessing deposit removal on supragingival surfaces. If the findings from the proof of concept study document the usefulness of the prototype in reducing the amount of

time needed for supragingival calculus removal, a subsequent study will be planned to test the product on subgingival deposits in a larger sample population. The purpose of this proof of concept study was to determine the efficacy of a calculus disruption solution (EXP-955; 3M Oral Care Solutions Division, St. Paul, MN) in facilitating the removal of supragingival calculus in-vivo, as measured by reduced examiner scaling time.

## Methods

A single-site, randomized, split-mouth clinical trial was conducted to compare the time needed to remove supragingival dental calculus on deposits pretreated with an experimental calculus disrupting agent vs. calculus deposits that were not pretreated. Data for the necessary time to remove the supragingival calculus deposits were analyzed following the completion of all treatment quadrants in the study sample.

### Sample population

Recruitment flyers advertising the study were placed throughout the University of Minnesota School of Dentistry. A total of 91 subjects were screened via telephone; and 64 met the criteria for the in-person screening. Inclusion criteria included being in good general health with no known allergies to commercial dental products; having at least 5 teeth in each study quadrant and the presence of supragingival calculus with a minimum rating of at least one, as determined by the Oral Calculus Index-Simplified (OCI-S) (Table I). Care was taken to select subjects having two quadrants matched for number of teeth and level of calculus deposits. Subjects who had a full mouth debridement, prophylaxis, and/or scaling and root-planing within the last year; those who required premedication prior to dental procedures; were pregnant, lactating, and/or lacking in the ability to provide consent, were excluded from the sample. Appointments were scheduled to treat eligible subjects within ten days of screening. Eligible participants received documentation to provide informed consent.

**Table I. Oral Calculus Index-Simplified criteria (OCI-S)**

Scores	Criteria
0	No Calculus Present
1	Supragingival calculus covering not more than third of the exposed tooth surface
2	Supragingival calculus covering more than one third but not more than two thirds of the exposed tooth surface
3	Supragingival calculus covering more than two thirds of the exposed tooth surface

## **Procedures**

All study procedures followed good clinical practice (GCP) guidelines. Full approval from the Human Subjects Protection Program (Institutional Review Board) at the University of Minnesota was obtained. The principal investigator (PI), was an experienced, licensed dental hygienist and the clinical director for the University of Minnesota Dental Hygiene Program. It was not possible to blind the PI to the treatment quadrants because of the visual chemical reaction made by the experimental solution. Therefore, for the purposes of this proof of concept study, the PI served as both the examiner and the operator who performed all treatment procedures in the clinical trial. The term PI will be used for both examiner and operator roles in this manuscript. Training on the application of the solution was provided by the manufacturer prior to study initiation.

Subjects who met the inclusion criteria were scheduled to return for the treatment visit. General health status, medication usage and eligibility to continue in the study were reassessed. An oral soft tissue examination to determine the presence of any oral complaints or symptoms was made by the investigator-examiner. The PI then rated the supragingival calculus level using the OCI-S criteria. The subjects' quadrants were scored; only study quadrants with both the same number of teeth and equal amounts of calculus, based on the quadrant's OCI-S scores were selected. Block randomization was used to allocate subjects' quadrants to study groups using a split mouth design.

In order to ensure that the calculus in the control quadrant was not inadvertently compromised by the experimental solution, the control quadrant was always treated first. The start and end time to complete the removal of the supragingival dental calculus for each quadrant was recorded using an electric digital clock. In order to obtain a visual record of any gingival and hard tissue differences following treatment, photographs of both study quadrants were taken before and after completion of hand instrumentation. Prior to beginning treatment, all instruments were sharpened; sharpness was checked using a plastic test stick. The following instruments were used on each subject: 13/14 Gracey curette; 11/12 Gracey curette (Hu-Friedy Mfg. Co., LLC; Chicago, IL, USA); and, a Montana Jack™ scaler (Paradise Dental Technologies; Missoula, MT, USA).

Prior to initiating treatment, each subject was asked to review questions that would be asked at the completion of the procedures. Questions queried subjects' perceptions regarding

the amount of time it took the PI to complete deposit removal, the amount of pressure used, and on taste/feeling of the experimental calculus disruption solution. Once the subject was familiar with the post-procedure questions, the PI recorded the starting time, and removed the supragingival calculus in the control quadrant with hand instruments, and recorded the end time. Next, the PI assembled the experimental calculus disruption solution dispenser, recorded the starting time, and then applied the solution to the supragingival dental calculus in the treatment quadrant. Once the solution was applied, the PI immediately began hand instrumentation in the treatment quadrant. The starting time for the removal of the supragingival dental calculus in the treatment quadrant included the time it took to place the solution. As this was a proof of concept study; dispenser assembly was not included in the time recorded, as the solution dispenser was not yet in its final form.

Upon completion of the scaling procedure, the subject's mouth was thoroughly rinsed with water. Standard assessment procedures, including a tactile evaluation with an 11/12 Explorer (Hu-Friedy Mfg. Co., LLC Chicago, IL USA), a visual evaluation with reflected light, and drying with the use of compressed air, were used to check for complete removal of supragingival dental calculus. Soft tissues were evaluated for changes in appearance and post-procedure photographs were taken. Each subject completed the patient questionnaire that they had viewed prior to treatment at the conclusion of the session. The PI completed the operator questionnaire at the conclusion of each session. The purpose of the questionnaire was to collect subjective feedback from the clinician regarding their perceptions of any differences in the amount of pressure used, the perceived amount of time spent to complete deposit removal, as well as to provide feedback on the solution's mechanics. Once the study procedures were completed, patients were offered an appointment to complete supra and subgingival deposit removal in all four quadrants.

## **Outcome measures and statistical analysis**

The primary outcome measure was the time it took the examiner/operator to complete the supragingival scaling in each study quadrant. The secondary outcome measure was the subjective feedback from subjects and the PI. Descriptive statistics were used to summarize subject demographics and deposit removal times. A paired t-test was used to compare the mean removal times (minutes) between the control and the treatment quadrants and statistical significance was set at  $p < 0.05$ . The statistical software program SAS V9.3 (SAS Institute Inc., Cary, NC) was used for data analysis.

## Results

Twenty-five subjects, seventeen males and eight females, met the inclusion criteria and consented to participate in the trial. Subjects were between 19 and 78 years of age, with a mean age of approximately 49.3 years (Table II). A statistically significant difference was found in the supragingival calculus removal times between the control, (M=12.5 minutes; SD=6.0) and the treatment, (M=9.7; SD=4.6) quadrants; Mean difference (95% CI) = 2.8 (1.8-3.7),  $p < 0.0001$ . The total mean instrumentation time for the control and treatment groups is shown in Table III. Feedback from the operator and patient questionnaires indicated that the calculus disruption solution was well tolerated by all subjects. No adverse reactions were recorded on the gingival tissues.

One of the features of experimental calculus disruption solution was the ability to disintegrate the calculus without causing adverse events to the oral soft tissues. Post treatment feedback comments from the PI regarding calculus removal in the control quadrants included observations of the calculus flaking or popping off, becoming airborne, and landing in areas inside and outside of the mouth. Comments regarding the calculus deposits in the treatment quadrants included that the deposits seem to glide, or shed off the tooth and did not land outside of the mouth. Additional subjective feedback included that it was easier to use hand instruments in the treatment quadrant than in the control quadrant and that less pressure was needed in the treatment quadrant compared to the control quadrant. Regarding the interaction of the experimental solution with the calculus, use of the solution made it somewhat

**Table II. Participant demographics (n=25)**

	n (%)
Gender	
Female	8 (32%)
Male	17 (68%)
Ethnicity	
White	15 (60%)
Black or African American	8 (32%)
Asian	1 (4%)
Unknown	1 (4%)

**Table III. Summary of calculus removal time**

Calculus removal time (minutes)	Control Quadrant	Treatment Quadrant
Mean (SD)	12.5 (6.0)	9.7 (4.6)
Median	12	9
Range	5-29	3-23

more difficult to visualize the calculus and the adjacent gingival tissues, requiring a greater reliance on tactile senses for deposit removal in the treatment quadrants. No adverse reactions were observed on either the tooth structures or gingival tissues in the treatment quadrants. Responses to the examiner questionnaire are shown in Table IV.

Subjects' views on the experimental solution were mixed. Some subjects stated they could tell a difference in the clinician's hand pressure and/or the amount of time it took to remove the calculus while others perceived no differences in pressure or time. A majority of the subjects (n = 24) stated that the experimental solution either tasted good, neutral, or had no taste. The majority of subjects (n = 24) also reported that there was no pain when the solution was applied. Subject responses are shown in Table V.

## Discussion

The ability to soften calculus for easier removal by dental professionals has numerous potential benefits. The goal of this proof of concept study was to evaluate whether the use of an experimental calculus disruption solution (EXP-955), reduced the amount of time required to remove supragingival calculus using hand instrumentation. As the solution is proprietary, the PI is not at liberty to share the active ingredients responsible for the mechanism of action. Results of this study provide preliminary data that the experimental solution reduces the amount of time needed to remove supragingival calculus in vivo. Findings of this study replicate the in-vitro results on extracted teeth with visible calculus deposits. Currently, there is not a product in the marketplace comparable to the experimental solution, therefore comparisons cannot be made to other research findings.

Musculoskeletal health can be compromised throughout the career of a dental hygienist. Due to repetitive motions, static and uncommon positions, the neck, shoulders, back, hands and wrists of dental hygienists are common areas of reported pain, muscle imbalance, and injury.<sup>32</sup> These physical symptoms may also have mental and emotional effects on a dental hygienist.<sup>33</sup> In this study the PI perceived that the use of the solution reduced the intensity of lateral pressure required during hand scaling, which may in turn improve ergonomics and provider fatigue. The PI cited the benefits of using the solution specifically on those participants in which the tenacity of the deposit was lower.

A majority of the participants provided feedback that they perceived that the cleaning was less painful when the calculus disruption solution was used. This solution may contribute to patient comfort, as it may be

**Table IV. Summary of operator (PI) responses**

Question	Responses	Examiner Response
How difficult was it to scale the calculus in the <b>control</b> quadrant?	Easy	6
	Moderate	7
	Hard	12
How difficult was it to scale the calculus in the <b>treated</b> quadrant?	Easy	12
	Moderate	7
	Hard	6
Were you able to <b>transfer</b> the investigational product to the patient's mouth easily (without the product dripping)?	Yes	25
	No	0
How was the investigational product's <b>consistency/thickness</b> ?	Too Thick	0
	Good Consistency	0
	Too Flowable	25
Were you able to <b>apply</b> the investigational product to the teeth easily?	Yes	25
	No	0
What is your overall satisfaction with the investigational product concept?	Good	24
	Bad	1
Did you feel that the investigational product helped you remove calculus on the treated quadrant more easily than on the control quadrant?	Yes	23
	No	2
Any comments or other likes/dislikes?	<p>Calculus was very tenacious. Amount of pressure needed was similar to both quadrants. Had to put product on multiple times. Hand became tired</p> <p>It's hard to see the gingiva</p> <p>Some calculus came off without pressure</p> <p>Seems to remove stain too</p> <p>Hard to see with product. To see need to give multiple rinses on both quadrants due to bleeding. The product seemed to help remove deposit</p> <p>Patient had sheet calculus that still seemed difficult</p> <p>Could tell that the product helped soften deposit</p> <p>I could tell in pressure but the calculus seemed just as hard to remove</p>	

an option for patients who have conditions contraindicating the use of ultrasonic instrumentation in addition to patients who do not want local anesthesia used during scaling procedures. Anecdotally, the solution may be help-

ful in periodontal recall appointments with patients who have more recession and sensitivity. Use of the experimental solution is contraindicated with ultrasonic instrumentation, as the water rinses the solution away. More research is needed to determine the effectiveness of the solution with use of ultrasonic instrumentation.

The literature acknowledges that scaling time has an effect on productivity; one could conclude that decreased scaling time may lead to increased efficiency and productivity in a dental practice.<sup>10,11,15,20</sup> Future studies testing the efficacy of the solution in subgingival deposit removal are needed as well as larger trial investigating the impact of the solution on provider fatigue and patient comfort.

This study had limitations. There are structural differences in supragingival and subgingival calculus, therefore this solution may not yield the same results with subgingival calculus removal. Further research will be needed to determine whether the solution can also reduce the time needed to remove subgingival deposits. Only one individual, the PI, used the solution for instrumentation and calculus removal. Future studies should be conducted with multiple examiners to elicit a greater range of opinions regarding its performance.

The PI and the subjects were not blinded to the treatment group, which could have introduced bias regarding the performance of the solution. Future research should blind both the examiner and the subject to increase internal validity. Ideally, the examiner scoring the calculus deposits, pre and post treatment, should be different than the clinician performing the calculus removal. Furthermore, someone other than the clinician performing the calculus removal should record the starting and ending times for the procedures. This

would keep the investigator-operator blinded to the actual time spent on each quadrant. It is also important to note, while this was a sponsored study, the PI did not receive any emolument

**Table V. Summary of patient responses (n=25)**

Question	Response	n
Did the investigational product <b>hurt or burn</b> when applied to your teeth?	No Pain	24
	Mild Pain	1
	Moderate Pain	0
	Extreme Pain	0
How did the investigational/ product <b>taste</b> ?	No taste	5
	Good	6
	Neutral	13
	Bad	1
Was there any noticeable <b>aftertaste</b> ?	No	15
	Yes good taste	1
	Yes neutral taste	9
	Yes, bad taste	0
Did you experience any <b>numbness</b> in your mouth during the procedure?	No	24
	Yes	1
Could you tell a difference in the <b>time</b> it took for the hygienist to remove the plaque on one side of your mouth over the other?	No	14
	Yes	11
	If Yes, which side took longer:	Right 6 Left 5
Could you tell a difference in the <b>amount of pressure</b> it took for the hygienist to remove the plaque on one side of your mouth over the other?	No	13
	Yes	12
	If Yes, which side used more pressure:	Right 6 Left 6
Additional comments/feedback:	<p>Good chemical</p> <p>It went great, no problems</p> <p>I did not feel pain like in my regular cleaning, just slight pressure</p> <p>She was very fast for the procedure</p> <p>The product left my teeth feeling smooth</p> <p>The product was pleasant and it felt like it required less effort by the hygienist to remove plaque with it on. I didn't notice a time difference though.</p> <p>Tx side was easier, was freaking out if there was danger if I should swallow product. Rt side went definitely easier. Taste was cinnaminty mediciny. I kinda' liked it.</p> <p>The right side started with the same amount of pressure but it lightened up shortly after.</p> <p>The left side was more painful and the right side was more comfortable.</p>	

and does not have any investment in the company or the solution.

### Conclusion

Use of an experimental calculus disruption solution facilitated faster removal of supragingival calculus when compared to hand instrumentation alone. This conclusion is based on the significant reduction in calculus removal time between the control and treatment quadrants. The experimental calculus disruption solution was well tolerated by all subjects and appreciated by the investigator-examiner. Further research is needed to determine if the time reduction demonstrated in this trial is reproducible with a larger study population. If the performance of this experimental solution is validated to facilitate easier removal of supra- and subgingival calculus, this finding may be of fundamental importance with respect to reducing operator fatigue and improving the patient experience. In addition, as dental professionals seek ways to reduce the aerosols created when using sonic and ultrasonic scaling instruments, access to a product to ease the removal of calcified deposits with hand instruments may be an attractive alternative.

### Disclosure

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# Effects of Professional Oral Health Care Programs for Elderly Residents of Nursing Facilities

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### Abstract

**Purpose:** The purpose of this study was to investigate the effects of a professional oral health care program on the oral health status and salivary flow of elderly people living in nursing homes.

**Methods:** Elderly residents aged  $\geq 65$  years, living in a nursing home, were randomly assigned to either a one-week interval, two-week interval, or control group, and received an oral health intervention accordingly over a period of 12 weeks. Plaque index, tongue coating, gingival index, and salivary flow rate were compared before and after the oral health intervention within and between the groups.

**Results:** The plaque, tongue coating, and gingival indices of the participants who received the oral health intervention decreased significantly; while the salivary flow rate significantly increased. Plaque, tongue coating, and gingival indices decreased most significantly in the one-week interval group, followed by the two-week interval group, relative to the control. The salivary flow rate increased most significantly in the one-week interval group, followed by the two-week interval group.

