



American  
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Hygienists'  
Association

# Journal of Dental Hygiene

February 2020 • Volume 94 • Number 1

- Evaluation of a Curved Design Rubber Bristle Interdental Cleaner on Patients with Gingivitis
- Drinking Water Practices Among Latino Families in North Carolina: A qualitative study
- Dental Hygiene Program Directors' Perceptions of Advances in Accreditation Standards
- Dental Hygiene Learning Outcomes Obtained Through Computer-Assisted Simulation Modules
- Oral Health of Older Adults in Washington State

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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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### Critical Issues Facing the Profession in 2020



Ann Battrell, MSDH



Ann Lynch, BA

We are grateful for the contributions the *Journal of Dental Hygiene* makes to the dental hygiene discipline by growing the body of knowledge as the underpinning of the profession. We embrace the ongoing evolution of the dental hygiene profession and share in the excitement of the expanding career opportunities for dental hygienists in improving the oral and overall health of individuals and communities. As we look at the issues facing the profession today, we must also consider the opportunities that lie before us.

First, let's consider one of the most significant changes to the dental hygiene profession that recently occurred in the U.S. Bureau of Labor Statistics Standard Occupational Classification (SOC). The SOC is a classification system used by federal statistical agencies to "classify workers into occupational categories for the purpose of collecting, calculating, or disseminating data." Information such as employment levels and projections, pay and benefits, skills required, and other demographics are widely used by the public, interested stakeholders and public policymakers.

As of 2018, the SOC now classifies dental hygienists as "Healthcare Diagnosing or Treating Practitioners," under the same category as dentists. Previously, dental hygienists were classified as "Health Technologists and Technicians." This change represents a marked advancement. We have long known that a dental hygiene diagnosis requires an evidence-based approach, including a critical analysis and interpretation of the patient's oral, as well as general, health needs in order to develop the appropriate dental hygiene care plan.

Two challenges that have long faced the profession are the single encounter, live patient, clinical examination and license portability. In 2018, the American Dental Hygienists' Association (ADHA) updated its policy to support elimination of the live patient, procedure-based, single encounter clinical

examination. Furthermore, we believe that a dental hygienist, by virtue of having passed a national board examination and earned a dental hygiene license, should be able to practice across state lines. To advance this work, we are excited to share that the ADHA will now play an integral role in the Coalition for Modernizing Dental Licensure (CMDL).

CMDL has two goals:

1. Achieve adoption of valid and reliable examinations for dental licensure that do not involve the use of single encounter, procedure-based examinations on live patients.
2. Achieve portability of dental licensure among all licensing jurisdictions in the United States for the benefit of the public and the profession.

At the inaugural meeting of CMDL in October 2019, we reiterated the many challenges dental hygienists face in seeking initial licensure and working or moving across state lines. The Executive Committee of CMDL is charged to oversee the management of the ongoing business of the coalition, develop long-range and strategic plans, and carry out the work of the coalition. We are delighted to have the voice of dental hygiene at the table in this important work, with Director of Advocacy and Education, Ann Lynch, serving as the ADHA representative on the Executive Committee of CMDL. Founding CMDL members include the American Dental Association (ADA), the American Dental Education Association (ADEA), and the American Student Dental Association.

We were pleased to hear the announcement that the Surgeon General, Vice-Admiral Jerome M. Adams, MD, MPH has commissioned an update to the 2000 report, "*Oral Health in America: A Report of the Surgeon General*." While it is extremely rare that the surgeon general

would direct that a second report be issued, it speaks to the priority and commitment that Dr. Adams has given to oral health. The new report, slated for release in late 2020, is expected to document the progress in oral health since 2000, identify existing knowledge gaps, and articulate a vision for the future of oral health in the United States. We are proud of the contributing writers and reviewers, including members of ADHA, who have been invited to assist the Surgeon General in developing the report. More importantly for the *Journal of Dental Hygiene*, it is expected that the new report will include an emphasis on the need for scientific evidence to transform the oral health of the nation.

To move dental hygiene forward and to ensure that all of our education programs are contemporary and meet the needs of the world we work in today, we applaud the Commission on Dental Accreditation (CODA) Dental Hygiene Review Committee for conducting a comprehensive review and offering revisions to the Accreditation Standards for Dental Hygiene Education Programs. With careful review and revision, we can ensure that today's graduates are well prepared to contribute to improving the oral and overall health of the patients and communities they will serve. It is incumbent upon the dental hygiene community to engage in CODA's year-long period of comment, including hearings at the ADEA Meeting, ADEA Program Director's Conference, ADHA Annual Conference and ADA Meeting.

Interprofessional education, competency-based assessments, the oral systemic link, license portability and the impact that scope of practice has on access to care represent the myriad of areas that warrant further dental hygiene research. It is the combination of research and advocacy that provides the impetus for the profession to evolve to meet the needs of community.

We appreciate our members who walk hand in hand with us and rise to the challenge of improving the nation's oral and overall health. We invite you to join us, along with dental hygienists from across the country, in New Orleans, June 12-14, 2020, for ADHA's Annual Conference to hear more on the opportunities and challenges for this growing and evolving profession. More details can be found at [www.adha2020.org](http://www.adha2020.org)

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# Evaluation of a Curved Design Rubber Bristle Interdental Cleaner on Patients with Gingivitis

Antonio J. Moretti, DDS, MS; Shaoping Zhang, DDS, MS, PhD; Sherrill T. Phillips, RDH, BS; Kristy Williams, RDH; Kevin L. Moss, Steven Offenbacher, DDS, MMSc, PhD

## Abstract

**Purpose:** The purpose of this clinical study was to evaluate the effectiveness of a curved rubber bristle interdental cleaner, as compared to dental floss, in the reduction of gingivitis and plaque.

**Methods:** Gingival Index (GI), Bleeding on Probing (BOP), Periodontal Probing Depth (PPD) and Modified QH Plaque Index (MQH-PI) parameters were evaluated in an examiner-masked, parallel group, controlled clinical study. A total of 50 participants with gingivitis (no site with PPD >4 mm, BOP  $\geq 10\%$  but  $\leq 50\%$ ) met the eligibility criteria. Participants were randomly assigned to either the curved rubber bristle interdental cleaner (cRBIC) group or the ADA-accepted dental floss (Floss) group. Participants used the devices for four weeks. Parameters were obtained at 2 and 4 weeks. Participants scored their level of product familiarity, satisfaction and motivation for interdental cleaning.

**Results:** There were no statistically significant differences between the two groups in changes from baseline to 2 or 4 weeks in GI, BOP%, and MQH-PI. However, cRBIC group showed greater reduction of PPD at 4 weeks from baseline, compared with Floss group ( $p < 0.05$ ). The cRBIC group showed overall better compliance level than Floss group. The mean score of “ease of use” of the cRBIC group was significantly greater than that of Floss group. However, Floss group showed higher levels of “satisfaction” than cRBIC group. Motivation for interdental cleaning was higher in cRBIC.

**Conclusion:** The cRBIC was similar to Floss in clinical effectiveness; however, PPD reduction at 4 weeks was greater with the cRBIC. Ease of use of cRBIC may have affected the participants’ motivation for interdental cleaning, resulting in better compliance.

**Keywords:** oral care behavior, dental devices, interdental cleaning, periodontal disease, oral hygiene

This manuscript supports the NDHRA priority area **Client level: Oral health care** (new therapies and prevention modalities).

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## Introduction

The most effective approach to maintain gingival and periodontal health is to regularly remove the accumulating bacterial biofilm. Dental biofilm’s extended presence on the tooth surface, adjacent to the gingiva, can lead to gingivitis and subsequently periodontitis. Dental plaque biofilm can be mechanically removed by toothbrushing. However, there is a higher risk for developing periodontal diseases in interproximal spaces, when the microbial plaque is not totally removed. Interproximal spaces are naturally difficult to reach for proper mechanical plaque removal. Dental anatomy and position in the dental arch vary among individuals, making it difficult to effectively remove plaque from all surfaces. Manual dexterity and motivation for maintaining proper oral

hygiene are also important factors to be considered. Use of interproximal plaque removal devices, such as dental floss and interdental brushes, are considered to be an integral part of proper oral hygiene. There have been numerous clinical studies demonstrating that the combination of using a toothbrush and interproximal cleaning devices improves the reduction in plaque biofilm accumulation and gingivitis.<sup>1,2</sup>

Various types of interproximal cleaning devices have been developed and released into the marketplace with the goal of improving patient compliance with interdental plaque control. Since their release, interdental brushes have gained popularity, due to their ease of use. The rubber bristle interdental cleaner



is one of the many types of interdental cleaning devices on the market; however, its design is unique when compared to other similar devices. Its design uses gentle rubber bristles (small ridges), as compared to devices with regular nylon bristles, which can potentially cause gingival irritation and trauma.<sup>3,4</sup> The longer handle in combination with a curved design, offers advantages for effectively reaching interdental spaces that may otherwise be inaccessible such as between premolars and molars.

The purpose of this study was to evaluate the efficacy of a curved rubber bristle interdental cleaner (cRBIC), as compared to an ADA-accepted leading brand dental floss (Floss), and examine how ease-of-use can promote the establishment of a hygienic routine of cleaning interproximal spaces in patients with gingivitis.

## Methods

### Study design

This parallel design, examiner-masked, randomized controlled clinical study took place at a single center from December 2016 to April 2017. Fifty evaluable patients diagnosed with gingivitis only were recruited from the General and Oral Health Center at the University of North Carolina (UNC), Chapel Hill, campus and were randomized with 2% attrition. The study was conducted according to the International Conference of Harmonization Guideline for Good Clinical Practices. All study materials and protocols were reviewed and approved by the University of North Carolina Institutional Review Board (IRB) prior to enrollment of the study participants. No changes occurred in the trial design after commencement of the study and the study was registered at [clinicaltrials.gov](http://clinicaltrials.gov).

### Study population

Male and female volunteers aged 18-70 years, considered to be in good general health, who could read; understand; agree to provide consent; and who were able and willing to follow study procedures and instructions were recruited to participate. Participants had no or little experience with interproximal cleaning devices, such as dental floss or interdental brushes. Each participant needed a minimum of 20 “scorable” teeth, excluding 3<sup>rd</sup> molars, with bleeding on probing (BOP) sites more than or equal to 10% and less than or equal to 50% of the mouth. Periodontal pocket depths needed to be less than or equal to 4 mm. Participants also needed to be non-smokers and have a minimum of 12 qualifying, interproximal units, (3 per quadrant), with closed contacts without crown or restorations. Table I summarizes the demographics and clinical measurements obtained at enrollment.