**Conclusion:** A professional oral health care program is effective for improving the oral health and salivation of elderly residents in nursing homes and the effect was found to be greater with interventions provided at one-week intervals. Oral health care professionals, including dentists and dental hygienists, must regularly monitor and manage the oral health of elderly residents.

**Keywords:** oral health promotion, oral health intervention, elderly, nursing home residents, oral health care, dental hygienists, caregivers

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### Introduction

It can be challenging for most elderly nursing home residents to implement oral health care independently due to chronic disease, disabilities, or decreased cognitive function and assistance in performing activities of daily living are often required.<sup>1</sup> Poor oral health can lead to oral diseases, which can decrease quality of life (QOL) and increase mortality risk.<sup>2</sup> Moreover, the elderly, particularly those in nursing facilities, often have chronic illnesses requiring medications with adverse oral side effects, such as xerostomia.<sup>3</sup> While regular oral health care is critical to maintain the QOL of the elderly in nursing homes, it often receives a low intervention priority.<sup>4</sup>

The lack of onsite dental clinics at Korean nursing homes is a barrier to dental care for elderly residents living in such

facilities.<sup>5</sup> Residents with oral health problems must visit the local clinic with the help of the nursing home staff, which can pose challenges. To address this access to care issue, the Korean government reformed the regulations to include dentists in the definition of “part-time visiting doctors” providing medical services in geriatric care facilities. However, general doctors and dentists are commissioned by the individual geriatric care facilities. Many of these facilities have chosen to extend their contract with the general medical practitioners who have been visiting the facility, rather than employ part-time visiting dentists. Hence, the oral health care of elderly residents is mostly managed by the institutional caregivers.

Caregivers often regard oral care provision for the residents as a minimal part of their overall work.<sup>6</sup> Even when the caregiver is committed to the care of these individuals, proper oral health care provision is hindered by the caregiver's lack of professional education and training in geriatric oral health care.<sup>7</sup> A recent qualitative study of caregivers revealed that methods and level of oral care provision for elderly residents varied across facilities, depending on the level of commitment of the facility head.<sup>8</sup> Choi emphasized the need for an oral health intervention program run by oral health professionals within the facility in order to provide quality dental service.<sup>9</sup>

Most previous research on geriatric oral health care in nursing homes has targeted caregivers nursing the elderly.<sup>10-12</sup> Some studies have utilized professional oral health care providers, but varied in terms of the method of care, intervention duration, and measurement index used.<sup>13,14</sup> Lee et al.<sup>15</sup> developed a one-week interval professional oral health care program based on the previous studies.<sup>13,14</sup> Their findings demonstrated that elderly residents' oral health status improved based on the intervention duration (4 weeks and 12 weeks). However, the study failed to consider the effect of the intervention interval, as only a one-week interval was used, which is challenging at the practical level within in the context of almost non-existent professional oral health care.<sup>16</sup>

The purpose of this study was to investigate the effects of implementing a professional oral health care program at different intervals, one week or two weeks, on the oral health status and salivary flow rate (SFR) of the elderly living in nursing care facilities.

## Methods

### *Sample population*

The target population was elderly persons aged  $\geq 65$  years residing in nursing homes in the Gyeonggi and Chungcheong Provinces in the Republic of Korea. Nursing homes were selected through convenience sampling, and informed consent was obtained. Each participant was assigned to either a one-week interval group, two-week interval group, or control group; participants were either bed-ridden patients with complete dependence in activities of daily living (ADL) or demonstrated partial dependence in ADL. Inclusion criteria were individuals who had not received any dental care within the past 6 months. Individuals who refused to open their mouth due to severe cognitive impairment, those with Sjögren's syndrome, or those who were on salivation stimulation medication were excluded from the study.

A power analysis was performed to determine the minimum sample size required for the t-test and was calculated using

G\*Power 3.1 for Windows. For a significance level of 0.05, effect size of 0.5, and power of 0.85, at least 38 subjects per group were required, however, considering drop-out, 135 participants (45 per group) was set as the sample size. Shinhan University Institutional Review Board approved the study. Additionally, informed consent from all participants was obtained following the explanation of the study objective and method of participation. In cases of elderly patients with communication difficulties, consent from guardians was received.

To test for homogeneity of the group participants, data on general characteristics, long-term care insurance (LTCI) level, length of stay (LOS), cognitive function, ADL performance, and general health- and oral health-related characteristics were collected via a questionnaire. Initial information regarding gender, age, education level, and participant-partner living arrangement was received prior to starting the questionnaire. The Korean version of Mini-Mental State Examination (MMSE-K)<sup>17</sup> was used to measure cognitive function. ADL performance was assessed using the modified Barthel index, which had been revised to reflect Korean culture and standardized by Jeong et al.<sup>18</sup> Data were collected on the following categories: number of chronic illnesses, number of current medications, recent bouts of pneumonia, daily oral care, refusal of oral care, and xerostomia. General characteristics and cognitive function were asked directly to residents and answers were recorded accordingly. Activities of daily living performance and general health- and oral health-related characteristics were assessed by the nursing staff, social worker, or caregiver.

### *Intervention*

The professional oral health care program was implemented for 12 weeks; at one-week intervals in the one-week interval group, and at two-week intervals in the two-week interval group. In the control group, no professional oral health care program was implemented. The intervention was designed based on the research method used previously by Lee et al.,<sup>15</sup> and was further modified and supplemented through expert consultation with a dentist, two dental hygiene professors, and two clinical dental hygienists. Professional oral care was performed by four dental hygienists and lasted about six minutes per participant. To avoid any experimenter bias, the study participants were randomly assigned to the same dental hygienist each time. Dental hygienists were blinded to group selection.

The professional oral health care intervention was carried out according to the following procedures. The lip area was first cleaned with gauze soaked in a disinfectant mixture of saline and mouth rinse (Listerine, McNeil Consumer Healthcare; Fort Washington, PA, USA). Vaseline Petroleum

jelly was then applied to the lips. For participants with dentures, each denture was removed and cleaned of debris via a suction device. The teeth and tongue were cleaned using a combination of rolling brushing, Watanabe brushing, and Bass brushing methods. Interdental brushes were used to clean the interproximal areas in the posterior region. The participant was then asked to rinse with water. If the participant had difficulty with rinsing, a suction device was used to remove the water. After removing debris in the oral cavity, the tongue was wiped using a sponge brush soaked in chlorhexidine and squeezed to remove excess. A moisturizer was then applied. The buccal mucosa was massaged using either the handle of a toothbrush or a finger, the upper/lower lips were stretched outwards for five seconds for each of three cycles, and the buccal and lingual gingivae were massaged using the thumb and index finger. Areas of the parotid, submandibular, and sublingual glands were massaged ten times each. Each participant was provided with an interdental brush and a sponge brush, which were replaced once every two months and at each visit, respectively. Patients wearing dentures were provided with denture cleansers.

### **Outcome measures**

The oral health status pre- and post-intervention was examined to evaluate the effects of the professional oral healthcare program. The O'Leary index,<sup>19</sup> Winkel Tongue Coating Index,<sup>20</sup> Löe & Silness gingival index,<sup>21</sup> and salivary flow rate (SFR),<sup>22</sup> were measured. Additionally, an oral examination was performed by a single dentist and post-intervention oral health status was assessed in all groups, three days after program termination.

The O'Leary index<sup>19</sup> is a quantitative measurement of individual oral status. Disclosing agent was applied to all teeth. Each tooth was first divided into four surfaces (mesial, distal, buccal, lingual) and the coloring on each surface was recorded as a score of 0 for "No plaque" or 1 for "With plaque," indicating poorer hygiene control. The occlusal and incisal surfaces and any missing teeth were excluded from measurement.

Tongue coating was evaluated using the Winkel Tongue Coating Index (WTICI).<sup>20</sup> With the patient's mouth wide open, the tongue was divided into six sections, two vertical sections from tip to base and three horizontal sections. Tongue coating for each section was rated as 0 for "No coating," 1 for "Light coating," or 2 for "Heavy coating." The sum of these scores (range: 0-12) indicated the total amount of coating.

The Löe & Silness gingival index<sup>21</sup> is widely used for measuring the level of periodontal disease by examining four sections (mesial, distal, buccal, lingual) of the gingival margin.

For each section, the level of inflammation was evaluated as 0 for "No inflammation," 1 for "Mild inflammation with slight changes in color and edema, but no bleeding on probing," 2 for "Moderate inflammation with redness, edema, and bleeding on probing," and 3 for "Severe inflammation with redness, hyperplasia, and spontaneous bleeding." The total sum of the scores was then divided by the total number of gingival margins examined, with 0 indicating healthy gingiva.

Salivary flow rate was measured using the swab method.<sup>22</sup> Without having brushed their teeth for two hours following breakfast, participants were asked to swallow to void the mouth of saliva prior to measurement. Dental cotton rolls were placed in the mouth (1.3 × 3.2 cm, Richmond Dental Company; Charlotte, NC, USA): one under the ventral surface (sublingual salivary gland) and one each in the left and right maxillary buccal regions (submandibular salivary glands). After five minutes without any movement, the cotton rolls were removed and their weight was measured using a CB Series (CB-200) digital scale with a resolution of 0.01 g (A&D Co., Ltd., Jinchoen, Korea).

### **Data analysis**

Data was analyzed using SPSS Statistics software (version 22.0, IBM Corporation, Armonk, NY, USA) and the significance level was set to 0.05. A chi-square test was conducted for categorical variables, For continuous variables, one-way analysis of variance (ANOVA) with Scheffe's post-hoc test was performed. Analysis of covariance (ANCOVA) was conducted to compare post-intervention-measured values between groups. However, SFR was not identified as a significant interaction term for ANCOVA. Therefore, the homogeneity of pre-intervention measurement values was first verified. Then, inter-group comparison of post-intervention measurements was then performed using one-way ANOVA. To identify pre-to-post changes, a paired *t*-test was performed.

## **Results**

Evaluation of the general characteristics, LTCI level, LOS, cognitive function, and ADL performance revealed that all variables except for cognitive function were not significantly different among the groups (Table I). No general health- or oral health-related characteristics differed significantly among the groups, confirming their homogeneity (Table II). The one-week interval group and the control group mostly had two illnesses; all three groups typically used one to three medications. Most had no recent history of pneumonia; performed daily oral care, did not refuse oral care, or reported having xerostomia.

**Table I. Participant demographics\* (n=125)**

Characteristic		1-week (n = 38)	2-week (n = 43)	Control (n = 44)	p-value**
Sex	Male	10 (26.3)	8 (18.6)	4 (9.1)	0.121
	Female	28 (73.7)	35 (81.4)	40 (90.9)	
Age (years)		82.63 ± 9.26	83.14 ± 8.13	85.02 ± 5.76	0.335
Education	None	15 (39.5)	19 (44.2)	23 (52.3)	0.268
	Elementary school	14 (36.8)	14 (32.6)	7 (15.9)	
	≥ Middle school	9 (23.7)	10 (23.2)	14 (31.8)	
Living with partner	Alive	6 (15.8)	11 (25.6)	8 (18.2)	0.509
	Widowed	32 (84.2)	32 (74.4)	36 (81.8)	
LTCI level***	Level 1	6 (15.8)	12 (27.9)	3 (6.8)	0.069
	Level 2	17 (44.7)	12 (27.9)	22 (50.0)	
	Level 3	15 (39.5)	19 (44.2)	19 (43.2)	
LOS (months)***		15.92 ± 13.37	15.49 ± 12.12	18.48 ± 9.08	0.434
MMSE-K***		17.18 ± 6.98 <sup>a</sup>	15.07 ± 6.12 <sup>ab</sup>	13.16 ± 7.84 <sup>b</sup>	0.039
ADL***		33.45 ± 28.67	46.56 ± 33.07	34.14 ± 27.18	0.079

\*Data are presented as mean ± SD or n (%)

\*\*p-values of age, LOS, K-MMSE, and ADL performance were calculated using ANOVA, chi-square tests were used for the remainder.

\*\*\*LTCI, long-term care insurance; LOS, length of stay; MMSE-K, Korean version of Mini-Mental State Examination; ADL, activities of daily living.

The results of the paired *t*-tests comparing the effects of the professional oral care program are displayed in Table III. After intervention, the O'Leary index decreased by 0.90 and by 0.47 in the one week and two-week interval groups, respectively ( $p < 0.001$ ). There was no statistically significant change in the control group. The Winkel Tongue Coating Index decreased by 3.81 post-intervention in the one-week interval group ( $p < 0.001$ ), but there was no significant change in the two-week interval or control groups.

The Löe & Silness gingival index decreased post-intervention by 2.18 and 1.09 in the one-week and two-week interval groups, respectively ( $p < 0.05$ ), with no significant change in the control group. The SFR increased post-intervention by 0.42 and 0.26 in the one-week and two-week interval groups, respectively ( $p < 0.05$ ), and decreased by 0.08 in the control group ( $p < 0.05$ ).

The plaque index, gingival index, and tongue coating index decreased most significantly in the one-week interval group, followed by the two-week interval and lastly the control groups; while SFR increased most significantly in the one-week interval group, followed by the two-week interval group ( $p < 0.001$ ).

## Discussion

This study aimed to assess the effects of an oral health care intervention program on the oral health status and salivary flow of elderly residents living in a long-term care facility. Prior to the intervention, homogeneity across the one-week and two-week interval groups, as well as the control group, was confirmed; only cognitive function differed between the

groups. Elderly residents in long-term care facilities frequently have difficulty performing oral care independently as a result of impaired cognition, mobility, or hand joint micromotion and are generally at high risk for oral diseases.<sup>23</sup> Patients with impaired cognitive function tend to forget about personal oral health care, display resistant behavior to oral care performed by nursing staff, and have difficulty expressing oral pain or discomfort, if present.<sup>24</sup> Although participants' cognitive function differed significantly across groups, the MMSE-K score was  $< 19$  (dementia) in all groups, indicating general impairment. Moreover, the ADL score was 25–49 in all groups, indicating maximum dependence.<sup>18</sup> Since most of the participants required assistance, this study concluded that there was no problem with the homogeneity between groups.

Pre and post evaluation revealed that plaque levels significantly decreased post-intervention in both of the intervention groups, consistent with previous findings.<sup>15</sup> According to recent studies, oral health care is critical to preventing aspiration pneumonia in the elderly and oral function maintenance, muscle strength recovery, and mental health.<sup>16,25</sup> The present study demonstrated the effect of using a combination of various brushing methods to clean the tooth surface and an interdental brush to wipe the interdental and posterior surfaces.

Elderly residents of nursing care homes can suffer hyposalivation due to adverse effects of multiple medications and the resultant increase in tongue coating can

**Table II. General and oral health-related characteristics**

Characteristic	Response	1-week (n = 38) n (%)	2-week (n = 43) n (%)	Control (n = 44) n (%)	p-value*
Number of chronic illnesses	≤ 1	12 (31.6)	17 (39.5)	11 (25.0)	0.587
	2	15 (39.5)	15 (34.9)	22 (50.0)	
	≥ 3	11 (28.9)	11 (25.6)	11 (25.0)	
Number of current medications	≤ 3	21 (55.3)	24 (55.8)	23 (52.3)	0.827
	4-5	14 (36.8)	18 (41.9)	18 (40.9)	
	≥ 6	3 (7.9)	1 (2.3)	3 (6.8)	
Recent pneumonia	Yes	3 (7.9)	2 (4.7)	0 (0.0)	0.184
	No	35 (92.1)	41 (95.3)	44 (100.0)	
Capable of daily oral care	Yes	25 (65.8)	20 (46.5)	26 (59.1)	0.122
	Somewhat	7 (18.4)	19 (44.2)	11 (25.0)	
	No	6 (15.8)	4 (9.3)	7 (15.9)	
Refusal of oral care	Yes	8 (21.1)	19 (44.2)	13 (29.5)	0.076
	No	30 (78.9)	24 (55.8)	31 (70.5)	
Xerostomia	Yes	32 (84.2)	29 (67.4)	36 (81.8)	0.138
	No	6 (15.8)	14 (32.6)	8 (18.2)	

\*p-values were calculated using chi-square test.

**Table III. Comparison of plaque index, tongue coating index, gingival index, salivary flow rate**

Variables	Pre-intervention Mean ± SD	Post-intervention Mean ± SD	p-value*	Between groups p-value**
<b>Plaque index</b>				
1-week	1.52 ± 1.53	0.62 ± 0.75	<0.001	<0.001
2-week	1.39 ± 1.40	0.92 ± 1.04	<0.001	
Control	1.50 ± 1.35	1.47 ± 1.36	0.237	
<b>Tongue coating index</b>				
1-week	5.92 ± 3.51	2.11 ± 2.86	<0.001	<0.001
2-week	5.14 ± 1.95	4.74 ± 2.21	0.215	
Control	4.68 ± 1.89	4.66 ± 1.90	0.323	
<b>Gingival index</b>				
1-week	2.76 ± 3.76	0.57 ± 2.04	<0.001	<0.001
2-week	2.65 ± 5.09	1.55 ± 3.45	0.002	
Control	5.02 ± 5.91	5.11 ± 5.81	0.781	
<b>Salivary flow rate</b>				
1-week	1.07 ± 1.30	1.50 ± 1.55	<0.001	<0.001
2-week	3.35 ± 0.49	3.61 ± 0.82	0.007	
Control	3.11 ± 0.40	3.02 ± 0.40	0.001	

\*p-values were calculated using a paired t-test.

\*\*p-values of SFR were calculated using ANOVA and the remainder with ANCOVA.

lead to increased risk of malodor, caries, periodontal disease, and fungal infections (e.g., oral candidiasis).<sup>26</sup> A sponge brush containing chlor-hexidine was used to wipe the oral mucosa and tongue followed by the application of moisturizer. Tongue coating significantly decreased in the one-week interval group, which was consistent with a previous study.<sup>15</sup> Tongue coating decreased slightly in the two-week interval group, but not significantly. Reduction effects on tongue coating can vary depending on the intervention interval.

The gingival index score also significantly decreased post-intervention in both intervention groups. According to Matthews et al.,<sup>27</sup> 66–74% of elderly residents in nursing homes have comorbid gingivitis and 32–49% require treatment for periodontal disease, a known risk factor of cardiovascular disease.<sup>28</sup> Efforts to prevent progression from gingivitis to periodontitis is necessary. The reduction of gingivitis and improvement of periodontal condition through oral hygiene care were confirmed in this study.

Salivary gland hypofunction disrupts the normal homeostasis of the oral cavity, contributing to a range of oral diseases including dental caries, taste disturbances, candidiasis, and difficulties with swallowing, chewing, and speaking.<sup>29</sup> Ohara et al. reported that oral health care, facial and tongue muscle exercises, and salivary gland massage can increase salivation in elderly patients with xerostomia.<sup>30</sup> This study demonstrated that SFR significantly increased in both experimental groups after massaging the salivary glands and oral muscles, with a greater effect observed in the one-week interval group. This finding has important implications for stimulating salivary function.

Across all measurement indices, the effects were two-fold greater in the one-week versus two-week interval group, which confirms that a shorter intervention interval more markedly improves the oral health status and SFR in the elderly, which has implications for the implementation of a professional oral health care program. However, this study only lasted 12 weeks, and as such, does not reflect the

results of continued care. Future studies should evaluate the effects of implementing the program over a longer time frame.

Limitations of this study include the small sample size and the possible inaccuracy of participant information related to general and oral health-related characteristics as obtained from the nursing staff responsible for the elderly resident. Future research should aim to enhance the sample both in size and representativeness.

## Conclusion

Results from this study demonstrated that the implementation of a professional oral health care program enhances the oral health and salivation in the elderly. Accordingly, oral health professionals, dentists, and dental hygienists, should monitor and manage oral health of the elderly in long-term care facilities. Relevant guidelines for institutions need to be established requiring daily oral hygiene care and regular dental care to elderly residents in nursing homes.

## Disclosure

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## Factors Associated with Burnout among Dental Hygienists in California

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### Abstract

**Purpose:** The Maslach Burnout Inventory (MBI) quantifies the characteristics of mental and physical exhaustion caused by one's professional life. The purpose of this study was to assess the key occupational factors that may contribute to burnout among dental hygienist members of the California Dental Hygienists' Association as measured by the MBI.

**Methods:** A 36-item electronic survey, consisting of questions assessing burnout, demographic information, clinical care and occupational environment, was sent to dental hygienist members of the California Dental Hygienists' Association (n=2211). Mean scores for each of the burnout subscales (emotional exhaustion-EE, depersonalization-DP, and personal accomplishment-PA) were computed using the MBI manual guidelines, and statistically related to the occupational factors.

**Results:** The response rate was 20.9% (n=443). Thirty percent (30.9%) of respondents reported burnout, as identified by the MBI guidelines; 30.0% of respondents reported high emotional exhaustion (scores  $\geq 27$ ) and 11.3% reported high depersonalization (scores  $\geq 10$ ). Only 41.1% reported low levels of personal accomplishment. Emotional exhaustion and depersonalization decreased with increasing age categories (EE:  $F=5.78, p \leq 0.05$ ; DP:  $F=9.26, p \leq 0.05$ ). Respondents between the ages of 35-44 had the highest levels of emotional exhaustion (EE=24.7) and depersonalization (DP=6.34). Respondents reporting higher levels of self-perceived appreciation in the workplace were more likely to have lower EE and DP scores (EE:  $F=5.12, p \leq 0.05$ ; DP:  $F=8.66, p \leq 0.05$ ).

**Conclusion:** Approximately one-third of the dental hygienists in the sample population experienced burnout. Data indicate the importance of expressing well-deserved appreciation to colleagues and the need to develop educational programs to teach practicing dental hygienists and dental hygiene students strategies to prevent and alleviate the symptoms of stress that often lead to burnout.

**Keywords:** dental hygienists, burnout, stress, emotional exhaustion, depersonalization, personal accomplishment

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### Introduction

Chronic occupational stresses can result in clinical disorders such as burnout.<sup>1,2</sup> The term burnout was first introduced to the scientific literature in 1974 by the American psychologist Herbert J. Freudenberger. Burnout was described as a state of mental and physical exhaustion caused by one's professional life, an outcome specifically related to frontline human service workers.<sup>1,3,4</sup> Shortly after burnout first appeared in the literature, Maslach further defined it as a psychological syndrome and developed the constructs of mental fatigue (emotional exhaustion-EE), negative perceptions and feelings about clients or patients (depersonalization-DP), and negative perceptions of one's self, in relation to job performance (reduced personal accomplishments-PA). These characteristics

formed the current Maslach Burnout Inventory (MBI).<sup>4,5</sup> The MBI categorizes the intensity of burnout into a high and low for each subscale. Burnout scores increase when emotional exhaustion and depersonalization subscale scores are higher and personal accomplishment scores are lower.<sup>5</sup>

The progression of burnout has been described as follows; an initial sign of burnout is emotional and physical exhaustion, with the individual feeling overwhelmed with the demands of work and detached from various aspects of the job.<sup>6</sup> Increased detachment may lead to the dehumanization of patients, as providers stop doing their best and are satisfied with performing the bare minimum.<sup>6</sup> As burnout progresses, the individual develops a lower sense of personal accomplishment and a loss

of self-confidence.<sup>6</sup> Burnout can eventually lead to poor health, addiction, depression, and suicide in some cases.<sup>3,7-9</sup>

Health care workers, who are experiencing burnout, have reported adverse effects on the quality of care and service they render to patients.<sup>4,7-13</sup> Health care, as an industry, places numerous pressures on healthcare providers, including the challenges of clinical work, time constraints, competing demands, lack of control over work processes and scheduling, and conflicting roles and relationships with leadership.<sup>4,7-13</sup> Burnout has been associated with job turnover, absenteeism, low morale, and personal dysfunction in healthcare workers and medical errors.<sup>3,4,10,14</sup> A small, but significant, portion of dentists have been found to be affected by burnout and reports have shown that their workplace environment significantly contributed to their burnout risk.<sup>15-18</sup>

Dental hygiene students have also been reported to be susceptible to burnout.<sup>7</sup> In one study, an estimated 22% of dental hygiene students met the criteria for emotional exhaustion and depersonalization.<sup>7</sup> In another study, dental hygienists were found to experience work overload, conflict, emotional disharmony and hurt while delivering patient care.<sup>19</sup> Dental hygienists, who had reported experiencing a lack of a supportive and protective dental management system and low self-efficacy, had significantly higher levels of burnout.<sup>19</sup> Each of these studies has shown that dental hygienists can be impacted by several occupational factors that negatively affect their well-being. While burnout is known to affect healthcare workers, little has been done to rigorously estimate the scope of burnout within the dental hygiene profession. The purpose of this study was to quantify the distribution of burnout, as identified by the Maslach burnout inventory, and to assess the key occupational factors that may contribute to burnout among dental hygienist members of the California Dental Hygienists' Association (CDHA).

## Methods

This cross-sectional quantitative study, was approved by the Institutional Review Board of The University of California, San Francisco (UCSF) and was conducted using Qualtrics® (Provo, UT, USA), an online survey research software program. Explicit permission was obtained from Mind Garden, Inc. (Menlo Park, CA, USA) for the use of the Maslach Burnout Inventory Human Services Instrument (MBI-HSS), and the authors and the researchers complied with the license and copyright agreements.<sup>5,20</sup> The target population was dental hygienists who were members of the California Dental Hygienists' Association (CDHA) and whose email addresses were available within the CDHA database.

The survey instrument consisted of 36 items in the following domains: the MBI-HSS (22, 7-point Likert scale items), clinical care and occupational environment (8 multiple choice items), and demographic information (6 multiple choice items). The MBI-HSS survey has proven to be a valid and reliable measurement for burnout among dental students and dentists.<sup>21-24</sup> Prior to finalizing survey items, 9 dental hygienists (one enrolled in the UCSF Master of Science in Dental Hygiene program, six UCSF dental hygiene faculty members, one retired clinician, and one full-time clinician) pilot-tested the survey to verify the content and clarity of the survey items. The survey was then revised and finalized based on the results of the feedback. Instructions to the survey stated that participants should respond to the survey items based on if they currently feel or have ever felt this way about their job.

The administration of the CDHA facilitated the recruitment of California dental hygienists by distributing the link to the study, including the informed consent and survey instrument, to all CDHA members whose email addresses were in the CDHA database (n=2100). The first distribution was sent May 4, 2019. Informed consent was implied by the participants responding to the survey items. Participants responded to the survey online and the resultant data were captured using Qualtrics® online survey platform. The CDHA sent a single follow-up email three weeks (May 24, 2019) following the initial request which included a message for participants, who previously had responded, to disregard the notice.

## Data analysis

Descriptive statistical analyses were used to report the frequencies with percent contributions for categorical variables and arithmetic means with standard deviations for continuous variables. Mean scores for each of the burnout (MBI-HSS) subscales have been estimated by calculating the mean value of the total contributing items. The burnout risk in terms of emotional exhaustion (EE), depersonalization (DP), and reduced personal accomplishments (PA) scores were computed by following the MBI manual guidelines.<sup>20, 24</sup> Individuals are considered to have burnout if they have EE scores (27 or higher), DP scores (10 or higher), and a PA score (less than 33).<sup>24</sup> Each of the MBI-HSS continuous subscales were divided into tertiles representing low, moderate and high scores.

To assess whether there was a significant difference between the presence and absence of burnout in reference to each of the demographic variables and professional characteristics, chi-squared tests were utilized for categorical variables and analysis of variance (ANOVA) for continuous variables. In

order to control the type 1 error rate, the Benjamin-Hochberg false discovery rate method was used. All statistical analyses were conducted at the 0.05 significance level and performed using the STATA Statistical Software release 13 (Stata Corp LP; College Station, TX, USA).

## Results

A total of 2,111 electronic surveys were emailed to members of the CDHA whose addresses were in their database; among those, 895 surveys were opened. Four hundred sixty-one members (n=461) responded to the survey, resulting in a response rate of 20.9%. Eighteen surveys were dropped due to excessive missing values yielding a final sample (n=443).

The average age of the respondents was  $50.9 \pm 13.1$  years. Respondents were mainly female, married, and graduated from an associate entry-level dental hygiene program. Almost half the respondents had earned additional degrees, primarily a bachelor's degree (data not shown). The average number of years practicing was  $23.2 \pm 15.4$  years. Most respondents were currently employed in private practice and worked four days a week. The non-clinical respondents were employed primarily at educational institutions and worked 1-3 days. Over half of all respondents perceived being appreciated at work always or most of the time. Respondent demographics are shown in Table I.

The specific survey items for each subscale of the MBI are listed in Table II. According to the MBI guidelines, higher

**Table I. Demographic characteristics (n=426)**

	n	%		n	%
<b>Age, n=417</b>			<b>Days per week practicing clinical dental hygiene, n=375</b>		
22-34	59	14.15	1 to 2	72	19.2
35-44	85	20.40	3 to 4	233	62.13
45-54	80	19.20	5 to 7	70	1.33
55-64	124	29.70	<b>Entry-level dental hygiene education, n=439</b>		
65 and over	69	16.55	Associate Degree	314	71.33
<b>Gender, n=426</b>			Bachelor's Degree	125	28.67
Female	421	98.83	<b>Clinical practice setting, n=405</b>		
Male	5	1.17	Private	343	84.69
<b>Marital status, n=428</b>			Community Health Center	25	6.17
Divorced/Separated	49	11.45	DSO/Corporate	17	4.20
Married/Partner	311	72.66	Academic Institution	20	4.94
Single	61	14.25	<b>Setting of non-clinical dental hygiene position, n=96</b>		
Widowed	7	1.64	Continuing Education	18	18.75
<b>Currently practicing dental hygiene, n=437</b>			Corporate/Private: Administrator	7	7.2
Yes	380	86.96	Educational Institution	54	56.25
No	57	13.04	Oral Health Industry	17	17.70
<b>Years practicing clinical dental hygiene, n=368</b>			<b>Days working in non-clinical position, n=120</b>		
1-5	73	20.38	1-3	77	18.51
6-10	43	51.71	4-7	43	10.34
11-15	35	10.34			
16-20	34	9.5			
20-25	29	8.4			
>25	154	39.77			

**Table II. Maslach Burnout Inventory survey items by subscales\***

Maslach Burnout Inventory Survey Items**	Mean of all Respondents	Standard Deviation
<b>Emotional Exhaustion (EE) Subscale</b>		
1. Emotionally drained from my work	3.74	1.79
2. Used up at the end of the work day	4.11	1.96
3. Fatigued when get up in the morning	3.35	1.94
6. Working with people puts too much stress on me	2.18	1.56
8. Burned out from my work	3.25	1.91
13. Frustrated by my job	3.57	1.90
14. Working too hard on my job	4.06	2.08
16. Working with people all day is a strain	2.59	1.65
20. At the end of my rope	2.24	1.68
<b>Depersonalization (DP) Subscale</b>		
5. Treat patients as impersonal objects	1.58	1.23
10. More callous toward people since I took this job	1.86	1.39
11. Worry that job is hardening me emotionally	1.77	1.47
15. Don't really care what happens to some patients	1.53	1.09
22. Patients blame me for their problems	1.97	1.44
<b>Personal Accomplishment (PA) Subscale</b>		
4. Can easily understand patient's feelings	6.4	1.30
7. Deal effectively with the patients' problems	6.54	1.07
9. Positively influencing people's lives through my work	6.28	1.22
12. Energetic	5.69	1.48
17. Can easily create a relaxed atmosphere for my patients	6.66	0.83
18. Exhilarated after working with patients	5.66	1.66
19. Accomplished worthwhile things in this job	5.84	1.60
21. Deal with emotional problems calmly in my work	6.00	1.58

\*Higher scores for the EE and DP subscales and lower scores for the PA subscale indicate burnout

\*\*Participants were instructed to respond to survey items based on "If you ever feel or felt this way about your job."

scores on the subscale EE and DP and lower scores on the subscale PA are associated with burnout.<sup>11,25</sup> The mean scores and standard deviations of the respondents on the MBI subscales were distributed as follows: (EE 20.0±14.0, DP 3.7±4.7, PA 40.2±7.7). Thirty percent of the respondents were classified as having high emotional exhaustion (mean EE scores 27 or higher), 11.3% of respondents were classified as having high depersonalization (mean DP scores 10 or higher), and 41.1% of respondents were classified as having low personal accomplishment (mean PA scores less than 33) (Table III). Based on the MBI subscales, 30.9% (n=137) of the respondents experienced burnout.