### Study products

Treatment products were dispensed to participants according to their randomization assignment. Participants received either the curved rubber bristle interdental cleaner (cRBIC) (GUM® Soft-Picks® Advanced; Sunstar Americas, Inc.; Chicago, IL, USA) as the test product; or dental floss (Floss) (Oral-B® Pro-Health™ Glide® Original; Procter & Gamble; Cincinnati, OH, USA) as the control product. The test product features soft, flexible tapered rubber bristles on a curved handle, allowing for easy access any area of the mouth (Figure 1). The dental floss control product, received the American Dental Association (ADA) seal of acceptance, and is lightly coated with natural wax for improved grip while its silky-smooth texture slides easily between teeth.



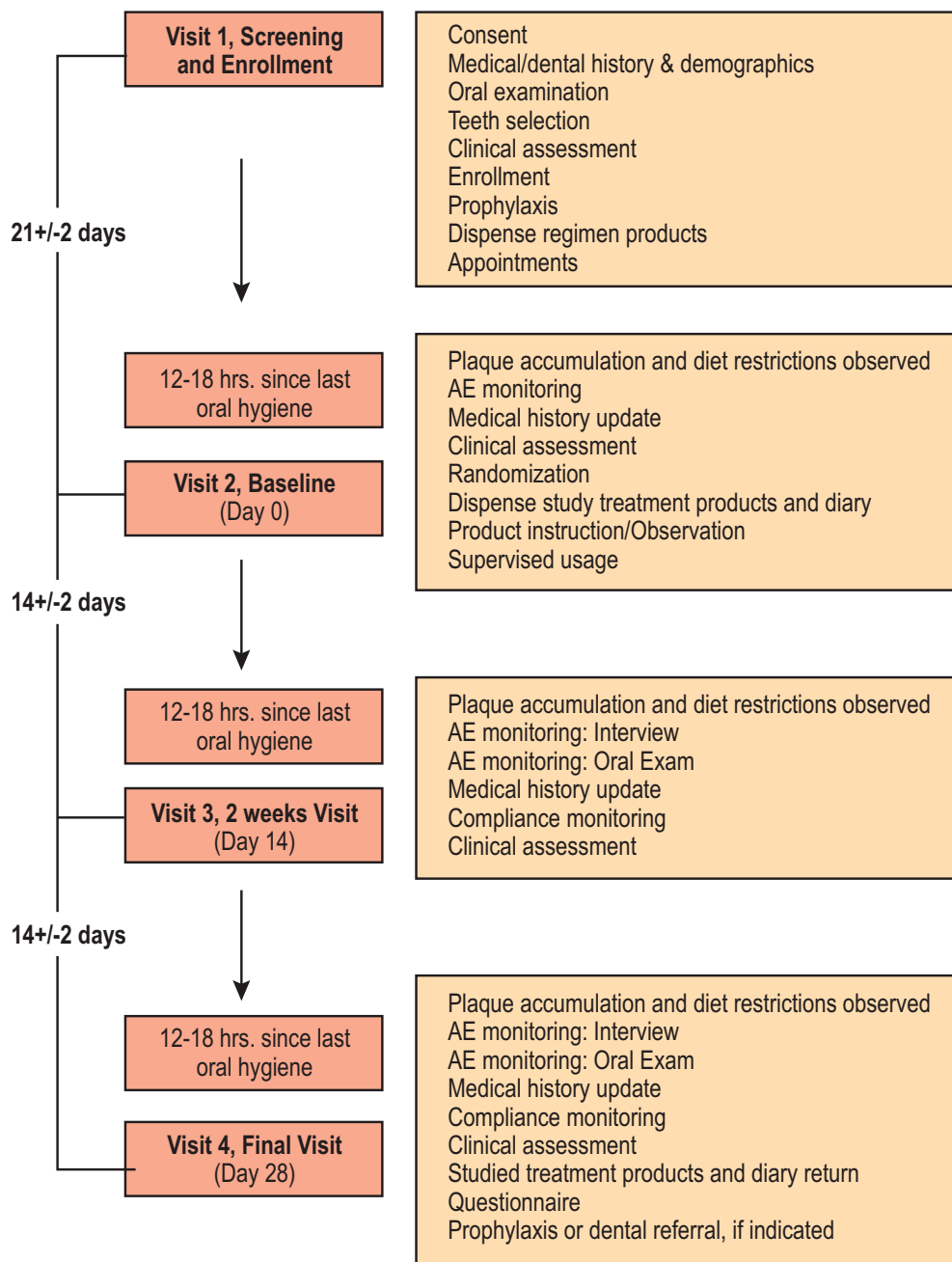
**Figure 1. Test product (curved rubber bristle interdental cleaner)**

### Study procedures

The study flow is illustrated in Figure 2. At the screening appointment (visit 1), informed consent was obtained from potential participants followed by a medical/dental history and oral examination performed by the study coordinator. Twelve interproximal units were selected and qualified (3 units per quadrant), to collect the Modified Quigley-Hein Plaque Index (MQH-PI)<sup>5-8</sup> and modification of the Löe and Silness Gingival Index<sup>9</sup> (GI). For the purposes of this study, grading included only interdental spaces. The categories were as follows: 0 = normal gingiva (pink, firm, stippled); 1 = mild inflammation: slight change in color, slight edema, no bleeding on probing; 2 = moderate inflammation: glazing, redness, edema, bleeding on probing; 3 = severe inflammation: marked redness and edema, ulceration, tendency to spontaneous bleeding. Full-mouth periodontal probing depth (PPD) and bleeding on probing (BOP)<sup>10</sup> were assessed at 6 sites per tooth.

Participants who met the eligibility criteria were enrolled and were provided with a dental prophylaxis, consisting of scaling and polishing. Enrolled participants received the same oral hygiene care products (Oral-B® Indicator manual toothbrush and Crest® Cool Mint Gel dentifrice; Procter & Gamble; Cincinnati, OH, USA) and instructed to use the products twice daily throughout the study period. Visit 2 was scheduled 21 days after the screening enrollment appointment. Participants were instructed to perform toothbrushing 12-18 hours before

**Figure 2. Study flow-chart**



their scheduled appointment. They were also instructed to refrain from chewing gum and other hard crunchy foods during 3 to 6 hours before the study appointment.

Clinical assessments (MQH-PI, GI, PPD and BOP) were carried out in the previously designated sites by calibrated examiners at visit 2. Examiners were blinded to which group each participant was assigned, until conclusion of the efficacy evaluations. Participants were randomly assigned to either the test group (cRBIC) or the control group (Floss) and instructed to use the assigned device once a day (afternoon or evening), at approximately the same time. Appropriate written instructions for the assigned product were provided, along with a detailed review of product use by a member of the research staff, at the time the assigned product was dispensed. Participants demonstrated back their understanding of

the interdental cleaning instructions during the supervised session. Participants were also provided an at-home user experience diary, as well as a compliance diary. The diary indicated the level of motivation to interdental cleaning and satisfaction to the assigned product.

Adverse events were monitored by interview; a health history update and oral examination took place at each visit following enrollment. Research staff performed a compliance check with a verbal interview and review of the diary at visits 3 and 4. Lack of compliance was recorded as follows: failure to follow brushing instructions; failure to complete study diary; failure to follow plaque accumulation instruction; prohibited medication usage; prohibited oral care product usage; and failure to return product. Clinical assessments were performed at visit 3 (MQH-PI, GI only) and visit 4 (all endpoints).

#### ***Power calculation and statistical analysis***

The sample size was determined based on calculations described by Noordzi et al. for randomized controlled trials comparing two groups of equal size.<sup>1</sup> The significance level alpha was set at 0.05. With a minimum of 22 participants per treatment group, the power is at least 90% to detect a difference of 0.25 in interproximal plaque indices, referenced in the results of a similar clinical study by Jackson et al.<sup>12</sup>

The primary analysis was performed on all randomized participants at baseline, visit 3, and visit 4 (efficacy evaluation; modified intent to treat, MITT). Participants with a compliance level of 75% were grouped according to the randomized treatment assignment. The analysis of safety included all randomized



participants who were exposed to treatment. All variables were summarized by descriptive statistics and analyses were conducted using Minitab® 18 (Minitab Inc.; PA, USA). Differences between the two treatment groups' continuous demographic characteristics (e.g., age) were analyzed using Student's t-test. Differences between the groups' categorical characteristics (e.g., sex, race, ethnicity) were analyzed using Chi-Squared test.

Differences for clinical endpoints (changes of measurements from baseline to 2 or 4 weeks) were tested with an analysis of covariance model (ANCOVA) adjusted by baseline data followed by post-hoc Tukey Simultaneous test. Superiority for the continuous effectiveness endpoints at each time point was tested with Mann-Whitney test. Comparisons between baseline and 2 or 4 weeks in clinical measurements in each group were performed by Wilcoxon signed-rank test. Qualitative data of the diary were tested with Student's t-test. The probability level of statistical significance was set to  $p < 0.05$ .

**Table I. Study demographics and clinical measurements at participant enrolment**

	Floss (n=24)	cRBIC (n=26)	<i>p-value</i>
Demographics			
Sex (male/female)	12/12	13/13	1
Ethnicity (Hispanic/Non-Hispanic)	5/19	5/21	0.887
Race			
African American	2	0	0.424
African American, Asian, Caucus	0	1	
American Indian/Caucasian	1	0	
Asian	3	3	
Caucasian	16	21	
Other	2	1	
Age (mean, SD)	26.92 (8.53)	26.27 (6.93)	0.771
Clinical measurements			
MQH-PI (Score)	3.71 (1.11)	3.12 (1.41)	0.172
GI (Score)	0.95 (0.29)	0.89 (0.30)	0.623
PPD (mm)	2.59 (0.24)	2.63 (0.30)	0.508
BOP (%)	33.9 (17.7)	36.1 (16.2)	0.689

Values represented in mean (SD).

## Results

A total of 53 patients were assessed for eligibility, and 50 eligible participants were randomized in nearly equal proportions to either the test group (n=26) or the control group (n=24). One participant of the test group was lost to follow up after 2 weeks. Participant demographics in the two groups was shown to be similar (Table I). There were no statistically significant differences between the control group (Floss) and test group (cRBIC) in regards to measurements of MQH-PI, GI, PPD and BOP at enrollment and baseline (Table II). Measurements of GI and BOP were significantly reduced from enrollment to baseline due to the oral prophylaxis provided at enrollment. There were no changes observed in MQH-PI and PPD between enrollment and baseline. No statistically significant differences were observed in the mean change between the two groups in any clinical measurements, from baseline to 2 weeks. A statistically significant difference was detected in the mean change of PPD at 4 weeks between the two groups (test:  $-0.16 \pm 0.21$ , control:  $0.00 \pm 0.23$ ,  $p < 0.05$ ), while there was no significant difference in any other clinical parameters (Table III).

Comparing to baseline, PPD was improved significantly in both groups at 2 weeks, and the improvement from baseline was still observed at 4 weeks in the test group ( $p < 0.01$ ). BOP was shown to improve from baseline to 2 weeks in both groups, but these changes were not statistically significant. Between 2 weeks and 4 weeks, BOP returned to a level worse than baseline in both groups; however, a statistically significant difference ( $p < 0.01$ ) was found only in the control group (Table III). There were no statistically significant differences between baseline and 2 or 4 weeks in MQH-PI and GI measurements.

Qualitative information of the diary, as well as clinical endpoints, were analyzed. The cRBIC (test) group demonstrated better compliance levels (%) than the Floss (control) group during the study period followed by the short learning curve (test:  $97.4 \pm 3.8$ , control:  $94.8 \pm 5.6$ ,  $p < 0.05$ ) (Table IV). Mean scores of "ease-of-use" of the test group was significantly greater than that of the control group ( $p < 0.01$ ). The control group

Table II. Clinical measurements at each time point

All sites	Floss (n=24)	cRBIC (n=26) <sup>a</sup>	<i>p-value</i>
<b>MQH-PI (Score)</b>			
BL	3.65 (1.15)	3.35 (1.43)	0.599
2W	3.36 (1.17)	3.38 (1.47)	1
4W	3.88 (0.87)	3.39 (1.31)	0.253
<b>GI (Score)</b>			
BL	0.59 (0.34)	0.63 (0.24)	0.771
2W	0.56 (0.32)	0.56 (0.25)	0.846
4W	0.62 (0.31)	0.61 (0.31)	0.912
<b>PPD (mm)</b>			
BL	2.53 (0.24)	2.63 (0.25)	0.255
2W	2.43 (0.23) <sup>*</sup>	2.45 (0.22) <sup>**</sup>	0.777
4W	2.53 (0.27)	2.49 (0.26) <sup>**</sup>	0.508
<b>BOP (%)</b>			
BL	13.0 (12.7)	15.7 (17.2)	0.76
2W	9.9 (12.2)	11.5 (13.0)	0.805
4W	26.0 (18.0) <sup>**</sup>	21.7 (16.6)	0.355

Values represented in mean (SD).

<sup>a</sup>N=25 for 4 weeks. One subject was lost follow-up after 2-week visit.

\*  $p < 0.05$ , \*\* $p < 0.01$  compared to Baseline.

Table III. Changes from baseline in clinical measurements

All sites	Floss (n=24)	cRBIC (n=26) <sup>a</sup>	<i>p-value</i>
<b>MQH-PI (Score)</b>			
2W	-0.07 (1.12)	0.03 (1.02)	0.863
4W	0.23 (0.93)	0.04 (1.19)	0.203
<b>GI (Score)</b>			
2W	-0.03 (0.32)	-0.07 (0.30)	0.806
4W	0.03 (0.37)	-0.02 (0.35)	0.836
<b>PPD (mm)</b>			
2W	-0.10 (0.21)	-0.18 (0.21)	0.486
4W	-0.00 (0.23)	-0.16 (0.21) <sup>*</sup>	0.048
<b>BOP (%)</b>			
2W	-3.1 (10.8)	-4.2 (15.7)	0.903
4W	13.0 (17.7)	7.0 (21.2)	0.317

Values represented in mean (SD).

<sup>a</sup>N=25 for 4 weeks. One subject was lost follow-up after 2-week visit.

\* $p < 0.05$  control group vs. test group.

Table IV. Qualitative data from a diary through the study period

Question	Floss (n=24)	cRBIC (n=25)	<i>p-value</i> <sup>*</sup>
What is your motivation level to clean your teeth (brushing)? <sup>a</sup>	3.24 (0.22)	3.46 (0.16)	0.000
What is your motivation level to clean your teeth (Interdental cleaning)? <sup>a</sup>	3.14 (0.23)	3.37 (0.17)	0.000
Was the assigned product easy to use? <sup>b</sup>	3.37 (0.17)	3.80 (0.21)	0.000
What was your level of confidence to use the assigned product? <sup>b</sup>	3.73 (0.13)	3.68 (0.21)	0.279
What is your level of cleaning Satisfaction? <sup>b</sup>	3.76 (0.15)	3.47 (0.16)	0.000

Values represented in mean (SD).

Rating scale of questions were from 1 (e.g. Not easy) to 5 (e.g. Very easy). \*t-test.

<sup>a</sup> Question before cleaning

<sup>b</sup> Question after cleaning

indicated better “satisfaction” than test group ( $p < 0.01$ ). Motivations for oral hygiene (brushing and interdental cleaning) were higher in the test group than the control group during the study period ( $p < 0.01$ ). No adverse events were reported during the trial.

## Discussion

Interdental cleaning has been a critical aspect of overall effective plaque control and prevention of periodontal diseases, and many publications have addressed this topic previously.<sup>13</sup> Recently, a meta-analysis was conducted to evaluate the efficacy of oral hygiene aids.<sup>14</sup> Kotsakis et al. concluded that there is lack of strong evidence to support one method over another and recommended that practitioners customize oral hygiene methods to meet the needs of the individual. Customized oral hygiene instructions with alternative approaches to meet the needs and preferences of the patient, still prevails in practice.

The use of a curved-design rubber bristle interdental cleaner (cRBIC) in this study demonstrated positive outcomes in regards to probing depth reduction and ease-of-use, as compared to dental floss. However, there were no clinically significant improvements in the parameters obtained between baseline and the end of the study in either the control or test groups. The lack of positive change parameters in either group is believed to be due to the professional prophylaxis provided to all participants 3 weeks prior to obtaining the baseline measurements. The oral health effects of the thorough

prophylaxis performed by dental hygienists quite likely lasted longer than 3 weeks, thus the GI and BOP at baseline were lower than those at enrollment. However, there were no differences in interproximal MQH-PI score and in PPD between the enrollment and baseline measurements. This finding may indicate that while the plaque accumulation was possibly improved by the prophylaxis and oral hygiene instruction at the first visit, the effect may have been gradually lost during the 3-week washout period. Improvements on BOP and GI may be due to the thorough removal of plaque and calculus at enrollment, with the effect lasting 2 weeks following the study initiation. A minor but significant improvement of PPD from baseline was detected in the test group at 4 weeks. Between 2 and 4 weeks, BOP clearly trended towards the level before professional prophylaxis, and was faster in the control group than the test group ( $p < 0.01$ ) indicating that using a cRBIC may help the effects of professional prophylaxis to last longer than using dental floss.

Rubber interdental cleaning devices, including the cRBIC, have been compared to other interdental cleaning devices in three other clinical studies. Hennequin-Hoenderos et al.<sup>2</sup> evaluated cRBIC to an interdental brush in participants with experimental gingivitis and found that using a cRBIC produced similar results to that of the interdental brush in plaque reduction. However, gingival bleeding at accessible interdental sites was reduced, when compared to the interdental brush at 4 weeks after the resumption of oral hygiene practices.<sup>2</sup> Yost et al.<sup>15</sup> showed that the effectiveness of RBIC (straight handle) was equivalent to floss in reducing plaque scores and gingivitis levels. The efficacy of the interdental brush was also shown to be superior to other interdental cleaning devices based on the clinical results of Yost et al.<sup>15</sup> Another study by Abouassi et al.<sup>16</sup> comparing a straight handle rubber interdental bristle to an interdental brush demonstrated similar clinical efficacy of the two devices. Plaque accumulation was not improved after either device was used for 4 weeks while bleeding was significantly reduced during the study period by both devices. A professional oral prophylaxis was also provided to all participants prior to the start of both the Yost et al.<sup>15</sup> and Abouassi et al. studies.<sup>16</sup> Since the target populations (experimental or spontaneous gingivitis patients); study designs (cross-over or parallel); and study conditions (timing of a professional prophylaxis) are not the same across these studies, some discrepancies in conclusions should be expected. However, when viewing the study results overall, it can be concluded that any type of interdental dental cleaning might be effective on gingival bleeding reduction in varying degrees and may be due to the fact that BOP is a reliable clinical parameter for diagnosing gingivitis.<sup>17</sup>

The efficacy of interdental cleaning is largely affected by the acceptability of the method by the patient and the degree of compliance to the technique. In the Hennequin-Hoenderos<sup>2</sup> study, participants were given a period of time to become familiar with an assigned device. The familiarizing period may have reduced an effect of participant acceptability to an assigned device on the clinical outcome. The results of other studies,<sup>1,2</sup> including the current study, may have reflected the effectiveness of the device itself and the participant's acceptance of the assigned device more than Hennequin-Hoenderos<sup>2</sup> due to the lack of a familiarizing period. Participants assigned to the cRBIC group showed an increase in the average score for the question on "ease-of-use" in the diary, gradually, during the first week of the study period (data not shown). This finding may indicate that the participants needed a learning period to become familiar with and to accept the new interdental cleaning method.

This study assessed patient acceptability to the assigned method through the use of a diary. The cRBIC group demonstrated significantly higher scores in assessment of motivation for interdental cleaning or brushing, as compared to the Floss group. Perhaps it was the design aspect of the cRBIC of only requiring the use of one hand and its unique long, curved handle, as compared to the straight design, that may have made it more user-friendly. Patients may be unable to use dental floss properly, due to challenges in maneuvering the floss interdentally, with both fingers in the mouth. Participants in the cRBIC group in this study gave a higher score in the handling property (ease-of-use) category than that of the Floss group. Ease-of-use of the cRBIC device may have affected the participants' motivation for interdental cleaning on a daily basis, ultimately resulting in better compliance. While the Floss group gave higher scores in satisfaction than the cRBIC group, satisfaction with the device did not seem to promote increased motivation for interdental cleaning. This finding can be interpreted to mean that while participants appreciated the performance of floss; this was not enough to motivate them towards the habit of interdental cleaning.

Patient acceptance of the interdental cleaning tools, through questionnaires at the end of the study period was used in the Abouassi et al.<sup>16</sup> comparing rubber interdental brushes to a control interdental brush. Rubber interdental bristles were given high scores for manageability of the device, less pain during usage, comfort of brushing, and willingness to buy the product, as compared to the control brush. Considering these findings, rubber bristle interdental cleaning devices, including the test device, can be used as an alternative interdental cleaning aid as an alternative to floss products or interdental brushes

due to the high level of patient acceptance. Findings from this study suggest that using a cRBIC may be advantageous in reducing and maintaining lower levels of gingivitis, and may promote a motivation to daily interdental cleaning due to its high level of patient acceptance. Future studies, should be of longer duration (minimum of 3 months) to monitor the efficacy of the clinical outcomes over a maintenance period.