**Table III. Binary distribution of respondents for each subscale and burnout, according to MBI criteria\***

	n	%
<b>Emotional Exhaustion Binary</b>		
Yes (≥ 27)	133	30.02%
No (< 27)	310	69.98%
<b>Depersonalization Binary</b>		
Yes (≥ 10)	50	11.29%
No (< 10)	393	88.71%
<b>Personal Accomplishment Binary</b>		
Yes (< 33)	261	58.92%
No (≥ 33)	182	41.08%
<b>Burnout Binary</b>		
Yes (EE ≥ 27 or DP ≥ 10)	137	30.9%
No (otherwise)	306	69.1%

\*Individuals have at least one symptom of burnout if they have scores in either EE (score of 27 or higher) or DP (score of 10 or higher) subscales

Mean MBI scores were significantly different across the five age categories in the entire study population. The ANOVA F-test showed that emotional exhaustion and depersonalization decreased with increased age (EE: F-test=5.78, p-value=0.0002, DP: F-test=9.26, p-value=0.0001). Bonferroni post hoc tests indicated statistically significant (p<0.05) differences in mean EE scores between the age groups 35 to 44 years (EE=2.3) and 65 to 85 years (EE=1.3), and between the age groups 55-64 years (EE=2.3) and 65 to 85 years (EE=1.3). No significant age differences were identified in personal accomplishment scores. Respondents who

**Table IV. Demographics characteristics of respondents and burnout**

	No Burnout		Burnout		Statistical test,* p-value
	n	%	n	%	
<b>Age</b>					c2 = 19.43, <0.001
<34	33	11.34	26	19.70	
35-44	47	16.15	37	28.03	
45-54	62	21.31	28	21.21	
55-64	95	32.65	28	21.21	
>65	54	18.56	13	9.85	
<b>Marital status</b>					c2 = 2.86, 0.413
Married/Partner	217	73.06	94	71.76	
Divorced/Separated	36	12.12	13	9.92	
Single	41	13.80	20	15.27	
Widowed	3	1.01	4	3.05	
<b>Entry-level education</b>					c2 = 2.72, 0.099
Associate degree	221	73.67	89	65.93	
Bachelor's degree	79	26.33	46	34.07	
<b>Currently practicing</b>					c2 = 0.56, 0.45
Yes	267	88.12	112	85.50	
No	36	11.88	19	14.50	
<b>Years practicing</b>	<b>21.3 yrs</b>	<b>SD = 15.37</b>	<b>20.9</b>	<b>14.14</b>	<b>T=0.26, 0.79</b>
<b>Number of days practicing</b>					c2 = 1.13, 0.566
1 to 2	47	17.94	25	22.12	
3 to 4	167	63.74	66	58.41	
5 to 7	48	18.32	22	19.47	
<b>Clinical setting</b>					c2 = 4.41, 0.220
Academic institution	10	3.83	10	8.77	
Community health center	16	6.13	9	7.89	
DSO/ corporate	12	4.60	5	4.39	
Private practice	223	85.44	90	78.95	
<b>Non-clinical setting</b>					c2 = 4.07, 0.40
Continuing education	12	4.69	6	5.66	
Corporate/private	4	1.56	1	0.94	
Educational institution	33	12.89	21	19.81	
Oral health industry	8	3.12	5	4.72	
<b>Appreciated at work</b>					c2 = 017.31, 0.002
Never	14	4.71	5	3.76	
About half the time	33	11.11	26	19.55	
Sometimes	67	22.56	16	12.03	
Most of the time	139	46.80	52	39.10	
Always	44	14.81	34	25.56	

\*c2= chi-square test; T = student's t-test

often felt appreciated at work were more likely to have lower EE and DP scores (EE: F-test=5.12, p-value=0.0005, DP: F-test=8.66, p-value=0.001). There were no statistically significant differences in EE, DP or PA scores for marital status, currently practicing, years practicing clinical dental hygiene, practice setting, days per week practicing. The sample demographics and burnout/no burnout are shown in Table IV.

## Discussion

This study quantified the distribution of burnout subscales, as identified by the Maslach Burnout Inventory Human Services Instrument (MBI-HSS) and assessed the key occupational factors that may contribute to burnout in dental hygienist members of the CDHA. Burnout was determined by the assessment of the three MBI-HSS subscales: emotional exhaustion (EE), depersonalization (DP) or cynicism, and personal accomplishment (PA) of the respondents. Based on the results, one third of the respondents experienced burnout. The mean scores on the MBI subscales (EE: 19:97, DP:3.65, and PA:40:21) of the respondents in this study were similar to the scores reported in a previous study of nurses (EE:22.0, DP:9.4, and PA:37.0). As the performance of the MBI-HSS items and reliability of the subscales in the multinational nursing study had been validated, the similarity of these data supports the validity of the MBI-HSS research tool in this study.<sup>23</sup>

The EE subscale scores of the respondents in this study and in the study of nurses from eight countries (United States,

Canada, United Kingdom, Germany, New Zealand, Japan, Russia and Armenia) were high and relate to the emotional exhaustion of the respondents. Respondents reported “feeling used up at the end of the day” and “feeling that they work too hard on the job”. Based on their MBI scores, 38% of the first- and second-year dental hygiene students at the Virginia Commonwealth University, also met the criteria for emotional exhaustion and depersonalization.<sup>7</sup>

The respondents’ scores for the subscale DP were lower than expected. Scores were low for questions asking “Do you treat patients as impersonal objects?” and “Do you care what happens to patients?” These findings support a study that also found low depersonalization scores among female health care workers.<sup>26</sup> Females have been reported to be more empathetic towards their patients than males and may avoid burnout by developing coping strategies.<sup>27</sup> Ninety-eight percent of the respondents in this study were female, so it is not unusual that the DP scores in this study were low.

The majority of respondents scored high in the subscale PA. According to Maslach, low, not high, PA indicates burnout.<sup>21,24</sup> Respondents in this study reported that they can easily create a relaxed atmosphere and that they can deal effectively with the patient’s problems. These findings are consistent with research conducted by O’Connor et al., who reported that despite a high level of emotional exhaustion and a moderate level of depersonalization, health care workers reported maintaining a high level of personal accomplishment.<sup>4</sup> Despite feeling exhausted, overextended, depleted and disconnected, they indicated that they still felt competent.<sup>4</sup> Additionally O’Connor et al, found that health care workers with a sense of autonomy and an ability to make their own decisions reported higher levels of personal accomplishment, which may also be related to an association of high personal accomplishment and increased age.<sup>4</sup> Another study by Rada et al. reported that people who display high levels of decisiveness, are self-reliant, maintain high self-worth and have developed good problem-solving and information-seeking skills, cope better under stressful conditions.<sup>2</sup> These attributes would relate to a higher personal accomplishment scores than those indicated for burnout according to the MBI.

Respondents in the older age group experienced less burnout than those in the 35-44 age group in this study. This 35-44 age group, born between 1975 and 1984, may include those in the generation X or the millennial generation, depending upon their position in the age range and the source of dates. Consequently, this age group may have characteristics associated with both generations, such as being independent, flexible, and adapting well to change.<sup>28</sup> Some

of these generational attributes may not work well with a structured dental office environment, such as a preference for managing one’s own time and tasks, and showing less respect for older workers in positions of authority,<sup>28</sup> which may create work-related stressors for the respondents in this age group. This age group may also have more family responsibilities, including child rearing and caring for aging parents, affecting their work/life balance. On the other hand, the respondents aged 65 and older, members of the baby boomer generation, are known to be good team players, with a preference for structure.<sup>28</sup> These characteristics are considered to be more conducive to the dental team relationship and in turn, may minimize work-related stress. Furthermore, these older respondents may have developed coping skills, learning how to adapt to stressful situations through life experiences. Future research could examine the specific stressors for generational age groups and explore their impact on burnout. While some studies have shown that increasing age has a positive effect on dentists’ mental health, resulting in less burnout,<sup>27,29</sup> Gorter reported that high numbers of dentists were leaving the profession and taking early retirement because of work-related stress.<sup>17</sup> Reconciling work-family conflicts have been identified as an important reason for physicians leaving clinical practice.<sup>26</sup>

This study separated the dental hygienists employed in academic or educational institutions into two categories: clinical (patient care) and non-clinical (teaching, research, and administration). As several survey items referred to “patients,” it is unknown how the non-clinical respondents responded to these items. These educators may have responded based upon their interactions with students, patients of the students, or their administrators. Interactions with each of the three would influence or be influenced by the others. Administrators of dental hygiene educational programs have been reported to experience stress and burnout; common stressors were reported to be family responsibilities, administration and faculty conflict, inability to supervise staff, academically struggling students, overwhelming accreditation procedures, heavy teaching or leadership loads and limited resources.<sup>30</sup> Dental hygiene educators, as well as administrators, who are experiencing stress and burnout, may impact the learning environment of their students. Deeb et al. described faculty burnout affecting burnout in students.<sup>7</sup> While the challenges of the dental hygiene curriculum may place students under chronic stress, both students and educators may also be experiencing stress due to personal life events and family demands. These same stressors may affect dental hygiene practitioners, along with the additional demands related to employment, such as issues with bosses, co-workers, and patients. However, dental hygiene

practitioners, who are often older than dental hygiene students, may have developed and refined stress management skills, so the intensity of the stressors may be diminished. The dental workplace environment in Korea was described by Jeung et al., as having rigid rules and greater expectations of employer-employee behaviors, which could be important job stresses, and may be similar to some dental practice environments in the United States.<sup>19</sup>

A major predictor of burnout was lack of appreciation from management. In this study, respondents, who felt appreciated at work more frequently, had less emotional exhaustion and less depersonalization. This finding is consistent with those of Jeung et al., who found that a lack of a protective or supportive management system was a significant predictor of burnout.<sup>19</sup> This also validates the six contributory factors described by Maslach and Leiter: lack of control, personal conflict, insufficient reward, work overload, absence of fairness, and breakdown of community.<sup>6,27</sup> Receiving recognition engages people in their work, and thanking colleagues for their contribution creates a culture of appreciation.<sup>6</sup> Dentists and dental auxiliaries who like each other and work well together, are able to raise each other's stress tolerance levels, resulting in less burnout.<sup>2</sup>

In order to prevent and alleviate burnout, dental hygienists need stress management training.<sup>2,4,6,12</sup> Preventive stress management strategies might include relaxation, health, nutrition, spiritual renewal and financial planning.<sup>4</sup> In a study by Gorter et al., dentists who scored high for burnout on the MBI, enrolled in a program to restore inner balance and develop a personal plan of action.<sup>31</sup> These dentists reduced their levels of burnout and post stress management program scores showed significant improvement on the MBI scales of emotional exhaustion and personal accomplishment.<sup>31</sup> Physical exercise, such as regular walking or working out, burns up the additional supply of adrenaline resulting from stress.<sup>2</sup> These coping strategies increase self-esteem, self-control and self-discipline. Studies have shown that strong positive self-images and knowing how to relax, reduces mental and emotional pressures and the ability to better cope under stressful situations.<sup>2,32</sup>

Burnout has been shown to be a risk factor for patient safety. Studies have demonstrated that health care workers experiencing burnout, can adversely affect the quality of care delivered to patients.<sup>8</sup> The respondents in this study may be experiencing burnout, due to their high scores for emotional exhaustion, but their scores for the depersonalization and personal accomplishment subscales indicate that patient safety may not be a concern in the sample population. In spite of high

emotional exhaustion scores, respondents indicated feeling interested and confident in delivering excellent patient care.

One limitation of this study is the response rate of 20.9%. Low response rates are common in web-based surveys of healthcare professionals, especially those that have been distributed by professional organizations using membership email addresses. Based on a meta-analysis comparing web-based survey response rates to other survey modes, Manfreda and colleagues reported an average of 11% for web-based surveys.<sup>33</sup> While Internet studies have the ease of administration, the lower response rates can contribute to response bias.

Another limitation is the use of a self-reported survey, which can suffer from recall bias and social desirability. Knowledge of the study topic (burnout) may have affected the participants' responses, as well as those who participated. Furthermore, generalizing these data to all California dental hygienists may be compromised by the fact that two of the demographic characteristics of the participants do not appear to be representative of the California dental hygienist population: age and degree granted from their entry-level dental hygiene program. The mean of 50 years may reflect that older dental hygienists have more time to complete surveys or may be more interested in burnout. The mean percentage of respondents graduating from a baccalaureate degree entry-level program was higher than expected, considering that California currently has only three baccalaureate degree programs, and 23 associate degree programs. However, the percentage may be more related to earlier proportions of the two types of programs, considering the mean age of the respondents. Limiting the sample population to CDHA members, also limits the generalizability of the results. Older dental hygienists, who were no longer CDHA members, would not have been included in the study. These individuals may have retired because of burnout.

In spite of these limitations, this study provides a foundation for further studies on burnout in dental hygienists. Surveying different groups separately, such as clinicians working in a dental practice, administrators working in dental hygiene practices, students, and educators, would yield more detailed information about the factors contributing to burnout in the specific group. Using separate sets of survey items, specific to the potential respondents, would avoid the limitation not knowing how non-clinical respondents responded to surveys items referring to patients. Another suggestion would be to use a database of licensed dental hygienists versus one of those belonging to a specific organization, especially if retired or inactive status is included in the database. It would be insightful to determine whether or not the retirement was a result of burnout.

## Conclusion

Based on the findings of this study, dental hygienists are susceptible to burnout, especially to emotional exhaustion. Burnout may have many negative ramifications, both personally and professionally. Dental hygiene students and practicing dental hygienists need to be made aware of the condition and be able to recognize the early signs and symptoms. Educational programs need to be developed, focusing on practices to prevent or alleviate the symptoms of stress, which often lead to burnout. The observed relationship between self-perceived levels of appreciation, emotional exhaustion and depersonalization indicates the need to teach coping behaviors for challenging situations and the importance of expressing well-deserved appreciation to colleagues.

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## Research

# Interprofessional Health Care Delivery: Perceptions of oral health care integration in a Federally Qualified Health Center

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### Abstract

**Purpose:** The purpose of this qualitative ethnographic case study was to explore the perceptions of a team of interprofessional healthcare providers regarding how oral health care was integrated into health care provided within a Federally Qualified Health Center (FQHC) in Brighton, Colorado.

**Methods:** Data were gathered through one-on-one, semi-structured personal interviews, which were recorded and professionally transcribed for evaluation. Purposive sampling included physicians, physician assistants, dentists, and dental hygienists. Descriptive analysis was used to describe the sample demographics. An inductive and deductive approach was utilized to assess the qualitative data and subsequently develop themes. Validity was established using triangulation, member checks, and peer review of data and themes by co-investigators.

**Results:** Eight participants (n=8) were interviewed. Subjects were between the ages of 31 and 58 and had been practicing between 5 and 30 years with an average of 13.6 years and had been employed by the FQHC an average of 6.8 years. Thematic analysis revealed seven themes: interprofessional collaboration supports patient care, immediate consultations lead to improved outcomes for all, shared expertise to optimize care delivery, oral health is health, increased communication through collocation, role clarity does not impede team functioning, and mission driven to provide excellent care. These themes support the domains of patient centered care, communication, and the role clarity of the Interprofessional Care Competency Framework and Team Assessment Toolkit (ICCFTAT).

**Conclusion:** Findings from this study can aid FQHC's in the implementation of integrated oral health care delivery systems. Further research is needed to understand how interprofessional health care collaboration (IPHC) affects the team dynamic in FQHC settings.

**Keywords:** oral health, oral health care integration, interprofessional health care, patient-centered care, medical home, Federally Qualified Health Center

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### Introduction

Oral health is an essential component of systemic health;<sup>1,2</sup> however, many people have limited access to oral healthcare services.<sup>3</sup> There are many explanations why accessibility may be an issue; socioeconomic, poor oral health literacy, lack of dental insurance coverage, race, and ethnicity can all play a role.<sup>4</sup> Access to oral health care is not only important, but is a basic human right; therefore, it should be available to all people in the United States (U.S.).<sup>2</sup> Providing avenues where patients are able to seek improved health care, including oral health, is an important aspect of overall health.

Federally Qualified Health Centers (FQHCs) are integral to the U.S. healthcare system; one in twelve people use this safety net for their health care.<sup>5</sup> Oral health is an important constituent of systemic health; oral health and systemic health have been demonstrated to be inextricably linked.<sup>1</sup> FQHCs have a unique opportunity to positively impact the overall health status of millions of people.

Creating opportunities where oral health care is integrated with patient-centered health care within the FQHC system is essential to realizing the health care goals set forth by Healthy

People 2020, the U.S. Surgeon General<sup>2</sup> and the National Academies of Sciences Engineering and Medicine, Health and Medicine Division (HMD).<sup>3</sup> According to the Health Resources and Services Administration (HRSA) in 2018, over 27 million people across the U.S. relied on HRSA-funded health centers for care.<sup>5</sup> These FQHC's serve as a safety net for people who otherwise might not have access to health care.<sup>6</sup>

Many health centers have incorporated teams of health care providers who work together to provide whole body care.<sup>7</sup> Approaching health care in this holistic approach may also improve patient outcomes. Recognizing good oral health is essential to quality of life, many FQHCs have also<sup>8</sup> incorporated oral health services in their mission.<sup>7</sup> According to Grisanti et al., "FQHCs with a dental component are a primary safety-net solution for vulnerable populations and help decrease the barriers and inequities at-risk populations face in accessing and utilizing oral care."<sup>9</sup> While FQHCs are mandated by the federal government to provide preventive oral health care services, there continues to be a gap between an effective, standardized system for providing comprehensive oral health services to the underserved.<sup>7</sup> For this gap to be minimized, it is essential that patient-centered medical homes implement oral health care programs.

Incorporating interdisciplinary health care teams increases communication between medical and in between providers to improve healthcare delivery. Interprofessional health care collaboration (IPHC) occurs when two or more professionals from different health care backgrounds work together, leveraging shared knowledge which promotes comprehensive health care for the patient.<sup>10-12</sup> There are many avenues for IPHC to be utilized, however, there is a decided lack of direction regarding best practices for execution of IPHC programs. Although this model of delivery has been supported by the World Health Organization and the HMD implementation of IPHC continues to lag.<sup>3</sup>

Recently, there has been an emerging interest in IPHC as an avenue to improve communication and health care outcomes.<sup>13</sup> There are many advantages for patients who receive their care through IPHC including an integrated health record allowing for greater communication between health care providers, timely care for improved overall systemic health, and patient-centered care.<sup>14</sup> As more research becomes available, linking poor oral health outcomes to higher systemic health risks, it is becoming increasingly important to interlink health care delivery. Even though IPHC is the recommended model for health care delivery, there continues to be separation between the delivery of oral health care and medical health care.<sup>3</sup> Creating patient centered medical homes

promoting IPHC is essential to improving oral and systemic health for all populations, regardless of the socioeconomic levels of the patients receiving care.

The Interprofessional Care Competency Framework and Team Assessment Toolkit (ICCFTAT) was developed by the Toronto Academic Health Science Network in collaboration with the University of Toronto Centre for Interprofessional Education.<sup>10</sup> This framework and toolkit were created as a means for multiprovider healthcare organizations to adopt IPHC as a method for health care delivery. The ICCFTAT consists of six domains or competencies: Patient/Client/Family/Community Centred Care, Communication, Role Clarity, Conflict, Team Functioning, and Collaborative Leadership.<sup>10</sup>

The first domain, patient centred care, seeks to engage the client in shared decision making.<sup>10</sup> In the communication domain, the team actively shares information and solicits communication from team members to aid in comprehensive understanding. Role clarity affects the functionality of the team. In this domain, the providers understand their individual roles and the roles of other providers and supporting collaborative members. Knowledge is leveraged to establish and achieve quality patient outcomes.<sup>10</sup> Within the conflict domain, the team confronts disagreements to develop resolutions. The fifth competency, team functioning, encompasses how well the team demonstrates the principles of team-work dynamics, principles and processes that enable effective IPHC. The final domain is collaborative leadership. In this competency, providers support a team culture which promotes shared decision making, equity, and leadership across all levels of the team.<sup>10</sup> These competency domains served as the theoretical framework for examining how oral health care was integrated into a FQHC medical home and how the integration affected the providers. The purpose of this qualitative ethnographic case study was to explore the perceptions of a team of interprofessional healthcare providers regarding how oral health care was integrated into health care provided within Salud Family Health Centers, a Federally Qualified Health Center (FQHC), in Brighton, Colorado.

## Methods

A qualitative approach was chosen for this ethnographic case study of how the health care provider culture of Salud Family Health Centers in Brighton, Colorado impacted the integration of oral health care into the patient-centered medical home of the FQHC. Data was collected by the principal investigator (PI), through recorded one-on-one semi-structured personal interviews. Participant anonymity was protected through the use of pseudonyms.

Once exemption status was determined by the Institutional Review Board at Idaho State University, a purposive sampling approach<sup>15</sup> was used to recruit the participants. This approach was selected since it is known to reflect the average person, situation, or instance of the phenomenon of interest.<sup>15</sup> Sample sizes were not pre-determined; recruitment continued until saturation was achieved. Inclusion criteria included individuals with a minimum of sixteen direct patient contact hours per week and employment for a minimum of one year in their position. Maximum variation was achieved through purposeful sampling, which has been shown to increase the transferability of the results.

Physicians, physician assistants, dentists, and dental hygienists were included in the sample. Informed consent was given verbally following receipt of a written consent document. Participants received a copy of the interview guide one week prior to their scheduled interview. Anonymity was safeguarded by employing pseudonyms during the interview process as well as on the transcripts. Audio recordings were transcribed verbatim by a professional transcriptionist, who signed a confidentiality agreement; participants' names were blinded to the transcriptionist. The interview guide was reviewed by the co-investigators to ensure rich contextual information would be gained through open-ended questions. One of the co-investigators joined a pilot video conference with the PI and a non-enrolled test subject to confirm that the PI was well versed in the interviewing technique. The interview guide is shown in Table I.

**Table I. Interview guide**

Can you tell me about a time when oral healthcare integration was used in patient care?
How did this impact your patient?
Can you tell me what impact oral healthcare integration has on your professional practice?
How do you feel about oral healthcare integration?
How does communication occur between medical and dental providers?
How does this type of communication impact the healthcare you provide?
How is patient information shared?
How is care coordinated between medical and dental providers?
How does role clarification and coordination of care impact healthcare operations at Salud Family Health Centers?

Descriptive analysis was used to describe the demographics of the sample. Information gathered included gender, age, role within the FQHC, number of years practicing, and number of years providing healthcare at Salud Family Health Centers. An inductive and deductive approach was employed to assess the qualitative data followed by identification of themes. The transcribed interviews were concurrently assessed and refined with current data collection to ensure rich contextual information was gained.

Establishing trustworthiness is crucial as it aids in ensuring the validity and reliability of the data. Several methods were employed to increase data authenticity. First, the study questions were gathered using a triangulation of data strategy; multiple perspectives were gathered from different subjects. This approach enabled the primary investigator to develop converging themes from these data.<sup>16</sup> Second, member checks or respondent validation was used to ensure initial findings were accurate with the subjects interviewed.<sup>15</sup> Finally, the PI's position as a member of the interprofessional team at Salud Family Health Centers was disclosed in all findings from this study. Data and themes were cross-checked by peer review with the co-investigators.

## Results

Eight health care professionals (n=8), between the ages of 31 and 58 years, participated in this study. Participants had been practicing in their respective professions between 5 and 30 years with an average of 13.6 years and had been employed by the FQHC an average of 6.8 years. Participant demographics are shown in Table II.

Thematic analysis revealed seven themes related to the research questions examining how oral health was integrated and how this integration affected the providers in the FQHC. The following themes were identified: interprofessional collaboration supports patient care, immediate consultations lead to improved outcomes for all, shared expertise to optimize care delivery, oral health is health, increased communication through collocation, role clarity does not impede team functioning, and mission driven to provide excellent care. Each theme will be explored in depth.

### *Interprofessional Collaboration Supports Patient Care*

Interprofessional collaboration supports patient care was the first theme to emerge from the data. Participants expressed thoughts of multiple healthcare professionals functioning as a single unit improved patient care. This collaboration was evident for both medical and dental providers. One participant stated:

**Table II. Participant demographics (n=8)**

	n	%
<b>Gender</b>		
Male	3	37.5%
Female	5	62.5
<b>Age range</b>		
30-39	6	75%
40-49	1	12.5%
50-59	1	12.5%
<b>Profession</b>		
Physician	2	25%
Physician Assistant	2	25%
Dentist	2	25%
Dental Hygienist	2	25%
<b>Range of years of practice</b>		
1-9	3	37.5%
10-20	4	50%
30-40	1	12.5%
<b>Span of years at Salud Family Health Centers</b>		
1-5	4	50%
6-10	2	25%
11-14	2	25%

*“I had an elderly patient who vaguely mentioned liver disease on her medical history. We did a simple extraction on her and the area bled excessively. I reached out to her primary care provider who is here at Salud and we had multiple conversations both in person and via our electronic medical record. Based on these conversations, we modified her treatment plan and avoided any future extractions.” - Bosco, dentist*

In addition to the primary theme, a subtheme of confirmation as part of collaboration was identified. Medical providers utilized the dental hygienists as the first responder to aid in confirmation of diagnosis.

*“I use it regularly, but anytime I have a patient that has an oral concern that I’m not quite certain what’s going on or I think I know, I will call in a hygienist to look in the patient’s mouth.” - Lucy, physician assistant*

### ***Immediate Consultations Improved Outcomes for All***

The second theme extrapolated from these data demonstrated that the immediacy of consultations improved outcomes for both patients and providers. Patients were positively impacted when providers were able to consult with other professions. One of the physicians stated, “It got him care and the biopsy a whole lot faster than if we had had to refer him out,” J. Lo. This impact was evident across the spectrum of health care providers. When discussing patient care, one dentist stated, “We had the whole team discussing every aspect of her treatment and how to proceed, so it was really beneficial to her.” Bosco.

Medical providers were also positively impacted by having immediate consultations as they offered further education, reassurance, and confirmation of follow-up care for the patient. Shannon, a physician assistant, stated how consultations with oral health professionals provided reassurance when diagnosing and treating the patient. She discussed her lack of formal education regarding oral health issues and how to treat oral disease.

*“We get a lot of patients that come in for facial swelling or dental pain. Because I am not trained very well in that area, it’s hard. I could make a general assumption of what’s going on, but I was able to get the dentist to come over and take a look and give me suggestions.” Shannon*

### ***Shared Expertise to Optimize Care Delivery***

Another dominant theme that became apparent was the perception of active involvement of experts in their fields in order to optimally deliver exceptional care to the patient. Providers felt practicing in this environment enabled them to provide enhanced care for their patients. One physician stated:

*“It certainly widens the scope of patients that I can take care of and makes me feel a lot more confident about patients coming in that they are getting the care they need. It makes my job easier. Obviously, I don’t have a lot of dental training and so to be able to have those resources and the staff members on staff that can help take care of those patients makes my day phenomenally a lot easier. When it’s integrated in the clinic setting, I can get those answers right away and it doesn’t take hours or extra work.” Victor Krum.*

This sentiment was echoed by Bosco, one of the dentist participants, who said, “It totally enhances my ability to care for patients.”

Several subthemes linked to this theme were apparent in the data. Health care providers realized that they were able to utilize the expertise of others felt more assured when treating medically complex patients. Bosco, a dentist, stated, “I feel confident having the resources in the same building to help me make sure our patients receive the best possible whole person care.” Practicing in this enhanced environment also led to increased fulfillment for several providers, as they were able to utilize the full scope of their education. Sara, a dental hygienist, stated, “I feel much more fulfilled. I feel like our patients get so much better care, through the MDI [medical dental integration] program but also through our clinical practice.”

## **Oral Health is Health**

Practicing health care within a facility with multiple professions working together and learning from each other, led to providers realizing the impact of oral health on systemic health. Rufus, a dentist, discussed how medical providers are affected by this proximity. “I think that Salud physicians are much more in tune to dental disease and preventing that, and how dental disease can impact the overall health of their patient.” Lucy, a physician assistant, echoed this sentiment with, “I think it [oral health] really affects overall long-term health.”

### **Increased Communication through Collocation**

The proximity of medical and dental providers practicing healthcare together facilitates open communication between the professionals. One of the dentist participants, stated,

*“I guess, officially through consults being sent, referrals being sent electronically. It can also occur with a physician from urgent care stepping over, walking through the doors and coming to one of our offices and asking us if we had time to take a look at something.” Rufus*

A sub-theme which arose within this category was that communication was fundamental in creating a medical health care home where patients were able to have multiple needs addressed in one appointment. A dentist, Rufus, indicated how open lines of communication can lead to safer health care choices and treatment for the patient. “...I think that having knowledge, you can be more informed in making a decision about their [the patient] treatment...can lead to a safer practice.” Furthermore, good communication strategies allow for a unified message to be heard by the patient being treated. One physician, Victor Crum, said, “I think when they [the patients] hear it from one person, it’s easily forgotten. But when you hear it from multiple sources, I think it gives the patients more reinforcement.”

### **Role Clarity Does Not Impede Team Functioning**

Providers within this FQHC were not unified when determining whether their roles were distinct or blurred. Perception of the individual’s role within the team can impact role clarity. Even though this area of the study was not clarified within the sample, it was evident that role clarity did not have a negative impact on how the team functions in the delivery of health care. Participants often discussed co-treating patients, implying a shared burden when it came to patient care which in turn impacted their ability to effectively treat patients. One of the dentists, Rufus, stated, “I feel that a lot of the medical providers at Salud feel comfortable diagnosing basic dental disease because we are here and because we do interact, and there is training and education that can go on.”

The participants also felt that having communal patients had a positive impact on patient outcomes. A physician, Victor Krum, stated, “Having the team on the same page...and able to talk about it at the time, those concerns get addressed appropriately and can be responded to quickly.”

### **Mission Driven to Provide Excellent Care**

The mission of the FQHC was found to be a major driving force in how care was delivered. The comprehensive approach to health care was related to the mission and culture of Salud Family Health Centers. One of the dentists, Rufus, said, “The ingraining of that comes in the systems that are established here at Salud, the physical closeness that we share with other providers, the fact that we have more of a sense of community.” A dental hygienist, Chris, discussed how the culture of Salud Family Health Centers felt more like a family rather than the aseptic medical offices he had previously practiced in. He said, “Honestly, the culture is that we try to make it as much of a family as possible.” In this FQHC, the participants indicated that they worked cohesively to provide the most effective patient care. Another dental hygienist participant, Sara, stated, “You’re [the healthcare providers] all here on that mission, let’s provide these patients with great care today.”

## **Discussion**

The primary purpose of this study was to determine how oral health care was integrated within this patient centered medical home as identified by the perceptions of the health care providers. FQHC’s are uniquely situated at the forefront for preventive health care infrastructure that has been developed to support comprehensive health care delivery.<sup>17</sup> Several elements have been identified for the successful integration of IPHC to occur within health care including collocation, patient sharing, and awareness of patient oral health care needs.

In a comparative study examining boundaries in inter-professional health care, teams were studied to better understand how roles were created within primary health care settings. MacNaughton et al. studied pharmacists, registered nurses, nurse practitioners, registered practical nurses, dieticians, and social workers and found that a barrier to IPHC was collocation.<sup>18</sup> When teams were not in close proximity to one another, the level of collaboration between healthcare providers declined. Another important aspect for developing increased collaboration is the belief in patient sharing; if providers thought of the patient as ‘ours’, rather than ‘their’ responsibility, improving the patients’ outcomes became a joint effort where interactions and knowledge was shared by different healthcare providers.<sup>18</sup>

A qualitative case study developed by Harnagea et al. examined the perceived barriers and facilitators for oral health care integration of providers in two public health centers in Quebec, Canada.<sup>19</sup> The first theme identified was drivers of integration, which included sub-themes of oral health care service missing in publicly funded health services and oral health needs as a driver of integration. A majority of the participants noted that oral health services were either inadequate to meet the needs of the population or non-existent.<sup>19</sup> The second theme identified was importance of IPHC. Non-dental health care providers who worked in public health clinics were especially aware of the challenges of meeting their patients' health care needs. Most participants felt oral health care integration would promote comprehensive care and that collaboration was critical to improving access to health care and preventing disease.<sup>19</sup> Participants in this study reflected on the benefits and ease of meeting the oral health care needs of their patients within the FQHC setting.

Furthermore, participants in this study highlighted the importance of the professional role in integrated oral health care. In the Harnagea et al. study, the majority of providers felt that they did not have the required skill set to meet the unmet needs of the population underscoring the need to increase the dental workforce in the patient centered medical home in order to impact oral health care integration.<sup>19</sup> The importance of meeting these needs were supported by the findings of this study as collocation, collaboration, patient sharing, and awareness of patient oral health care needs fostered comprehensive health care for the benefit of the patient as perceived by the health care providers.