## Conclusions

A curved rubber bristle interdental cleaner was similar to an ADA seal of acceptance dental floss product in clinical performance; however, the PPD reduction at 4 weeks was greater in the cRBIC group. Measurements of BOP in both groups trended toward levels recorded prior to professional oral prophylaxis, however use of the cRBIC appeared to help maintain the effects of the prophylaxis longer. Ease of use of the cRBIC may have affected the participants' motivation for interdental cleaning, resulting in better compliance, as compared to dental floss.

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# Drinking Water Practices Among Latino Families in North Carolina: A qualitative study

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## Abstract

**Purpose:** The purpose of this study was to understand the beliefs, experiences and practices regarding drinking water among the North Carolina (NC) Latino community, and to gather information on what would make effective messages to promote fluoridated community water (CW) consumption among Latino families.

**Methods:** Phone interviews were conducted with Latino stakeholders, consisting of parents of young children and key community informants (n=15). The interviews were audio-recorded, and transcripts were analyzed qualitatively using Atlas.ti.8 software.

**Results:** Major themes emerging from the interviews included: poor characteristics of CW misconceptions and lack of knowledge about CW fluoridation and safety, ingrained culture/upbringing that devalued CW consumption, and reasons for consuming CW. Participants suggested that effective efforts to promote fluoridated CW consumption among the NC Latino community should be implemented in a variety of formats and involve a collaborative approach between Spanish-speaking health professionals and community workers.

**Conclusion:** Successful promotion of fluoridated CW consumption among NC Latino communities requires engagement of both health professionals and community stakeholders. Effective interventions aimed to promote fluoridated CW consumption need to be widespread, informative, persuasive, credible, culturally sensitive, and interactive.

**Keywords:** community water fluoridation, cultural competency, dental caries, fluoride, health promotion, public health

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## Introduction

The introduction of community water (CW) fluoridation, one of the ten great public health achievements of the last century, has contributed to large decrements in dental caries burden among both children and adults since the 1960s.<sup>1-4</sup> Despite the well-known benefits of fluoridated CW, the consumption of bottled water (BW) has more than doubled over the last fifteen years.<sup>5</sup> Of note, Mexico was the leading country worldwide in per capita consumption of BW in 2016, consuming approximately 71% more BW than individuals in the U.S.<sup>6</sup>

Multiple studies have shown BW consumption and tap water avoidance are prevalent practices among Latino communities.<sup>7-10</sup> It has been reported that these practices may stem from pervasive beliefs that CW is unsafe to drink due to

its perceived poor aesthetic qualities, such as cloudy appearance, salty taste, or smell of chlorine.<sup>7,8</sup> Others have reported not drinking CW due to fear of getting sick.<sup>9</sup> Such perceptions and beliefs are thought to originate from personal experiences with natural disasters, such as hurricanes and earthquakes, and historical events, such as cholera outbreaks, which actually rendered the tap water in certain regions of Latin America unsafe to drink for extended periods of time.<sup>10-15</sup>

While BW consumption may be viewed by many as a harmless, or even a healthy practice, relying on BW as one's primary source of drinking water can have negative oral health implications. Most BWs do not contain the optimal 0.7ppm level of fluoride recommended by the United States

(U.S.) Public Health Service for dental caries prevention.<sup>16</sup> Some BWs have also been shown to be slightly acidic, nearly reaching the critical pH for dentin (6.5) and enamel (5.5), which can have implications for dental erosion.<sup>17,18</sup>

According to data from the 2015-2016 National Health and Nutrition Examination Survey (NHANES), Hispanic children experience the highest rate of dental caries among youth aged 2-19 years in the U.S.<sup>2,19</sup> The disproportionate burden of dental disease among Hispanic children, combined with the popularity of BW among Latino communities, suggests that fluoridated CW is underutilized among the Latino population segment, and that the youth who are at greatest risk for dental caries are among those least likely to reap the oral health benefits of CW fluoridation.

In the state of North Carolina (NC), 9% of its residents are Hispanic or Latino, with 25% of Latino residents living in the state's two most urban counties: Mecklenburg and Wake.<sup>20</sup> It is noteworthy that 88% of NC residents on CW systems received optimal levels of fluoride in their CW in 2014, indicating its relatively easy accessibility.<sup>21</sup> While studies have reported on various barriers preventing families from consuming CW, no study to date has reported attempts to design an intervention to promote switching from BW to CW consumption among Latino families.

There is ample motivation to advocate for fluoridated CW among Latino communities in NC. The purpose of this study was to better understand Latino community members' and stakeholders' experiences and views on fluoridated CW versus BW consumption in NC, and gain insight into their perspectives on what they consider are effective messages and strategies for promoting fluoridated CW consumption among Latino communities.

## Methods

Qualitative data collected for this study relied on phone interviews with Latino stakeholders in NC using semi-structured interview guides. Institutional Review Board (IRB) approval was obtained (#16-2716) from the University of North Carolina (UNC), Chapel Hill. Participants were recruited from two broad stakeholder categories, "community members" or "key informants." Community members (CM) were defined as parents of elementary school-aged Latino children. Inclusion criteria for this group included fluency in the English language, self-identification as Hispanic/Latino(a), and parental status of at least one elementary school-aged child. Key informants (KI) were defined as professionals who worked, to a considerable degree, with Latino families and children in NC. Inclusion criteria included fluency in the

English language and professional status involving frequent interactions with Latino families and children.

Interview guides were created for each stakeholder group; the guide for community members included probing and open-ended questions about their child/children's water-drinking practices, determinants, and influences. The guide for key informants included questions about their observations of Latino children's water-drinking practices and their insights on what would make effective messages and strategies for promoting fluoridated CW consumption among Latino families. Pilot interviews were conducted with one community member and one key informant, and the interview guides were further iteratively revised during the course of the study.

In collaboration with faculty members and students from the University of North Carolina (UNC) Adams School of Dentistry, the investigators utilized purposive sampling to recruit an initial group of Latino community members from various municipalities and key informants from different professions in order to gain a diverse representation of perspectives. Snowball sampling was used thereafter to recruit additional participants via word of mouth; initial participants recommended and provided contacts of additional individuals who could provide valuable information as potential study participants. This process was continued until theoretical saturation was reached.

Interviews were conducted during daytime and evening according to the participant's availability and convenience. Verbal consent was obtained from each stakeholder prior to beginning the interview session and study participants were informed they would be mailed a \$20 gift card following their interview as compensation for their time. At the end of each session, uninformed or misinformed participants were presented facts about fluoridated CW and BW, and any fluoridated CW myths revealed were dispelled by the interviewer. All interviews were conducted by the same investigator (YO) between September and November of 2017, audio-recorded, transcribed verbatim, coded in vivo based on frequently used words, categorized into broad domains, and analyzed using Sandelowski's qualitative description framework<sup>22</sup> with Atlas.ti 8 (Scientific Software Development GmbH) software.

## Results

A total of 15 participants (10 community members and 5 key informants) were interviewed between September and November 2017. Interviews lasted between 20-45 minutes, with key informant interviews generally lasting longer than community member interviews. A majority of the community

members interviewed were first-generation immigrant parents of young children from Mexico or El Salvador. One member self-identified as Puerto Rican. Key informants included an English as a Second Language (ESL) elementary school teacher, Latino social advocates, a Spanish-speaking nurse from a local health center, and a Latino oral health sciences student. Recurring themes emerging from the interviews were organized into the following five domains: 1) poor characteristics of CW, 2) misconceptions and lack of knowledge about CW, 3) ingrained culture/upbringing that devalued CW consumption, 4) reasons for drinking CW, and 5) ideas for an intervention to effectively promote fluoridated CW consumption among Latino communities.

### ***Poor characteristics of CW***

While several Latino parents of elementary school-aged children believed that water was the best beverage option for their children's overall and dental health, most parents relied on sugar-sweetened beverages (e.g., juices and sodas) and BW as their primary beverage choice and did not allow their children to consume CW. A common influence of these practices was the belief that CW was unclean and unsafe to drink due to its aesthetic qualities related to discolored appearance, taste of chlorine, and unpleasant smell:

[CM #8]: *"The water wasn't clear in the cup, and in the clear cup you would see it kind of yellowish-orange. It wasn't clear."*

[CM #6]: *"My kids, my son does not like the flavor in it, the chlorine flavor, and so he would spit it back out and I'd have to give him the bottled."*

[CM #5]: *"To brush our teeth, you could sometimes smell, the water smelled weird, when you turned on the water."*

### ***Misconceptions and lack of knowledge about CW fluoridation and safety***

Other common reasons for parents discouraging their children from drinking CW were their mistrust or lack of knowledge regarding the sanitation process of public water, lack of awareness of the fluoridation of most CW systems, and lack of knowledge on the dental health benefits of fluoridated CW. Participants were forthright in voicing their uncertainties and concerns:

[CM #1]: *"Well, one of my questions about the water... They clean out the water and they make to run again to the community's house.... I would like to know more about that. I don't know how they clean, how they... if it's good to drink again or not because I don't understand [how] people do that."*

Interviewer: *"Community water fluoridation is when they add a little bit of fluoride to the water. And do you know what the purpose of that might be?"*

[CM #8]: *"Not really, I guess to clean it? I'm not sure."*

[CM #4]: *"We use reverse osmosis water because the fluoride is... Yeah I know for science, fluoride is good for your teeth. That's what they say. But the fluoride that came from earth is good for your teeth. Not the fluoride they add as a chemical... it is not good for your brain."*

### ***Ingrained culture/upbringing that devalued CW consumption***

In addition to the previously cited reasons for the underutilization of CW by the NC Latino community, a recurring theme linked to the growing popularity of BW over CW was the heavily ingrained habit of avoiding CW throughout the childhood of the interview participants, both in their native countries and in the U.S. In countries such as Mexico where the local tap water may be unpotable in some areas, a heavy emphasis was placed on avoiding tap water, and positive reinforcement was given to consuming beverages other than tap water, including BW, juices, and sodas. Fluoridated CW is considered to be the most advantageous beverage one can drink from a dental health standpoint in the U.S., however it may also be the most avoided beverage within parts of the NC Hispanic/Latino community:

[CM #6]: *"Well, just in our community in general, I think that the Hispanic community tends to think that... We come from a place where water, tap water, is not good, and you're told you shouldn't drink it. I think some of those beliefs come with people when they move here and then they still think that tap water is bad so they have to drink bottled water or buy gallon water. I think it's just a cultural thing."*

[KI #3]: *"Like I will say, honestly, it was shock for me. I mean, I was a child, but I remember that it was like odd that I could drink from the tap [here]. I mean that just seemed so revolutionary because it was very clear to me, it was like very ingrained when I was growing up that of course you can't drink the water from the tap, and so you just know that. And it takes a while to realize that it is okay."*