In addition to evaluating the integration of oral healthcare into Salud Family Health Centers, a secondary purpose for this study was to clarify how this integration affected the health care providers practicing at the FQHC. The ICCFTAT provided the theoretical framework for the data evaluation. Results from this study supported the domains of patient centred care, communication, and role clarity from the IPHC theoretical framework. Health care providers at Salud Family Health Centers were enacting IPHC through the provision of comprehensive health care. Both medical and dental professionals were able to leverage the expertise of other professions to effectively meet the health care needs of their patients. While role clarity was ambiguous, it did not negatively affect the functionality of the team's ability to provide integrated health care. Practitioners at this FQHC seemed to have an inherent understanding that stabilizing the patients' medical health would take precedence over oral health care needs. Findings from this study support the Interprofessional Care Competency Framework, moving theory to practice, and may provide a purposeful model for other

FQHC's to follow. Providing the FQHC with specific domains may enable a smoother transition when moving from a multi-practitioner model of delivery to an interprofessional model.

This study had limitations. The PI was a member of the interprofessional team at the facility where the study took place. Brief engagement occurred during the recorded interviews. However, while there was occasional participant engagement, thematic overlap was found across the sample population, indicating that this limitation did not impact the results. Further research is needed to support more widespread implementation of oral health integration models into health care delivery systems. Data to determine the impact of oral health integration on patient outcomes and promote easily accessible patient centered medical homes is needed to increase actualization of these integrated programs. Further study focusing on the complexities of role clarity in collaborative health care teams is also needed.

## Conclusion

Results from this qualitative case study identified the recurring themes of physicians, physician assistants, dentists, and dental hygienists regarding how oral health care is integrated into an FQHC and how that integration affects them as health care providers. The seven themes were: interprofessional collaboration supports patient care, immediate consultations lead to improved outcomes for all, shared expertise to optimize care delivery, oral health is health, increased communication through collocation, role clarity does not impede team functioning, and mission driven to provide excellent care. Findings from this study can assist other FQHCs in implementing an oral health care integration through the use of a theoretical framework. Further research is necessary to understand how IPHC affects the health care team dynamic and how that dynamic impacts patient health outcomes.

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# Innovations in Dental Hygiene Education

## Implementing a Prenatal Oral Health Program in Dental Hygiene Curriculum

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### Abstract

**Purpose:** Inadequate prenatal oral health education in dental hygiene (DH) curricula can negatively impact patient care by graduating clinicians lacking competence in the provision of care for this population. The purpose of this study was to assess the knowledge, opinions, and willingness of DH students to provide oral care services to pregnant patients before and after participating in a prenatal oral health educational program (pOHP).

**Methods:** Senior DH students were invited to complete a baseline and post-program survey to evaluate their experiences in the pOHP at the University of North Carolina, Chapel Hill. All senior DH students attended a one-hour lecture on prenatal oral health guidelines and practices prior to their clinical rotation in the pOHP. Each survey consisted of items on knowledge, confidence, and attitudes related to screening, counseling, and willingness to provide oral care services to pregnant patients.

**Results:** Over a period of three years, 93 DH students (n=93) completed both the baseline and post-program surveys for a 96.8% response rate. Participants reported gains in knowledge and confidence for screening and counseling pregnant patients. Post-program survey respondents agreed that dental providers should deliver oral health counselling to pregnant women (99%, n=93) and perform an oral health examination during prenatal care (99%, n=92). Nearly all of the respondents, (98%; n=90) reported they are likely to take care of pregnant women upon graduation and deliver preventive oral health messaging to this population (98%, n=91).

**Conclusion:** Dental hygiene student participants in a prenatal oral health program (pHOP) demonstrated positive trends in increasing knowledge and confidence in screening and counseling pregnant patients in the dental setting. Inclusion of a clinical experience played an influential role in changes in knowledge regarding the safety of care during pregnancy, indicating a need for both didactic and clinical immersion opportunities to enhance cognitive and affective transformations.

**Keywords:** oral health education, pregnancy, prenatal oral health, dental hygiene students, interprofessional education

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### Introduction

Inadequate prenatal oral health education in dental hygiene (DH) curricula can negatively impact patient care by graduating clinicians lacking competence in the provision of care for pregnant patients. Current research and published national standards support the safety and efficacy of dental care throughout all stages of pregnancy.<sup>1-5</sup> Patients who have been deferred oral health care during pregnancy can experience significant detrimental effects on their own health and the health of the developing fetus. Patient education and appropriate preventive treatment recommendations made by the dental hygienist can help reduce confusion in current practice standards and increase positive treatment behaviors by the dental team.

### *Oral health considerations in pregnancy*

Inconsistencies in care and practice standards have been influenced by numerous reports of adverse pregnancy outcomes and oral disease. Several research studies have supported a relationship between poor maternal oral health with an increased risk of preterm delivery, low birth weight, preeclampsia, gestational diabetes, and stillbirth with strong evidence demonstrating that maternal oral health is associated to the oral health of the newborn.<sup>1,6-12</sup> Pregnancy may also increase the risk of future dental decay due to behaviors of the expectant mother.<sup>13-14</sup> Women with active decay-causing bacteria can transmit cariogenic bacteria from their

own mouths to the mouths of their infants.<sup>13,15</sup> Additional data indicates that children of mothers with high levels of untreated decay are three times more likely to have children with dental caries.<sup>13,16</sup>

### ***Dental care during pregnancy***

Few women utilize dental care services during pregnancy, with the lowest use documented among those in underserved communities.<sup>17</sup> Studies consistently indicate low percentages of women seeking dental care during pregnancy, even when a problem arises, due to fears of adverse fetal development and low oral health literacy levels.<sup>2,9,18-20</sup> Some barriers noted in the literature include low reimbursement, time restrictions, culture and language differences, lack of demand and poor oral health literacy.<sup>21</sup> Inconsistent messaging from medical and dental care providers may also lead to discrepancies. Some health care providers may have learned different protocols throughout their time of training; such as delaying oral care until the second trimester or until after delivery.<sup>21</sup> Messaging to expectant mothers may be influenced from preconceived culture and language beliefs that affect awareness of safety to receive dental care during pregnancy.

Oral health care providers play an essential role in adopting and delivering timely, evidenced-based practices for provision of oral health care. Results from a study evaluating knowledge and practice behaviors of general dentists in North Carolina indicated that while the majority of respondents believed in the importance of dental care during pregnancy; only 48% provided comprehensive oral health care to these patients.<sup>21</sup> Further analysis also supported the hypothesis that an increase in knowledge scores correlated with the likelihood of providing comprehensive care services for pregnant women.<sup>21</sup> In a survey of dental hygienists' knowledge, attitudes, and practice behaviors for pregnant patients in the state of Michigan, the vast majority of respondents (96%) agreed that prophylaxes could be provided throughout pregnancy.<sup>22</sup> However, responses varied regarding levels of safety for scaling and root planning (76%), restorative care (62%), and exposure of radiographs (50%) in all trimesters.<sup>22</sup> Over half of the respondents (64%) indicated that they wanted to receive additional education concerning care for the pregnant patient.<sup>22</sup>

Research also indicates inconsistent oral health recommendations from primary care providers. One study of pregnant women indicated that less than one quarter (20%) of those surveyed, actually received advice to visit a dentist during pregnancy from their maternity care provider.<sup>23</sup> Fewer than half, indicated that they were instructed on the importance of good oral health, reiterating the necessity of oral health care providers to promote prevention and

treatment during pregnancy.<sup>23</sup> *Oral Health Care During Pregnancy: A National Consensus Statement*, addressing the oral health needs during pregnancy, was issued in 2012 by an expert workgroup, coordinated by the National Maternal and Child Oral Health Resource Center.<sup>2</sup> Participants from the workgroup included the American College of Obstetricians and Gynecologists and the American Dental Association. The statement provides consistent criteria, recommendations for care, and information regarding the calibration of care and messaging to patients and health care providers.<sup>2</sup>

### ***Prenatal oral health in education***

Little has been reported in the literature regarding the prenatal oral health content in DH program curricula. In a survey of the infant, toddler, and prenatal oral health content of dental and DH programs in Canada, 70% of the dental and 83% of the DH programs reported a prenatal oral health curricular component. Time restraints and a lack of patients were cited as the most impactful barriers to teaching and providing clinical experiences.<sup>24</sup> A 2012 study examined the amount of time devoted to prenatal oral health education in United States (US) dental schools and obstetrics and gynecology (OB-GYN) residencies.<sup>25</sup> A majority of dental school respondents (94%) reported including a minimum of one hour and 61% of schools included three or more hours.<sup>25</sup> Conversely, only 32% of the obstetrics and gynecology respondents reported a minimum of one hour of prenatal oral health education and only 6% reported three to four hours.<sup>25</sup> A positive relationship was identified with program directors' knowledge of the national standards consensus statement and the number of hours of prenatal oral health education in the curriculum.<sup>25</sup>

### ***Prenatal Oral Health Program (pOHP)***

Currently, there is no known data indicating the number of DH programs offering didactic and clinical rotations to provide experiential learning in the management of oral care for pregnant patients. The Prenatal Oral Health Program (pOHP) at the University of North Carolina (UNC), Chapel Hill, offers a unique experience to prepare students for prenatal oral care via a didactic seminar and an intraprofessional clinical experience with pregnant patients. The program was originally established in 2012 as a collaborative effort between the UNC Adams School of Dentistry and the UNC School of Medicine, led by a pediatric dentist, and an obstetrician/gynecologist. The purpose of the program was to educate medical and dental students about prenatal oral health and establish a clinic for this population to receive dental care.<sup>26</sup> Emphasis was placed on training for screening, counseling, treatment, and referral to and from medical and dental health care providers.

As the pOHP evolved, the addition of senior DH students became an essential component of the program design by adding members to the dental team with a focus on disease prevention. The DH students gained valuable didactic and clinical experiences. Didactic content was provided as part of their curriculum; clinical rotations in the pOHP were included to facilitate educational experiences and patient care. The clinical structure included appointment blocks for dental and DH students to work together with patients referred to the clinic.<sup>26</sup> Administrative support staff and faculty were calibrated on the pOHP and supervised the students and patient care. Dental and DH students worked collaboratively to provide a comprehensive oral examination, obtain radiographs as needed, perform a dental prophylaxis, and provide pregnancy-focused oral health education.<sup>26</sup> Students benefited by working together in a team-based care model to solve patient problems and provide care leading to positive educational and patient experiences. The purpose of this study was to assess the knowledge, opinions, and attitudes of DH students who participated in a prenatal oral health educational program as part of a program evaluation.

## Methods

This study was reviewed by the Office of Human Research Ethics at the University of North Carolina and determined to be exempt (IRB #12-1167). A pre-post survey was used to evaluate the knowledge, confidence, and attitudes of DH students related to screening, counseling, and willingness to treat provide prenatal oral care. All senior DH students from the UNC Chapel Hill graduating classes of 2015, 2016, and 2017 and participating in the pOHP met the inclusion criteria. Data were collected in the same manner for each cohort.

### *Recruitment*

Due to the educational design and the requirement that all students experience the pOHP learning opportunity, the study design did not include a control group. The baseline survey was distributed during a clinical orientation session at the beginning of the second academic year. The DH students had completed one academic year including one semester of preventive and therapeutic DH patient care services. All senior DH students were invited to participate and complete the baseline survey. Students were informed that participation was voluntary and non-participation would not have a negative effect on their grade. Post-program surveys were distributed to the same cohort of students eight months following the baseline survey distribution, and following completion of participation in the prenatal oral health program.

### *Survey instrument*

The survey instrument was a modification of an existing pOHP survey developed for medical and dental students.<sup>26</sup> The revised pOHP instrument examined similar constructs; modifications were made specific to DH. The modified survey was pilot tested by four recent graduates from the DH program; minor revisions were made based on the feedback provided.

The baseline survey instrument consisted of items including subset statements using a Likert-scale response (1=strongly disagree to 5=strongly agree) regarding levels of experience, agreement, and confidence. Question themes included: demographics (3 items), clinical experiences (1 item), and procedures performed with pregnant patients (12 items), knowledge regarding treatment safety (8 items), confidence of providing oral health services to pregnant patients (7 items), and additional statements asking to evaluate willingness to implement prenatal care and perception of resources, and practice behaviors (14 items). The post-program survey followed the same format as the baseline survey and included additional questions to gain evaluative program feedback (9 items).

### *Prenatal Oral Health Program*

All senior DH students received a one-hour presentation that included review of practice standards for treatment and management of pregnant patients during the fall semester clinical orientation. The presentation content included a review of literature, trends of pregnancy and dental treatment, common oral conditions for pregnant patients, medical and oral considerations, review of consensus standards for screening, referral, and treatment of pregnant patients.<sup>2</sup> An 18-minute educational prenatal oral health video was also included.<sup>27</sup> The presentation was provided by the same professor each year of the study duration, and content remained consistent for each cohort. Information regarding the clinical rotation in the pOHP was also reviewed to provide instruction for preparation and completion of the clinical rotation. The students had one semester of patient care experiences in a preventive recall clinic; however, few had provided care for a pregnant patient. The DH students began their scheduled clinical and didactic coursework the week following orientation. Each student was scheduled to rotate a minimum of one time in the pOHP clinic as a part of their clinical course.

### *Statistical analysis*

Univariate and bivariate analysis of the proportionality of the responses was completed. Since all students experienced the same didactic content, the only differences in their intervention was if they had a clinical patient experience. The

McNemar test or the Bowken's test of symmetry was used to evaluate changes in responses from baseline to post-program and the Mantel Haenszel row mean score test was used to assess whether the change in responses differed between those who had a clinical experience with a pregnant patient and those who did not. The primary outcome for the effect of experience was the change in their response values so that an increase was indicated by a positive number. Level of significance was set at  $\leq 0.5$ .

## Results

A total of 95 DH students (n=95) completed the baseline survey for a response rate of 99%. At the end of the semester 93 DH students completed the post-program survey for a response rate of 87% (n=93). Ninety-three matched surveys were completed (n=93) for a response rate of 97% on the baseline and post-program surveys. The majority of the respondents were female (97%) and the average age at participation was 24 years. Over one-half of the participants (53%, n=46) reported having a pregnant patient experience facilitated through the pOHP. The most common types of care provided to pregnant patients included a comprehensive oral examination, oral health education, and completion of a prophylaxis. Sample demographics are shown in Table I.

**Table I. Survey response rates by graduation year**

Year	n	Baseline survey n (%)	Post-survey n (%)
2015	32	31 (97%)	30 (93.8%)
2016	30	30 (100%)	30 (100%)
2017	34	34 (100%)	33 (97%)
<b>Total</b>	<b>96</b>	<b>95 (99%)</b>	<b>93 (97%)</b>

Baseline data was collected to evaluate the educational gain and perceived value from the program. Table II illustrates responses to constructs of confidence, knowledge, and willingness, between the baseline and post-program data. A general increase in confidence for screening and counseling was noted, with 46% of the respondents (n=43) reporting increased confidence in examining a pregnant patient's mouth ( $p=0.04$ ). Baseline willingness to implement prenatal oral health care education into their dental visits, when appropriate and needed, was positive; however, decreases were noted in post-program responses ( $p=0.01$ ). Regarding concern for the safety of pregnant women to receive dental care while pregnant, 29% of the 2015 cohort demonstrated increased knowledge and 33% in the 2016 cohort; however, in 2017, only 6% indicated increased knowledge ( $p=0.02$ ).

The majority of all post-program survey respondents agreed that the dental provider should perform oral health counselling to pregnant women (99%, n=93) and perform an oral health examination during prenatal care (99%, n=92). Nearly all respondents (98%, n=90) reported they are likely to take care of pregnant patients upon graduation and that they are likely to deliver preventive oral health messaging to pregnant women (98%, n=91).

The pOHP objectives also included infant oral health and early dental practices. Post-program responses demonstrated a high level of confidence with counseling women how to care infant gums and teeth (98%, n=91), and discussing timing of dental visits (99%, n=93). Eighty-six percent of post-program respondents (n=80) reported feeling confident in discussing proper infant feeding practices.