[KI #2]: *"...you go to somebody's house in a rural area, what they will offer you, which is like a treat, is a soda instead of water. Like who would want to drink water when you have access to something that's fancier? And I feel like that has stuck around a little bit, it's like a sign of celebration, it's something positive, it's a reward."*

## **Reasons for consuming CW**

While the majority of interview participants reported drinking primarily or exclusively BW, a few supported consuming CW. Reasons included the affordability of CW, fewer adverse environmental impacts, trust in their local water company, and alternative options available to purifying CW, such as using a commercial water filter or boiling tap water:

[CM #2]: *"For me, tap water is better for the reasons I gave. You don't have to pay for it. You avoid polluting with plastic bottles... I know that there is a risk, that there are probably things that we don't know about the water from the tap. But I trust the [water sanitation] company..."*

[CM #2]: *"We use the... the container that has the filter inside it. We have the Brita... During the summer, I do the water from the fridge. And I think that there's a filter there."*

[CM #10]: *"We use tap water because in my mind, [when] you boil the water, you're purifying it. So I just feel like it's getting the chemicals out when you're boiling hot water."*

## **Ideas for an effective intervention promoting fluoridated CW**

When participants were asked to offer their insight into what they believed may be effective ways to promote fluoridated CW consumption (where available) specifically among Latino families in NC, many voiced the importance of educating the public on the presence of fluoride in their CW and its dental health benefits. Some also suggested discussing the cost-saving benefits of switching from BW to fluoridated CW. Others stressed the importance of making messaging appealing to both parents and children when promoting fluoridated CW via use of visuals, as well as having the information delivered in their native language (i.e., Spanish) by expert community and health professionals in interactive settings (e.g., festivals, doctor's and dental visits, radio shows, etc.) where they can be engaged and ask questions. They also preferred these interactions to take place in settings where transportation is not a barrier. Specific suggestions for interventions were categorized according to messages, deliverers, mode of delivery, and location of delivery.

## **Messages**

[KI #5]: *"Look, it's safe. It's clean. It's fluoride. It prevents cavities."*

[KI #2]: *"Perhaps showing specific savings. Like, 'so there's a family of four and this is how much they spend a week on bottled water. If they only switched, this is how much they would save, and this is the impact that it would have on the kids' teeth because of the fluoride.'"*

[CM #5]: *"...more pictures. More slides... so they can actually see what the differences of teeth of somebody that just drinks bottled water and then somebody that drinks tap water over their life."*

## **Deliverers**

[CM #10]: *"A Spanish-speaking dentist, assistant, just somebody that maybe... The ideal person would probably be the person working in that field. They're studying it."*

[KI #4]: *"Nonprofits that have a strong family base."*

## **Mode of Delivery**

[KI #1]: *"...if you somehow can get a professional on the radio station and you promote this space, 30-minute space or whatever, and ask the audience to call in with some questions... I think you will dissipate a lot of misunderstandings, misinformation, or whatever."*

[KI #1]: *"...you grab a newspaper and it's free... On those newspapers, they're advertising for dentists and doctors and whatnot and lawyers, but also have topics about immigration and things like that... so I think people, parents with young children, or all kinds of children, are more likely to be receptive from newspaper than from the radio."*

[CM #7]: *"Definitely the Internet, but I would look like in an organization [for] anything with like a factual website that I can actually get the correct information..."*

## **Location of Delivery**

[KI #3]: *"It seems more beneficial doing like a community outreach type approach. Like meeting the families, like if there's a gathering in their neighborhood, or the common area, or a church, or a community center, something like that, where transportation is not a barrier. And also making it known and well-advertised that it will be delivered, the information will be given, in their native language."*

[KI #2]: *"...having folks at festivals... having an opportunity where people can talk to somebody [who] can explain why [drinking tap water is] important and share information and provide goodies."*

## **Discussion**

The findings of this study support the perception that a considerable proportion of Latino community members in NC may avoid drinking CW due to its unpleasant aesthetic qualities, misconceptions about its safety, lack of awareness about fluoridation (where applicable) and its dental health benefits, and ingrained habits and reinforcements on drinking any beverage rather than plain CW. These results



are consistent with an earlier report of a study conducted in rural California, in which Latina mothers of young children did not drink municipal water due to its colored appearance and salty or chlorine taste and smell.<sup>8</sup> Similar findings were reported at a university in Mexico, wherein approximately 75% of the university staff and student participants reported drinking exclusively BW, primarily due to the poor aesthetic features of CW, and secondarily due to health concerns.<sup>10</sup> In another study of primarily low-income Latino parents, about 30% of parents reported avoiding drinking CW while approximately 40% stated they never gave it to their children for fear that it may cause illnesses.<sup>9</sup>

A recurring theme in this body of literature is the concept that unpleasant qualitative features of CW (e.g., cloudy appearance and taste/scent of chlorine) are signs of unpotable water that should be avoided. While this may be an instinctive assumption, it is fallacious. First, according to the U.S. Environmental Protection Agency (EPA), when CW is treated, chlorine is added as an oxidizing and disinfecting agent to control microbial growth and to eliminate various harmful contaminants and poor qualitative factors, such as color, taste and odors. Ironically, the EPA has also reported that while increasing chlorine dosages raises its disinfecting and oxidizing power, it could potentially create a less-than-favorable taste and odor.<sup>23</sup> As a result, the taste and smell of chlorine are frequently misinterpreted as dangerous, when they are actually indicators of greater safety. This misinterpretation can negatively direct individuals to alternative sources of hydration, such as BW, sugar-sweetened beverages, resulting in inadequate fluoride exposure, increased sugar intake, or xerostomia due to dehydration; all ultimately making individuals more susceptible to dental caries.

In addition to experiences relating to the poor aesthetic features of CW, experiences growing up in geographically vulnerable areas of Latin America with compromised CW safety, may likely have reinforced reliance on BWs. Examples of such experiences include Hurricane Maria in 2017, the 1985 and 2017 earthquakes in Mexico City, or the 1991 cholera epidemic.<sup>10-15</sup>

Results of this study support that Latino cultures, life experiences, and upbringing largely impact beverage consumption practices, and that these conditioned practices may be difficult to modify. Based on these findings, more intentional efforts should be made in dental clinical settings to assess patients' beverage consumption practices, including focused dental history questionnaires, patient interviews, or dietary assessments. Dental professionals should actively initiate regular discussions particularly with Latino patients

identifying as BW drinkers to provide information on the multiple benefits of CW. Dental professionals should also be aware that culturally ingrained beliefs that CW is harmful may not change overnight. Initiatives promoting CW consumption are crucial in community settings as well. According to participants' responses, educational interventions should highlight the specific benefits of CW including caries prevention, optimal oral and systemic health, cost-savings, and low environmental impact. Messages should be delivered in Spanish in a variety of formats (e.g., visual, audio, written and interactive) for maximum effectiveness. Dental hygienists can play a key role in all of these education efforts.

This study had limitations. First, the major emerging themes from this qualitative study cannot be generalized to the entire heterogeneous Latino population, including more recent immigrants, due to the limited ethnic backgrounds represented in the sample and due to inclusion criteria of fluency in the English language. Second, because the interviews were conducted by phone, this mode of data collection automatically excluded community members who either could not afford or did not have access to a phone due to financial constraints. This aspect of the study protocol may have excluded stakeholders unable to afford to buy BW and relied solely on CW due to finances. In spite of these limitations, findings from this study provide some clarity on Latino families' rationales and motivations for their drinking water choices and provides insights into possible future steps for educational interventions and research.

## Conclusion

The participants of this qualitative study provided valuable insights into the phenomenon of BW preference among Latino communities and offered ideas for promoting the change to consuming fluoridated CW. Various strategies and messages were suggested on how to best educate NC Latino families on the benefits of fluoridated CW. Results indicate that a multifaceted approach involving expert opinion (e.g., medical, dental, allied health and water treatment professionals) using various forms of delivery (e.g., one-on-one interactions, flyers, news/radio segments) in multiple settings (e.g., Latino health fairs, dental visits, school functions) in a language that Latino families can understand (i.e., Spanish), is key to promoting successful behavioral change. Effective interventions aimed to promote fluoridated CW consumption need to be informative, persuasive, credible, culturally sensitive, and interactive. Efforts must be collaborative and inter-professional, involving not only that of health professionals, but also of other community stakeholders (e.g., school teachers and non-profit agencies).



Further research will be needed to test the effectiveness of these strategies on behavioral change among this population segment.

## Disclosure

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# Dental Hygiene Program Directors' Perceptions of Advances in Accreditation Standards

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## Abstract

**Purpose:** Dental hygienists have increased opportunities as work-force models expand opportunities for the profession. The purpose of this study was to identify entry-level dental hygiene program directors' perceptions regarding advancing accreditation standards in dental hygiene education.

**Methods:** An electronic questionnaire was distributed via three mailings during the spring semester of 2019 to the 332 entry-level dental hygiene program directors across the United States for this exploratory, descriptive study. The survey instrument addressed the various dimensions related to changing the accreditation standard for the entry-level dental hygienists to the baccalaureate degree. Descriptive statistics and chi-square tests of association were used to analyze results.

**Results:** A total of 178 responses were received (n=178) for a response rate of 53.6%. Most program directors agreed students complete three years of college education (n=152, 85.4%), and should be educated to understand current and emerging workforce delivery models (n=166, 93.2%). More than half disagreed (n=94, 52.9%) with the statement that there is ample time in the curriculum to prepare students for employment in a variety of oral healthcare settings. Respondents were equally divided concerning changing the accreditation standard for the entry-level to the baccalaureate degree but were in support of modifying the standard to require didactic educators to have a master's degree.

**Conclusion:** Dental hygiene program directors were divided regarding advancing accreditation standards to the baccalaureate degree for entry-level dental hygienists. Further research is needed to include dental hygiene educators' and leaders' perspectives to provide comparative information and a greater understanding regarding increasing accreditation standards.

**Keywords:** dental hygiene education, dental hygiene workforce models, dental hygiene faculty, professional development; baccalaureate degree, accreditation standards

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## Introduction

The first dental hygiene school was founded by Dr. Alfred C. Fones in 1913. Dental hygiene students were educated in "mouth hygiene" and instrumentation techniques to remove "plaque, stain and tartar" accretions on the teeth.<sup>1</sup> Fones's vision was for this professional to provide preventive oral health care in a variety of public health settings, such as infirmaries, schools, dental private offices, and public clinics.<sup>1</sup> The dental hygiene profession continues to have a primary focus on oral disease prevention in a variety of settings; however, education in mouth hygiene and instrumentation alone is no longer sufficient for oral disease prevention. Significant advances in health science research have identified a multitude of systemic conditions that contribute

to oral diseases.<sup>2,3,4</sup> It is now understood that localized biofilm and calculus removal are only one of the factors to consider in oral disease prevention.<sup>5,6,7</sup> Ongoing evidence-based research has established oral-systemic correlations, including bidirectional relationships between diabetes and periodontitis;<sup>7,8</sup> cardiovascular conditions and periodontal disease;<sup>9,10</sup> increased susceptibility of immunocompromised patients to oral infection;<sup>11,12</sup> and increased caries risk due to medication induced xerostomia.<sup>13,14</sup> These correlations require dental hygienists to have additional scientific knowledge to understand oral-systemic relationships and host-inflammatory responses in order to make appropriate recommendations for preventing and treating oral disease.