Participants were asked to provide attitudes and opinions regarding quality improvement for the pHOP education experience. These data demonstrate the trends of individual intraprofessional experiences and positive impressions of the pOHP resources. The majority of respondents favored other team-based rotations with dental students (91%, n=83) and continuation of the pOHP rotation (79%, n=72). Table III illustrates respondent feedback and program review data.

## Discussion

Research strongly supports the safety and necessity for prenatal oral health.<sup>2</sup> The pOHP provides a platform for intra and interprofessional dental education and clinical practice to promote oral health care during pregnancy. Including DH students into this teaching and patient care model provides an opportunity to increase the oral health safety net for women during pregnancy. Dental hygiene student participation in the pOHP rotation promoted a more comprehensive approach to care while facilitating intra-professional education in an academic setting.

Overall, the pOHP received positive feedback from the DH students with a majority (73%) recommending that the program continue for future DH students. High response rates may indicate interest and eagerness to learn more and become involved. Negative feedback received from students focused on low numbers of patient experiences with a noted desire to have more opportunities to provide clinical and educational care for pregnant patients during their clinical education. The lack of exposure to pregnant patients during the respondent's individual rotation may have impacted those responses indicating diminished value in continuing the experience.

Differences in the various cohorts regarding safety of care during pregnancy were most likely impacted by their clinical

**Table II. Comparison of survey responses for items rating confidence, knowledge, and attitude**

Variable		Statement	Baseline Survey Data			Response Change			p-value
			Not Confident % (n)	Somewhat Confident % (n)	Confident % (n)	Decrease % (n)	No Change % (n)	Increase % (n)	
Confidence*	Screen	Examining a pregnant woman's mouth	6% (6)	16% (15)	78% (73)	13% (12)	41% (38)	46% (43)	0.04
	Counsel	Counseling pregnant women about their own oral health	5% (5)	28% (26)	67% (63)	15% (14)	47% (44)	38% (35)	0.32
Knowledge*	Safety	It is safe for pregnant women to have dental care during pregnancy	Disagree	Not Sure	Agree	Decrease	No Change	Increase	
			0	3% (3)	97% (91)	14% (13)	64% (60)	22% (21)	0.87
Attitude**	Willingness	How willing are you to implement prenatal oral health care education into your dental visits when appropriate/ needed?	1-4	5-7	8-10	Decrease	No Change	Increase	
			3% (3)	9% (8)	88% (83)	30% (28)	55% (50)	15% (14)	0.01

\*Confidence and knowledge scales: 1 = not confident (strongly disagree) 2 = not very confident (disagree) 3 = somewhat confident (neutral) 4 = confident (agree) 5 = very confident (strongly agree).

A decrease by 1 unit was considered a decline in confidence/knowledge while an increase by 1 unit was considered an improvement.

\*\* Attitude/willingness scale: 1-10, 1=not willing; 5=neutral; 10=very willing

**Table III. Attitudes and opinions regarding the pOHP program experience**

Post-survey Statement	Total Respondents (n)	Yes % (n)	No % (n)
Did your pOHP rotation give you the opportunity to work with a dental student in treating a patient?	94	73%(69)	27%(25)
Do you feel that the pOHP rotation provided you with an interdisciplinary experience of working as a dental team?	93	62%(58)	37%(35)
Do you feel that the pOHP rotation was a valuable component to your clinical education?	92	71%(65)	29%(27)
Would you recommend that the pOHP rotation continue for DH students?	91	79%(72)	21%(19)
Did you find the pOHP website helpful for patient education?	92	91%(84)	9%(8)
Would you use the pOHP website for patient education in private practice following graduation?	91	91%(83)	9%(8)
Based on this experience, would you recommend other clinical rotations for dental hygiene students to occur with dental students?	91	91%(83)	9%(8)

experiences. The 2017 cohort had the lowest number of DH students who were able to see a pregnant patient and only 6% of the respondents indicated a gain in knowledge regarding safety while providing care during pregnancy. When the results of the three cohorts were combined, respondents who reported treating a pregnant patient were more likely to rate increases in safety during the provision of care.

A general increase in confidence for screening and counseling of pregnant patients was noted. High knowledge levels for safety of treatment during pregnancy were noted at baseline and post-program. Baseline survey responses indicated consistent levels of willingness to implement prenatal oral health care education. However, decreases in willingness to implement prenatal oral health education were identified in post-survey feedback. This decrease in willingness may have been impacted by a negative clinical rotation experience, lack of clinical experiences with a pregnant patient, or inherent challenges of faculty calibration. Students may also have time management considerations and anxiety that a more thorough prenatal oral health education element would negatively impact completion of care in a time-structured setting. A similar decline in willingness to implement oral health education in prenatal care visits was observed in a study reviewing the outcomes of the UNC pOHP research studies with third-year medical students during their obstetrics and gynecology clerkships.<sup>28</sup> Multiple variables may produce negative affective changes including a difficult patient or lack of experience. Unanticipated events such as broken or cancelled appointments can impact one's perception and cause negative stereotyping that may lead to a belief that these patients are less likely to keep appointments. Poor clinical structure including a lack of organization, inability to identify resources, or a negative attending faculty experience can also impact attitudes in the learning environment. Research has demonstrated the impact that the learning environment, psychosocial interaction, culture, and teaching factors has on achieving student learning outcomes and student self-confidence.<sup>29</sup> Additional programmatic evaluation should be completed to better understand the underpinnings of this finding in order to make revisions for future students.

An overarching goal of the pOHP program includes the promotion of evidence-based practice behaviors in alignment with the content and goals of the *Oral Health Care During Pregnancy: A National Consensus Statement*.<sup>2</sup> High levels of familiarity with the prenatal oral health guidelines can positively impact practice behavior changes by increasing perceptions of knowledge and confidence in having adequate information and comprehension of standards of care.<sup>30</sup> If clinicians feel that they have been well educated, then they

may be more likely to practice according to the recommended guidelines. Experience with the guidelines may also provide them with the confidence to be leaders in their clinical practice settings. These educated and experienced clinicians could also share their knowledge with other colleagues who are either unaware of the current oral health guidelines for pregnant patients or are choosing to practice under the umbrella of outdated standards.

Inclusion of prenatal oral health in DH curricula should model practice standards and challenge novice learners to think beyond oral health. Pregnancy has systemic effects on the body, and there are multiple implications to the mother and baby if she is in poor health.<sup>31</sup> While oral health is a key component in this equation, other factors such as diet, exercise, medication intake, pre-existing health considerations, and perinatal health concerns are all closely linked. Dental hygienists must be knowledgeable about prenatal health considerations and the systemic links to adverse pregnancy outcomes. Dental hygienists are well positioned to provide dietary as well as oral health counseling and have the skills to communicate with primary care providers to provide optimal and personalized care for pregnant patients.

Barriers preventing the inclusion of prenatal oral health in the dental curricula have been noted in several studies.<sup>24,25</sup> Lack of time, priorities for completion of competences, lack of pregnant patients, are common reasons.<sup>24-25</sup> These barriers are exacerbated by inconsistencies in individual practice behaviors from dental faculty and an unawareness of current national consensus guidelines.<sup>2,17,20</sup> These challenges are often compounded by the finding that pregnant women tend not to seek dental care during pregnancy, and furthermore may be advised to avoid dental care by their obstetrician.<sup>2,17,20</sup> Curricular integration across the health professions can increase awareness of the current practice standards and enhance knowledge and confidence for screening and counseling pregnant patients, as evidenced by the results of this study.

Respondents gave positive feedback regarding the intra-professional learning opportunities in this study. Post-program survey feedback noted these opportunities as a program benefit and indicated a desire to have more opportunities for intraprofessional student interaction. Learning in teams can not only enhance educational experiences while providing opportunities for peer-teaching and learning, but also modeling the intraprofessional care that is expected post-graduation.

### ***Dental hygiene implications***

Dental Hygiene programs are charged with educating students to be competent, practice-ready clinicians through curricula that is current, contemporary, and evidenced-

based. Development and implementation of the pOHP learning experience aimed to disseminate updated practice standards to the future dental and dental hygiene workforce. Creation of a prenatal curriculum can be modeled after the pOHP to include collaboration with other disciplines and provide experiential education. Multiple resources found on the pOHP website facilitate the implementation of such program into a variety of educational and clinical settings.<sup>27</sup> A focus on prevention and early intervention for infants and children provides an excellent opportunity to align with the changing landscape of health care and develop intra- and interprofessional learning opportunities. Educating dental hygienists who are adaptable to changing practice standards and leaders in patient care can be achieved with innovative curricula that challenges existing boundaries should be the goal of teaching future oral health care providers.

When considering the changing health care setting, it is important to envision the potential roles utilizing the skills of dental hygienists. One example of how dental hygienists can be incorporated into health care settings is Michigan's Grace Health, a nonprofit Federally Qualified Health Center (FQHC).<sup>32</sup> Grace Health features a combination of medical and dental clinics. Dental hygienists may provide preventive services under indirect supervision from dentists employed by Grace Health with certification from Michigan's Public Dental Prevention Program. Under this indirect supervision model, an operatory was created in the obstetrics and gynecology clinic for pregnant patients to receive dental hygiene care. Each patient in the clinic receives at least one DH care appointment per trimester and one post-partum appointment. This care model includes preventive services, oral health counseling, and referral to the Grace Health dental clinic for patients without a dental home or presenting with urgent dental care needs. This team-based approach to whole-person care is an example of how the dental hygiene profession can bridge the gap between medical and dental providers and promote the provision of oral and systemic health care, in a timely, patient-centered manner.

Dental hygiene graduates should be prepared to practice in health care settings that include interprofessional models of care such as an FQHC. While an important design feature of the pOHP was to prepare all health care providers to screen, counsel, treat, and provide necessary referrals, the pHOP model does not currently provide for clinical education experiences. This is a key limitation to the pHOP program model and can be an opportunity to expand and enhance. Students may be able to acquire the didactic content, but there may be greater impact by having a clinical experience. This was evidenced in the results from this

study, with data demonstrating the influence clinical patient experiences regarding knowledge of the safety aspects for dental treatment during pregnancy. Respondents with fewer clinical experiences demonstrated fewer gains compared to cohorts with greater clinical experiences ( $p=0.02$ ). Students with experiential educational opportunities in the curricula may be more confident to apply content learned rather than exposure to didactic content and simulation alone. Dental hygiene educators must include innovative teaching styles integrating a multi-disciplinary approach to challenge the practice mindset beyond the head and neck area and prepare clinicians for future dental hygiene workforce models.

### ***Limitations and future research***

This study had limitations. Changes within the pOHP clinical design during the three-year study period may have impacted individual student experiences. Additional limitations may include high patient broken appointment rates impacting the students' clinical experiences. The survey instruments were designed to gain program outcomes and feedback, limiting the generalization of the findings. Also, the survey reliability was not established. Future research should continue to examine the impact of combining didactic content and clinical experiences in caring for pregnant patients. Inclusion of intra and inter-professional educational designs would also provide value to the learning experience and model expectations for future oral health care providers.

### **Conclusion**

Dental hygiene student participants in a prenatal oral health program (pHOP) demonstrated positive trends in increasing knowledge and confidence in screening and counseling pregnant patients in the dental setting. Inclusion of a clinical experience played an influential role in changes in knowledge regarding the safety of care during pregnancy, indicating a need for both didactic and clinical immersion opportunities to enhance cognitive and affective transformations. A solid foundation in prenatal oral health, including clinical experiences, will provide future clinicians with evidenced-based strategies to care for patients during pregnancy and the confidence to influence dental team members regarding the current standard of care for this population.

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# Innovations in Dental Hygiene Education

## Utilization of Objective Structured Clinical Examinations (OSCE) as an Assessment for Clinical Competency and Licensure: A survey of dental hygiene directors' knowledge and attitudes

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### Abstract

**Purpose:** Objective Structured Clinical Examinations (OSCEs) have been established as a gold standard assessment for determining clinical competence. The Coalition for Dental Licensure Reform called for the acceptance of the Dental Licensure Objective Structured Clinical Examination (DLOSCE) to replace the live-patient examinations (LPE) for dental licensure, which are often viewed as biased, unreliable, and in some cases unethical. The purpose of this study was to assess dental hygiene program directors' awareness of and attitudes toward the DLOSCE, whether their curricula included OSCEs, and perceived barriers to implementing OSCEs.

**Methods:** A nine-question electronic survey was developed, and pilot tested by five-dental hygiene program directors across three-dental hygiene institutions. The survey was emailed to the directors of all dental hygiene program directors in the United States (n=332). Descriptive statistics were used to analyze the data.

**Results:** A response rate of 36% (n=121) was achieved. Nearly 30% of respondents were unaware of the developing DLOSCE, however, the majority (80%) were in favor of the acceptance of the examination. Nearly three-quarters of the respondents considered OSCEs as valid assessments of clinical competence, however, over half of the respondents reported not currently utilizing OSCEs in their curricula. Barriers reported were time (22%), perceived lack of best practices (21%), and lack of resources (18%). Respondents who currently employed OSCEs were more likely to agree they were both valid and reliable assessments ( $p=0.05$ ).

**Conclusion:** The majority of dental hygiene program directors were in favor of eliminating the single-encounter LPE in favor of an OSCE for licensure. However, more than half do not currently utilize OSCEs for clinical assessments. Further studies are needed to explore implementation of OSCEs in dental hygiene education, and how a potential dental hygiene licensure OSCE might impact the current curricula and licensure of dental hygienists in the United States.

**Keywords:** dental hygiene education, clinical evaluations, clinical competence, Objective Structured Clinical Examinations, live patient examinations

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### Introduction

The purpose of clinical licensure examinations is for clinicians to demonstrate their knowledge and competency prior to serving the public.<sup>1,2</sup> However, debates surrounding the use of human subjects in dental and dental hygiene clinical licensure examinations have been discussed among dental communities for decades.<sup>2-5</sup> While some argue that this clinical demonstration of competency necessitates the use of human subjects, others counter that live-patient examinations (LPE) assess a narrow range of clinical skills,

and raise considerable ethical concerns for the patient, candidate, and profession.<sup>5</sup> Alternative methods to assess the clinical competence of dental professionals have been explored across the United States (U.S.) however, LPE remain to be the most frequently used method in dentistry to date.<sup>6</sup>

The pathway for dental licensure was established in 1929 by the National Board of Dental Examiners (NBDE).<sup>7</sup> The NBDE oversaw the development and administration of both the written and clinical portions of licensure examinations

until 1937, when clinical licensure examinations were relinquished to individual state boards of dentistry. Subsequently, each state became the profession's governing body, issuing dental licenses and ultimately limiting their portability. As a means to develop, calibrate and administer clinical examinations, state boards of dentistry grouped together to form regional boards.<sup>8</sup> These boards rely on regional testing agencies to administer clinical licensure examinations. Although licensure requirements may vary from state-to-state due to differences in state laws, there are three standard national requirements for licensure: 1) a degree from an accredited program, 2) a passing score on the written national board examination, 3) a passing score on a regional/state clinical examination.

Currently, dentistry is the only health care profession that requires the use of human test-subjects for licensure examinations.<sup>9</sup> Concerns surrounding the use of human test-subjects for licensure examination are well founded; by their nature, they may introduce potential harm to the patient during the delivery of irreversible care.<sup>10</sup> Within the context of the examination, candidates are more likely to attend to the licensure examination requirements, rather than the patient's primary oral health needs.<sup>2,4</sup> This can lead to delaying care, resulting in the mistreatment of these patients.<sup>2,4</sup> Mistreatment may also occur upon completion of the examination, due to lack of follow-up care, or failure to plan treatment for substandard care.<sup>2,4,5,10</sup> Additional ethical concerns surround the financial exchanges that occur during patient recruitment which may be misconstrued as coercion or bribery.<sup>10</sup>

The American Dental Association (ADA), the American Dental Education Association (ADEA), and the American Student Dental Association (ASDA) formed the Task Force on Assessment of Readiness for Practice (TARP), in 2016 to resolve the issues surrounding LPE and licensure portability. In 2017, TARP issued a report recommending further development and pilot testing of alternative methods to measuring clinical competence for initial licensure. The TARP report called for the replacement of LPEs and the acceptance of valid alternatives such as Objective Structured Clinical Examinations (OSCEs) as a replacement. Currently, OSCEs are being used as measures of clinical competency for initial licensure by the U.S. Medical Licensing Examinations, the Medical Council of Canada Qualifying Examination, and the National Dental Examining Board (NDEB) of Canada OSCE.<sup>11-13</sup> Considering the validated successes of the NDEB of Canada OSCE, the ADA Board of Trustees voted to adopt the Dental Licensure Objective Structured Clinical Licensure Examination (DLOSCE) as a replacement for LPE. Piloting of the DLOSCE began in November 2019 and will be launched in June 2020.<sup>14,15</sup>

In response to the TARP report, the Coalition for Modernizing Dental Licensure was formed to begin lobbying individual state dental boards to accept the DLOSCE for initial licensure. Considering the wide variations in state dental practice acts, obtaining approval for the DLOSCE may be a lengthy process. However, as the ADA stated in their April 6, 2020 press release, they have seen an increased demand from state dental boards for the DLOSCE as a means to better protect the public during the current COVID-19 pandemic.<sup>15</sup>

In 2019, the American Dental Hygienists' Association's (ADHA) application to join the Coalition for Modernizing Dental Licensure was approved. As members of this coalition, the profession of dental hygiene will need to develop and submit a similar LPE alternative to state boards of dentistry, as the DLOSCE was created for dental students. Additionally, ADEA has created the Compendium of Clinical Competency to assist in the development of LPE alternatives. The compendium contains two assessment rubrics for clinical competence: one for dentistry and one for dental hygiene. These working rubrics were created to serve as guides for clinical assessments in educational programs, in addition to professional associations to create their own OSCEs for initial licensure.