Technology utilized by dental hygienists has changed dramatically since the profession was established in 1913. The available consumer options of a few manual toothbrushes has grown exponentially into an abundance of choices ranging in size, shape, and bristle type. Power toothbrushes are commonly used and require a different brushing technique. Over-the-counter rinses, toothpastes, and whitening products require professionals to be aware of the potential chemical reactions between products and adverse reactions in the oral cavity. Oral cancer screening devices have been created to enhance visualization of abnormalities within the oral cavity,<sup>15,16</sup> and salivary diagnostic testing provides a means to identify specific microorganisms associated with oral disease.<sup>17,18</sup> Oral health care providers must be able to understand current research in evaluating the scientific evidence and appropriateness of these devices and tests for clinical practice.<sup>15,16</sup>

Advancements in assessment instruments and treatment procedures require additional training beyond the traditional methods. Periodontal probing devices now allow the dental hygienist to enter information by foot or voice controls.<sup>19</sup> Clinical procedures within the oral cavity are enhanced by power driven instrumentation, laser therapy, and perioscopes.<sup>20,21,22</sup> Electronic dental programs are commonly used to record the patient's assessment and treatment information.<sup>23</sup>

Access to oral health care has increased as a result of technology supported teledentistry enabling patients in rural locations to receive oral health care provided by oral health care professionals while the dentist is in a different location.<sup>24</sup> Providing oral health care in remote settings requires an increased emphasis on the development of critical thinking skills as part of the dental hygiene education process.<sup>25</sup> These skills are particularly important in teledentistry for the identification of general health conditions requiring medical referrals as well as the oral conditions for review by a virtual dental home dentist.<sup>25,26,27</sup> Looking beyond patient care and the clinical role of the dental hygienist, six other roles or specialty areas for the profession have been identified: research, corporate, public health, educator, administrator, and entrepreneur. These roles provide dental hygienists with increased responsibilities and opportunities to work in a wide range of settings outside of clinical practice.<sup>28,29</sup>

Advancements in oral health care and technology, as well as expanding professional roles, have required changes in dental hygiene education standards. The Commission on Dental Accreditation (CODA) is the current accrediting body responsible for dental hygiene education. In 1975, the newly formed CODA established the requirements for dental hygiene

education programs and identified a two year minimum for completion.<sup>30</sup> While CODA has modified and expanded education standards, the commission has not made any changes in the minimum number of years for completion.

Currently, all dental hygiene students are required to meet the same educational standards, however they are not awarded the same degree. For example, CODA Standard 2.8 refers to the required inclusion of content specific to four areas: general education, biomedical sciences, dental sciences, and dental hygiene sciences. General education content includes oral and written communication, psychology and sociology; and biomedical sciences includes anatomy, physiology, chemistry, microbiology, nutrition, and pharmacology.<sup>30</sup> Both the general education and biomedical science coursework would be considered pre-requisites prior to beginning a dental hygiene education program. The dental sciences include course content areas related to tooth morphology, oral embryology and histology, oral pathology, radiography, periodontology, and pain management; while health promotion, clinical dental hygiene, community oral health, medical and dental emergencies, legal and ethical issues, and infection and hazard control management fall under dental hygiene sciences, all completed as part of the dental hygiene education program.<sup>30</sup> While all dental hygiene programs must adhere to the education content required by Standard 2.8, students receive either an associate's or a bachelor's degree upon program completion.

A recent retrospective study identified dental hygiene students are completing educational requirements exceeding the degrees granted.<sup>31</sup> O'Hehir compared the number of educational hours currently required for associate and baccalaureate degree programs in the state of Arizona to those required in 1945. Historically, educational hours were discussed as contact hours. For the purposes of comparison, current credit hour requirements were converted to contact hours. O'Hehir's findings showed that a two-year dental hygiene program required a total of 112 contact hours in 1945 as compared to the current 157 contact hours for associate programs and 170 contact hours for bachelor programs in Arizona.<sup>31</sup> Dental hygiene students receiving an associate degree are completing approximately 45 contact hours more than what was required in 1945 and are dedicating nearly the same number of contact hours as baccalaureate degree students. O'Hehir concludes that today's dental hygiene student deserves to be awarded the degree that accurately reflects their education.<sup>31</sup>

One barrier associate degree students may encounter



upon completion of the additional required credits for a baccalaureate degree is the institution in which the dental hygiene program is located. Various educational institutions (i.e., community colleges, technical colleges) may not have the ability to grant a baccalaureate degree. To address this barrier, two current options are available, dual enrollment and degree completion. Dual-enrollment is a partnership between the educational institution offering the dental hygiene associate degree and another university.<sup>32</sup> Students enrolled in the associate degree program would concurrently enroll in the partnering university to concurrently complete the necessary credits for a baccalaureate degree. A second option is a degree completion program, which does not usually occur concurrently with the associate degree curriculum. Degree completion programs are typically intended for licensed dental hygienist who graduated with an associate's degree and would like to earn a bachelor degree.<sup>33</sup>

The American Dental Hygienists' Association (ADHA) recognizes the need for dental hygiene education related to increased roles, responsibilities and workforce models. In 2017, ADHA approached the Commission on Dental Accreditation (CODA) and proposed revisions to Standard 2-1 related to entry level dental hygiene education and Standard 3-7 related to faculty education requirements (master's degree or higher) for teaching didactic courses. In their response, CODA requested an impact study related to these proposed changes, including assurance that every CODA accredited dental hygiene program director had an opportunity to provide comment.<sup>34</sup> As a means to provide an avenue for all dental hygiene program directors to provide input on the proposed changes, an electronic survey was developed to examine viewpoints of entry-level dental hygiene program directors concerning various aspects of elevating the degree required for entry into dental hygiene practice to the baccalaureate degree within their institution as well as their viewpoints regarding the requirement of a master's degree or higher for teaching didactic courses. The purpose of this study was to identify entry-level dental hygiene program directors' perceptions regarding advancing accreditation standards in dental hygiene education.

## Methods

An exploratory, descriptive, cross-sectional study was designed to assess entry-level program directors' perceptions of changes to accreditation standards using an original 19-item survey instrument. Variables addressed included the following: type of entry-level dental hygiene program, program setting, program director demographics, and dimensions related to elevating the degree required for entry into dental hygiene practice to the baccalaureate degree. The

survey was reviewed by a subset of expert dental hygiene faculty, researchers, and participants from the American Dental Hygienists' Association (ADHA), to establish content validity. The survey was also reviewed by a measurement expert and biostatistician to ensure congruency with survey items and research questions. Feedback was provided and modifications were made. The study design and survey underwent IRB review and was approved by the Idaho State University Human Subjects Committee (IRB-FY2019-100).

Dental hygiene program directors from 332 entry-level dental hygiene programs (n=332) were invited to participate in the survey. Qualtrics® (Provo, UT) was used to distribute the questionnaire via three electronic mailings during the spring of 2019. All surveys were confidential and included an informed consent form. Descriptive statistics and chi-square analysis were used to analyze results. To hold the familywise error rate to  $p=.05$ , the Bonferroni adjusted criterion for statistical significance for each test was established as  $p=.01$ . When there were cells with expected frequencies less than 5, the Bonferroni adjusted criterion for statistical significance was established as  $p=.0125$ .

## Results

A total of 178 responses were received (n=178) for a response rate of 53.6%. A majority (n=164, 92%) of individuals were female, have been involved in dental hygiene education on average for 20 years (range: 3-45 years), and have been a program director for an average of 8 years (range: 1-38 years). Nearly three-quarters (n=130, 73%) of the program directors held a master's degree. Respondent demographics are shown in Table I.

Program directors were asked to identify the degree awarded upon completion of the dental hygiene program at their school, type of institution, and location of the program. The majority of respondents indicated that their entry-level programs granted an associate degree (n=139, 78%), while one-fifth (n=38, 21%) were from baccalaureate degree programs. The distribution of these results was representative of the available ADHA data on the U.S. dental hygiene programs showing that 82.5% (n=274) offer associate degrees and 17.5% (n= 58) offer baccalaureate degrees. Most programs (n=102, 57%) were housed in a community college (n=102, 57.3%), located in an urban setting (n=75, 42%).

### *Perceptions of Dental Hygiene Education*

Five items related to dental hygiene education were presented in a Likert format at the beginning of the survey (Table II). Respondents were asked to identify the extent to which they agreed or disagreed with each statement. Most



**Table I. Demographic characteristics of dental hygiene program directors**

Characteristics	n*	%**
Female	164	92.1%
Male	10	5.6%
<b>Degree of Program Director</b>		
Baccalaureate Degree	2	1.1%
Master's Degree	130	73.0%
DDS/DMD	10	5.6%
Other Doctoral Degree	34	19.1%
<b>Degree Earned at Institution</b>		
Associate Degree	139	78.5%
Baccalaureate Degree	38	21.5%
<b>Type of Institution</b>		
Community College	102	57.3%
Technical School	25	14.0%
University/College with a Dental School	17	9.6%
University/College without a Dental School	32	18.0%
<b>Location of Program</b>		
Urban	75	42.1%
Suburban	64	36.0%
Rural	37	20.8%

\*Not all respondents answered each item; sums may not total 178

\*\*Percent may not equal 100% if the n does not total 178

program directors agreed or strongly agreed that students enrolled in dental hygiene education programs typically complete three years of college education (n=152, 85.4%), that students should not be knowledgeable about all seven roles of the dental hygienist in their entry-level education program, (n=147, 82.6%) and should be educated to understand current and emerging workforce delivery models (n=166, 93.2%). Respondents were divided in agreement on whether topics essential to 21<sup>st</sup> century dental hygiene practice can be taught sufficiently within the two-year entry-level dental hygiene program, and more than half of the respondents disagreed regarding the statement that there is ample time in the curriculum to educate entry-level students to prepare them for employment in a variety of oral healthcare settings (n=94, 52.9%). Respondents were provided space within the survey to comment on any of the five statements and over 80 comments were made. The majority of comments were pertaining to the issue of time within the curriculum to adequately educate entry-level dental hygiene students; examples are shown in Table III.

A chi-square test of association was used to determine

whether there was an association between the responses to the statements regarding dental hygiene education and degree offered (associate versus baccalaureate) by the entry-level program (Table IV). Program directors from associate degree institutions tended to agree that students enrolled in entry-level programs typically complete three years of college education (89.2% vs 71%) and while more respondents from baccalaureate programs tended to disagree with this statement than those from associate programs (26.4% vs 5.7%). Respondents from associate degree programs also tended to agree that topics essential to 21<sup>st</sup> century dental hygiene can be taught sufficiently within the two-year entry-level program as compared to cohorts from baccalaureate programs (47.5% vs 7.9%). Lastly, more respondents from associate degree programs agreed that there is ample time in the curriculum to educate students to prepare them for employment in a variety of oral health care settings than those from baccalaureate degree programs (43.9% vs 10.5%).

A chi-square test of association was conducted to identify whether there was an association between responses to the statements about dental hygiene education and type of institution and location of entry-level dental hygiene program. Statistical significance was found for the statement regarding the ability to teach topics essential to 21<sup>st</sup> century dental hygiene within the two-year entry level dental hygiene program and type of institution (Fisher's Exact Test 13.26, df=4, p=.009, Cramer's  $V = .28$ ). Significance was set at .01 level, with a familywise error rate equal to .05. No other areas of statistical significance were found between the remaining statements and the demographic variables.

### ***Baccalaureate Degree Option***

Respondents were asked if their educational institution/department offered or have they thought about offering a baccalaureate degree option for their dental hygiene entry-level program. Nearly half of the respondents (n=84, 47.2%) indicated "yes", while one-third (n=58, 32.6%) replied "no", and nearly one-fifth (n=34, 19.1%) choose "possibly." Statistical significance was found regarding the type of degree awarded (associate versus baccalaureate:  $X^2 41.40$ , df=2, p<.000, Cramer's  $V = .485$ ) and the responses to this item. More respondents from programs granting a baccalaureate degree have considered offering/offer a baccalaureate degree as compared to those from an associate degree program (94.6% vs 35.3%). Statistical significance was also noted between the responses and type of institution (community college, technical school, university/college with a dental school, university/college without a dental school:  $X^2 43.70$ , df=6, p<.000, Cramer's  $V = .353$ ). In this case more respondents

**Table II. Responses to dental hygiene education statements\***

Statement	Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree	
	n	%	n	%	n	%	n	%	n	%
Students enrolled in entry-level dental hygiene education programs typically complete three years of college education.	83	46.6%	69	38.8%	8	4.5%	15	8.4%	3	1.7%
Dental hygiene students should NOT be knowledgeable about all seven roles of the dental hygienist (i.e., clinician, corporate, public health, researcher, educator, administrator, and entrepreneur) in their entry-level education program.	5	2.8%	10	5.6%	16	9.0%	41	23.0%	106	59.6%
Topics essential to 21 <sup>st</sup> century dental hygiene can be taught sufficiently within the two-year entry-level dental hygiene program.	24	19.7%	34	19.1%	27	15.2%	45	25.3%	37	20.8%
Dental hygiene students should be educated to understand current and emerging healthcare workforce delivery models (i.e., public health dental hygienists, independent practice dental hygienists, collaborative practice dental hygienists, community dental hygiene coordinators, dental hygiene therapists, teledentistry).	96	53.9%	70	39.3%	6	3.4%	1	0.6%	4	2.2%
There is ample time in the curriculum to educate entry-level dental hygiene students to prepare them for employment in a variety of oral health care settings (i.e., hospitals, long-term care facilities, school settings, childcare settings, physician practices).	27	15.2%	38	21.3%	18	10.1%	64	36.0%	30	16.9%

\*One respondent did not answer item 4 and 5; totals were 177 for these items; percentages do not equal 100.

**Table III. Comments related to time within the curriculum**

Comments in support of the need for more time	Statements in support of two year programs as is with no additional time needed
<p><i>"Two years of professional sequence courses is clearly not enough time to address the rapidly changing facets of health care and the inter-professional collaboration of the dental team."</i></p> <p><i>"If we truly strive to provide the quality care to society, then we must move our dental hygiene curriculum to a BSDH entry-level degree. Two to three years is simply not adequate to fit the science curricula that needs to be taught in order to graduate competent dental hygienists with the capability to practice in all settings and with patients with many complex issues."</i></p> <p><i>"Dental hygienists are well-educated individuals who often pursue 1-2 years of classes prior to entering dental hygiene-which is then a two- year program. This costs lots of extra time and money for the individual, but they graduate with a degree that doesn't match the time and effort they put in."</i></p> <p><i>Additionally, the amount of material covered in their courses is enormous and does not compare to the other associate degree healthcare professions, but rather, the bachelor degree healthcare professions. In a world where respect is equal to degree earned, the dental hygienist is left behind many other professionals- despite the fact that they have an equal or higher educational foundation."</i></p>	<p><i>"I feel that an AS level degree is ample for entry-level dental hygiene."</i></p> <p><i>"Entry level programs continue to adequately prepare students for various clinical settings. Graduates of two-year degree programs have the ability to complete additional education specific to their interest and desired career track while they are able to (simultaneously) gain experience as much needed clinical hygienist."</i></p> <p><i>"Our students come from very diverse populations. Many of them are first generation college students. The opportunity to earn an associate level degree and move into a family sustaining career is a game changer for many of them. I would hate to see this opportunity go away."</i></p>

**Table IV. Chi square test of association for questions related to perceptions of dental hygiene education**

Likert Statement	Valid n	$\chi^2$ or Exact Test	df	p	Cramer's V
Students enrolled in entry-level dental hygiene education programs typically complete three years of college education	177	12.32	4	.009**	.29
Dental hygiene students should NOT be knowledgeable about all seven roles of the dental hygienist (i.e., clinician, corporate, public health, researcher, educator, administrator, and entrepreneur) in their entry-level education program	177	8.64	4	.054	.23
Topics essential to 21 <sup>st</sup> century dental hygiene can be taught sufficiently within the two-year entry-level dental hygiene program.	177	27.16	4	<.001**	.39
Dental hygiene students should be educated to understand current and emerging healthcare workforce delivery models (i.e., public health dental hygienists, independent dental hygienists, collaborative practice dental hygienists, community dental hygiene coordinators, dental hygiene therapists, teledentistry).	176	7.62	4	.067	.21
There is ample time in the curriculum to educate entry-level dental hygiene students to prepare them for employment in a variety of oral health care settings (i.e., hospitals, long-term care facilities, school settings, childcare settings, physician practices).	177	15.91	4	.002**	.29

**\*\*statistically significant at .01 level and familywise error rate equal .05.**

from community college settings chose “no” as compared to the other institution types (77.6% vs 22.3%) and more respondents from community college settings chose “possibly” than respondents from other institution types (73.5% vs 26.5%).

A majority of respondents (n=133, 74.7%) made comments related to considering a baccalaureate degree option for their institution. Of those respondents currently offering a baccalaureate degree option (n=57, 42.9%) and those offering entry-level, degree completion and dual enrollment, comments were in favor of having a baccalaureate degree option (n=46, 34.6%). Conversely about one-fifth (n=30, 22.6%) offered comments against having a baccalaureate degree, entry-level program. Respondent comments were primarily related to their institution being unable to offer a bachelor's degree either due to state regulations or pressure from the dental school, lack of understanding the concepts of articulation agreements/ dual enrollments, higher cost of tuition, and concerns about possible lower enrollment.

Respondents were also asked whether there were elements about a baccalaureate entry-level dental hygiene education that would be more valuable than the current entry-level dental hygiene education. Most individuals (n=176) replied to this item with more than half (n= 95, 53.4%) responding “yes”, and one-fifth (n=35, 19.7%) indicating “no”, and one-fourth (n=46, 25.8%) indicating “possibly.” Statistical significance was found related to type of degree awarded and responses ( $\chi^2=27.14$ , df=2, p<.000, Cramer's V=.393). More respondents from programs offering a baccalaureate degree responded favorably to this item as compared to those from associate degree programs who answered “yes” to this item (91.9% vs 43.9%). Of the open-ended comments (n=119), one-fifth (n=24, 20.2%) indicated feeling that the associate degree was sufficient for clinical practice of an entry-level dental hygienist, and if the graduate wanted to do something outside of clinical practice, they could obtain additional education through a degree completion program. Additionally, several individuals (n=7, 5.9%) stated that the associate degree was more valuable because of its reduced cost to the students. Conversely, slightly more than half (n= 65, 54.6%) of respondents perceived the value of a baccalaureate degree to be more beneficial due to the increased time to allow for students to synthesize and apply materials, develop critical thinking and professional skills, and increase career opportunities following graduation. Others

(n=23, 19.3%) commented on the added benefits of increased learning opportunities in a variety of settings and populations found through baccalaureate education.

Institutional issues related to the consideration of a baccalaureate degree or a dual enrollment articulation agreement responses and themes are shown in Table V. The range of comments included: no issues, policy changes and/or affiliation agreements would be needed, or there were cost concerns for students and for developing the program if dual enrollment or a baccalaureate degree were to be offered.

**Table V. Concerns related to considering dual Enrollment or offering a baccalaureate degree\***

Response Theme	n	%
No issues	35	28.5
Policy changes/affiliation agreements needed	34	27.6
Cost (to students and for developing the program)	24	19.5
Not allowed by the state	7	5.7
Students overloaded with credits/may not be successful in completing the program	5	4.1
Problems with student's financial aid	4	3.3
Time for developing the program	4	3.3
No issues	4	3.3

\*6 comments were unrelated to the item

### Accreditation Changes

Another survey item specifically addressed the ADHA proposed accreditation change to Standard 2-1 elevating the required entry-level degree for dental hygiene to the baccalaureate degree. Respondents were asked to indicate whether they could support this advancement in dental hygiene education. Forty-four percent (n=79) of the respondents supported the baccalaureate degree for entry into the profession, while 39.3% (n= 70) did not support the change from the associate's degree level, and 16.3% (n=29) responded "possibly." A chi-square test was conducted to determine if associations existed between responses to this item and demographic variables. Statistical significance found in responses related to type of degree awarded and the respondent's academic institution ( $X^2=40.48$ ,  $df=2$ ,  $p<.000$ , Cramer's  $V= .478$ ). Respondents from programs offering a baccalaureate degree tended to support the accreditation change more frequently than respondents from programs offering an associate degree (89.5% vs 31.7%).