The purpose of an OSCE is to minimize patient and evaluator variations while standardizing the skills and knowledge assessed.<sup>16,18,19</sup> Decades of evidence across a wide range of health care disciplines have confirmed the validity of OSCE assessments as the standard for determining clinical competence.<sup>16</sup> Since the mid-1970's, OSCEs have been universally recognized as the gold standard for the assessment of clinical competence of allied health and other professional students<sup>16</sup>

An OSCE is a station-based examination, designed to assess multiple students' clinical performances over the same materials, at the same time. Stations are timed and create a simulated scenario with the use of examination mechanisms including standardized patients, typodonts, manikins, medical histories, radiographs, mouth models, and instruments. Stations are evaluated by calibrated proctors using standardized rubrics and checklists to assess clinical performance. OSCEs are resource intensive to develop and implement, as compared to other assessment tools, making feasibility a practical consideration. Time constraints and lack of resources are common barriers reported in literature.<sup>20-22</sup> Despite the labor-intensive nature of OSCEs, studies show that educators believe OSCEs are valid and reliable tools for the assessment of clinical performance of students.<sup>18-20,22-24</sup> Furthermore, OSCEs have been incorporated in dental school curricula since the 1990's to assess a variety of skill sets, including communications, patient education, clinical skills, and critical thinking.<sup>17,25,26</sup>

While OSCEs are widely recognized in dental education; research is limited regarding utilization trends of OSCEs in dental hygiene education. In 2009, Navickis, et al., surveyed dental hygiene program directors to explore the use of various standardized clinical examinations in dental hygiene curricula.<sup>20</sup> At the time of the study, 59% of the respondents utilized OSCEs and 46% felt that OSCEs were effective tools for verifying clinical performance; however 37% cited time as a barrier for implementation.<sup>20</sup> There is a gap in the literature regarding current OSCE utilization trends in U.S. dental hygiene program curricula, raising concerns as to how an OSCE for dental hygiene licensure might impact the profession. While this study was not conducted during the current pandemic, it is important to note the relevance of OSCE assessments in light of the barriers to live patient treatment and face-to-face teaching introduced in the last year. The purpose of this study was to assess dental hygiene program directors' current utilization of OSCEs, the perceived barriers of OSCE utilization and attitudes and awareness of the developing DLOSCE for dental licensure.

## Methods

The study was determined exempt from University of Michigan Institutional Review Board oversight (HUM00147564). A nine-question, anonymous electronic survey was developed for distribution using Qualtrics (Provo, UT) survey software. The survey was initially reviewed and edited by the University of Michigan (UM) Survey Research Center for content validity and reliability. Survey questions explored descriptive demographic information including years as program director, highest degree offered at the respective institution, questions related to OSCE utilization and barriers, and awareness of the developing DLOSCE. Five-point Likert-scale questions assessed the perceptions of program directors regarding support of replacing LPEs with an OSCE for licensure, and their perception of the validity and reliability of OSCEs to assess the clinical competence of dental hygiene students. The survey was pilot tested by five dental hygiene program directors across three-dental hygiene programs. Modifications were made based on feedback.

A list of U.S. dental hygiene program directors' email addresses (n=332) was obtained from the American Dental Hygienists' Association (ADHA) Entry-Level Dental Hygiene Program Directory. A recruitment email introducing the purpose of the study and informed consent was sent along with a link to the survey. The survey was open to participants for eight weeks; three reminder notifications were emailed at two-week intervals.

Data were collected and analyzed in Qualtrics Survey Software; SPSS, version 25 (IBM Corp. Armonk, NY) was used for further analysis. Descriptive statistics included frequency distributions, percentages, and standard deviations were calculated to provide a summary of the findings. Inferential statistics such as ANOVA and Welch's two-Samples *t*-tests were sought to provide inferences about the sample population. Significance was set at ( $p < 0.05$ .)

## Results

Of the 332 electronic surveys sent, 129 program directors initiated the survey and 121 completed the survey, for a response rate of 36%. The majority of respondents (60%) had served as a dental hygiene program director for ten years or less, and the majority (69%) reported the highest dental hygiene degree offered at their learning institution as an Associate Degree. Demographic frequencies types of degrees awarded at the institution are shown in Table I and reflect the national trend in dental hygiene education programs. Fewer than half of the respondents (49%, n=59) reported incorporating OSCEs in program curricula (Table II).

**Table I. Demographics (n=121)**

Years as program director	(%)
1-5	32%
6-10	27%
11-20	31%
21-30	6%
31-40	2%
40+	<1%
Highest degree awarded at institution	(%)
Associate	69%
Baccalaureate	25%
Master's	6%

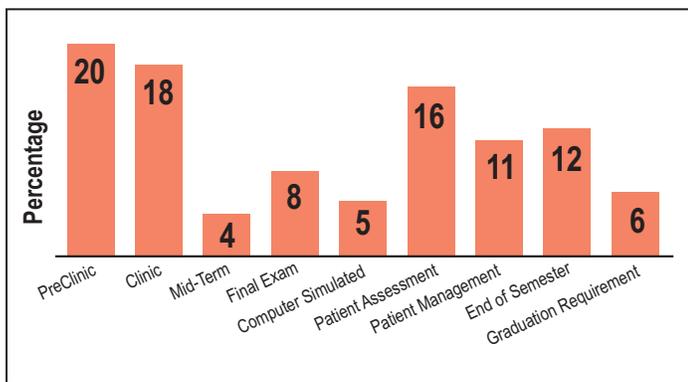
**Table II. OSCE utilization in dental hygiene program (n=120)**

	n (%)
Yes	59(49%)
No	61(51%)

Figure 1 illustrates how and/or when OSCEs are used to assess clinical performance in the dental hygiene curricula. Of the respondents utilizing OSCEs, 20% reported their use in pre-clinic while 18% reported their use in clinic to assess competencies, test cases, and proficiencies. Only 6% of pro-gram directors reported using an OSCE as a requirement for graduation. More than one-half of the respondents reported not incorporating OSCEs in their dental hygiene curricula (51%, n=61). Lack of time (22%), lack of evidence-based development processes (21%), and lack of resources (18%) were cited as barriers to implementation, while 9% reported that they were unfamiliar with OSCEs (Figure 2).

Nearly one third of program directors were unaware

**Figure 1. Types of OSCE utilization (n=59)**

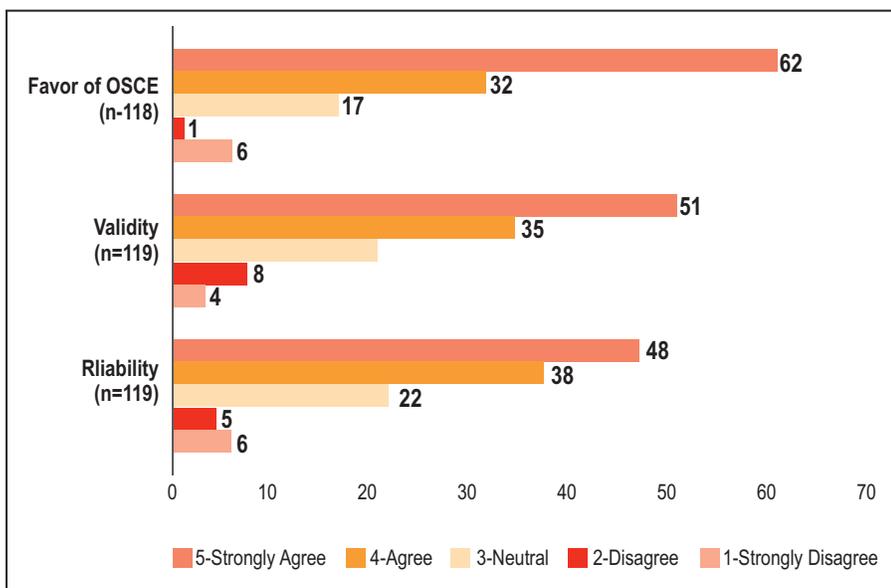


**Figure 2. Perceived barriers (n=61)**



of the development of the DLOSCE for dental licensure. However, the majority of respondents (80%) indicated they were in favor of the DLOSCE as a replacement of the LPE (Figure 3). Furthermore, nearly three quarters (72%) of respondents felt OSCEs were a reliable and valid methods for evaluating the clinical competence of dental hygiene students.

**Figure 3 Respondents' attitudes of OSCEs**



Three Welch's two sample *t*-tests were calculated to compare mean ratings of attitudes regarding favorability, validity, and reliability between respondents who utilized OSCEs and those who did not (Table III). Regarding favorability, statistical significance was not observed between the average ratings of respondents who utilize OSCEs compared to those who did not ( $p=0.131$ ). However, statistical significance was observed in beliefs that OSCEs are valid ( $p=0.006$ ) and reliable ( $p=0.011$ ) assessment measures in respondents who utilize OSCEs compared to those who did not.

An ANOVA test was conducted to compare whether the number of years as program director affected favorability of replacing LPE with an OSCE. No significant difference between the average favorability rating among respondents based on ranges of years of service was observed ( $f(5,12)=0.336, p=0.890$ ).

## Discussion

OSCEs have been a valid assessment measure of clinical competence of dental students for decades.<sup>25</sup> This study was developed to assess the utilization of OSCEs in dental hygiene programs in the U.S. and the current attitudes of dental hygiene program directors towards the replacement of the single-encounter, LPE and the subsequent development of the DLOSCE by the ADA. It is of note, that this study was conducted prior to the COVID-19 pandemic and the current constraints on all face-to-face encounters are not reflected in the survey or study results.

In this study, nearly half of program directors reported utilizing OSCEs in their curricula. This is lower than those of Navickis, et al., who reported that 59% of program directors surveyed, utilized OSCEs in their dental hygiene curricula.<sup>20</sup> While the findings of the current study cannot

confirm a decrease in OSCE utilization nationally, there does not appear to be a positive trend in the growth of OSCE utilization over the past decade. Both studies reported time constraints as their greatest barrier to OSCE utilization. However, when exploring attitudes; 72% of respondents in this study believed that OSCEs are a valid assessment tool, compared to 46% in the Navickis, et al. study. This growth rate in attitudes towards validity may be attributed to an increased awareness of OSCEs across healthcare education or increased understanding due to the recent efforts in dental education to change initial dental licensure pathways. Furthermore, results

**Table III. Attitude comparisons between respondents not utilizing OSCEs**

Welch's two-sample t-tests: two-sided <i>p</i> -value						
	Utilization	n	Mean	SD	t(df)	<i>p</i> -value
Favorability	Yes	56	4.357	0.724	t(95.974)=1.524	0.131
	No	61	4.066	1.289		
Validity	Yes	57	4.298	0.844	t(106.552)=2.815	0.006**
	No	61	3.754	1.233		
Reliability	Yes	57	4.245	0.851	t(105.704)=2.576	0.011*
	No	61	3.737	1.263		

\**p*<0.05, \*\**p*<0.01

from this study demonstrated that dental hygiene program directors who currently utilized OSCE assessments in their curricula had a statistically significant higher levels of belief towards OSCEs as a valid and reliable means to assess clinical performance in dental hygiene students, as compared to those who did not utilize OSCE assessments in their curricula.

Between 2011 and 2016, over 400 articles have been published regarding the validity of OSCEs.<sup>25</sup> Despite this evidence, more than half of program directors in this study reported not utilizing OSCEs within their curricula, with one-fifth reporting there was not enough evidence to support best practices in the development of OSCE assessments. The design of an OSCE is crucial to its validity as an assessment instrument, and the desire for an understanding of OSCE best practices is a valid concern. Furthermore, with approximately 9% of the program directors in this study unsure of what an OSCE is, it may be worthwhile to explore the ways dental hygiene program directors obtain information and stay current regarding trends in dental hygiene education such as the use of OSCE or other alternative clinical competency assessment strategies.

Interestingly, even though half of the respondents do not use OSCEs in their curriculum, 80% are in favor of replacing LPEs with OSCEs for licensure. These results are reflective of a 2016 survey of ADEA Allied Dental Program Directors, which noted that 78% of respondents did not feel the LPE adequately assessed clinical competence, with the vast majority (86%) supporting the elimination of the LPE.<sup>23</sup>

The decision to develop the DLOSCE for dental licensure is based on the consistent evidence that OSCEs are the gold standard among clinical assessments based on their ability to expose clinical and didactic strengths and weaknesses, in addition to enriching student learning.<sup>1, 5, 27</sup> This evidence contradicts the argument that a LPE is the only valid way to determine competency for clinical practice in dentistry. By the same rationale, it disputes the question of the validity the current assessment strategies of student performance in

clinical education settings. Student clinical assessments are dependent on the often-unknown patient presenting and the faculty member performing the assessment, which introduces a host of variability and subjectivity issues across the assessment process. Alternatively, OSCE assessments remove the often unpredictable and unreliable variables of standard clinical patient-based graded assessments.<sup>16</sup>

With the projected implementation of the DLOSCE as early as June 2020, licensure change is likely on the horizon for the dental hygiene profession. Therefore, it is crucial to consider standardizing the use of OSCE assessments in all dental hygiene programs. Implementing OSCEs throughout a student's dental hygiene education can be an effective, valid, and reliable way to not only accurately assess clinical performance but also prepare dental hygiene education programs for these potential changes to licensure. As the ADHA supported Coalition for Reform in Dental Licensure prepares to lobby state boards of dentistry for alternatives to LPE for initial dental licensure, dental hygiene educators must be prepared to actively pursue viable future LPE alternatives for dental hygiene students.

This study had limitations. The 9-item survey instrument was intentionally brief to increase compliance; however, it restricted the breadth of the data collected. Self-reporting was another limitation as it increases the risk for biased responses and the results may not be representative of all dental hygiene programs. Limitations also existed surrounding the data analysis of dental hygiene directors' perceived barriers of OSCE utilization in dental hygiene curricula. When asked to identify which barriers existed, the option resources were not explicit, making interpretation of the responses subjective.

Future studies should explore the potential impact of an OSCE-based dental hygiene licensure exam would have on an inadequately prepared dental hygiene education system, as well as current resources to prepare educators for such a change. Future research should also explore the awareness, knowledge acquisition and implementation of OSCE assessments by dental hygiene programs currently utilizing them for clinical competency assessment. Lastly, since nearly one-third of dental hygiene program directors in this study were unaware of the efforts to eliminate LPE for initial dental licensure or the subsequent DLOSCE, future studies should explore the attitudes and barriers that contribute to these knowledge gaps.

## Conclusion

A majority of dental hygiene program directors in the U.S. were in favor of eliminating the single-encounter, LPE and favored assessments such as the DLOSCE, for initial dental hygiene licensure. However, nearly half of all program directors surveyed do not utilize OSCEs in their programs, suggesting that dental hygiene education programs may be unprepared to institute the development and integration of OSCEs into their curricula. Dental hygiene education programs may need additional resources and support regarding OSCE development, integration and best practices to help overcome barriers and increase utilization. Future studies are warranted to assess best practices of OSCEs in dental hygiene education and how the implementation of an OSCE for dental hygiene licensure may impact dental hygiene education in the U.S.

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