Program directors were offered an opportunity to add comments (n=114) related to this accreditation change item and nearly half (n=56, 49.1%) were favorable towards the baccalaureate degree for entry into the profession. Most comments related to the need to advance the profession and provide students with

additional time for educational learning. Several (n=5, 8.9%) program directors stated that it would be important for students to receive the degree they deserve from the amount of credits required in their programs. Conversely, half of the respondents (n=58, 50.9%) did not support the baccalaureate degree for entry-level. Regarding maintaining the associate's degree for entry-level, 22% (n=13) preferred having both the associate and baccalaureate options for students while an equal number (n=13, 22%) did not support the higher degree due to increased costs to students. Others were concerned that programs would be closed (n=11, 18.6%) or felt that the associate degree provided sufficient education for clinical practice (n=10, 17.0%). Several (n=5, 8.5%) expressed concern that student enrollment would decrease. Selected respondent quotes are displayed in Table VI.

Respondents were asked regarding what changes would be required to maintain CODA accreditation if they were to offer an entry-level dental hygiene baccalaureate degree at their institution. Of the 123 responses, one-third (n=41, 33.3%) focused on the need for a change in curriculum and/or faculty with advanced degrees, while others (n=20, 16.4%) stated they would be unable to offer a baccalaureate degree and their program would close. Some respondents (n=14, 11.4%) indicated that legislative changes and/or affiliation agreements with neighboring institutions would be required while a similar number (n=15, 12.2%) were unsure of what changes would be required.

The survey item asked about revising Standard 3-7 to require all full-time and part-time faculty providing didactic instruction hold a master's degree or higher. Respondents were asked to indicate agreement on the importance of revision; nearly three-fourths (n=130, 73%) agreed while a little more than one-fourth (n=47, 26.4%) were not in agreement. Statistical significance was found only related to the respondents type of institution ( $X^2=12.77$ ,  $df=3$ ,  $p=.005$ , Cramer's  $V=.270$ ). Respondents from associate degree and technical programs selected "no" more frequently than those from programs in university/colleges with or without a dental school (63.6% vs. 15.3%). In general, most individuals supported changing Standard 3-7 and there were no differences between the groups in regards to demographic variables. Over half (65%, n=115) of the respondents offered comments ranging from agreement for this change (n=52, 45.2%), already require a master's degree for faculty providing didactic instruction (n=30,



Table VI. Comments related to changes to accreditation Standard 2-1

Comments in support of changes	Comments opposed to changes
<p><i>“With dental hygiene being an integral part of the access to care dilemma and part of the solution, it is imperative to prepare students for alternative practice sites and for interprofessional models of care, including potential as mid-level providers. This preparation will require more education, time and advanced training. This is the way of the future that is already here and we must get onboard and prepare these practitioners alongside our other healthcare colleagues in preventing and treating diseases of the total body.”</i></p> <p><i>“I strongly support this advancement; however with most of the hygiene program in the US being 2 year programs, there needs to be skillful transition into that education system; i.e., dual enrollment with a bachelor program while enrolled in a two-year program, or state license standards that allow someone to obtain one license with just an AAS degree but do not allow the candidate to renew that license without a BS degree.”</i></p>	<p><i>“The student should have the option to continue with their education in dental hygiene if they so choose. With a bachelor degree in dental hygiene, the individual would open our doors if they would desire to be an educator in a university setting or conduct research in the field. Not all hygienists desire to continue forward with research or even teaching hygiene.”</i></p> <p><i>“There is no need to require extra courses for dental hygiene students to take in order to become skilled clinician. Two years of instruction and clinical practice is more than sufficient for students to master the skill of dental hygiene.”</i></p>

26.1%), difficult to find qualified educators (n=22,19.1%), emphasis should be on teaching methodology (n=19, 16.5%).

Discussion

Dental hygiene program directors were provided an opportunity to respond to statements regarding elevating dental hygiene education accreditation standards. While there were variations in agreement and a multitude of comments provided, two key assertions were noteworthy. First, program directors discussed time as an overriding concern. It takes a minimum of three years, not two, to complete the dental hygiene education program and the majority of students earn an associate’s rather than a baccalaureate degree for their investment in their education. Furthermore, there is not enough time in the curriculum to adequately teach all of the required concepts. Second, respect is correlated with the degree awarded. Students may come close to earning a baccalaureate degree but are not able to command the respect from other health care professionals because they do not obtain that degree. They are not comparable with other health care disciplines nor can they expect to be without the credentials of a baccalaureate degree. These sentiments have been expressed since the 1980s.<sup>28,29,35</sup>

Respondents expressed mixed opinions concerning proposed changes to Standard 2-1 (curriculum requirements and degree awarded). Those who responded in agreement identified increased course requirements, insufficient time for

students to synthesize and apply educational materials, and increase workforce models as the main reasons for agreeing to the change. It is encouraging that many dental hygiene educators are aware of the need to increase educational requirements and prepare professionals capable of becoming the primary source to address the access to oral health care problem in America. Over 47 million people in the United States live in areas with limited access to dental care.<sup>36</sup> Poor oral health increases the risk for a plethora of systemic conditions including diabetes, rheumatoid arthritis, premature births, cardiovascular disease (endocarditis), gastrointestinal disorders, and an increased risk for pneumonia in the elderly.<sup>36</sup> Due to these correlations, the medical profession is beginning to identify the need for dental hygienists to be part of collaborative patient care. In the call to action for the inclusion of the dental hygiene profession into the U.S. health care system, Vanderbilt et al. underscored the need for educational qualifications that will enable dental hygienists to safely provide the scope of care and services as part of their expanded professional roles, along with the ability to effectively participate as members of interprofessional teams.<sup>36</sup>

In contrast, program directors from institutions not in agreement with changing the accreditation standards, stated the associate’s degree is sufficient for a “clinical hygienist” and graduating students would not be paid more by the dentist if they had an advanced degree. In addition, many stated if the student preferred to have a different career besides “clinical dental hygiene” they should have the choice to seek further



education. Respondents were clear in expressing the opinion that “clinical hygienists” obtaining associate degrees save money on tuition. Although clinical dental hygiene remains an important aspect of the profession, advances have been made since the time scaling and root planing was considered the primary treatment for restoring and maintaining oral health. Currently, 42 states allow dental hygienists to provide preventive oral health care services without the presence or direct supervision of a dentist.<sup>37</sup> This correlates with 84% of the states allowing community-based workforce models. Dental hygiene students should be educated to become primary care providers for underserved populations.<sup>28,29</sup> Other comments opposing advancing the required entry-level degree was that the institution cannot offer a baccalaureate degree and would be “shut down.” These perceived barriers could be addressed by providing more education to program directors about affiliation agreements, dual enrollment and/or degree completion programs.

Significant support was identified for the proposed changes to Standard 3-7 (requirement of dental hygiene educators to hold a master’s degree or higher). Dental hygiene educators holding a master’s degree are a valuable asset to students as shown by the Stanley et al. study, which identified the importance of evidence-based decision making as a critical component of the dental hygiene curriculum.<sup>38</sup> In this study, educators with a master’s degree demonstrated an increased ability and confidence to teach evidence-based decision making compared to educators with a baccalaureate degree.<sup>38</sup>

Discussions regarding the baccalaureate degree as entry-level to the profession have been ongoing since the mid 1980’s when the ADHA published its *Prospectus for Dental Hygiene* and dental hygiene practice workshops were provided to educators and clinicians.<sup>35</sup> ADHA policy supporting baccalaureate dental hygiene education has been in existence for 33 years;<sup>39</sup> when it was acknowledged that health care and workforce models were changing and dental hygiene education needed to advance so dental hygiene students would be prepared to function in new environments and with other healthcare providers. This scenario has become even more significant, and if ever there was a time for advanced education of entry-level dental hygiene students, it is now. Health care, technology, industry, economy, all will continue to evolve. Other health care professions have adapted their education standards to meet these ever-evolving systems. The question remains when will the profession of dental hygiene recognize the need to change and adapt irrespective of which organization controls accreditation standards.

Although this research provided insight into dental hygiene program directors perspective on the need to advance

the entry-level dental hygiene degree, a limitation was the lack of a validated survey instrument. However, content validity was established and opportunities for comments were offered throughout the survey following each item. Additionally, some respondents may not have clearly understood that the purpose of this study was to respond to CODA’s request for information about changes to elevate the accreditation standards. Some comments reflected concern that the researchers were trying to change the accreditation standards rather than gather information to assist another organization (CODA) in their decision making. Strengths of the study include the response rate and reflective nature of the comments provided.

This research serves as a reference point for understanding issues related to entry-level baccalaureate dental hygiene education and changes to accreditation standards. Further research should include the perceptions of dental hygiene educators at large regarding this change. Examining the perspectives of key leaders in the profession would provide a dynamic qualitative study. Additionally, a comparison study of the curriculum of entry-level programs offering associate degrees versus baccalaureate degrees would be valuable in determining the extent of differences between courses taught, and preparation to work as primary care providers in various workforce models for diverse populations.

## Conclusion

Program directors of entry-level dental hygiene programs were surveyed to determine their perceptions of advancing accreditation standards. Respondents were equally divided concerning changing the accreditation standard for the entry-level degree from an associate’s degree to a baccalaureate degree, but were in support of modifying the accreditation standard to requiring educators to have a master’s degree for teaching didactic courses. Further research is needed to include dental hygiene educators’ and key leaders’ perspectives to provide comparative information and a greater understanding regarding increasing accreditation standards.

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# Dental Hygiene Learning Outcomes Obtained Through Computer-Assisted Simulation Modules

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## Abstract

**Purpose:** Education reflecting current knowledge is required for competent health care providers but the number of educators and/or lecture/clinical contact hours are often limited. The purpose of this study was to evaluate the learning outcomes and practicality of interactive simulation modules developed for a computerized learning system in dental hygiene education.

**Methods:** Twenty-nine Japanese fourth-year dental hygiene undergraduates were given access to five interactive modules, delivered via a learning management system (LMS), for one month. The modules provided virtual clinical settings to take learners through decision-making processes for explaining procedures and treatments, and making appointments in English. Pre- and post-tests and a questionnaire were used to evaluate the knowledge gained and to receive learner's feedback. Participants were classified into two groups (study group and non-study group), based on their use/non-use of modules made available during the five-week period for statistical analysis.

**Results:** Post-test scores were significantly higher in the study group ( $n = 22$ ) than in the non-study group ( $n = 6$ ), ( $p = 0.024$ ). Post-test scores were also significantly higher than the pre-test scores in the study group ( $p = 0.001$ ). No significant differences in the post- versus pre-test scores were found in the non-study group. The questionnaire response rate of 100% ( $n = 29$ ) indicated that participants considered the interactive modules, including the system operation, as convenient and beneficial.

**Conclusion:** Modules made available via a LMS for self-study were beneficial for Japanese undergraduate dental hygiene students in the acquisition of knowledge and skills for clinical decision-making in English.

**Keywords:** computer-assisted instruction, learning management systems, dental hygiene education, learning outcomes, multimedia, teaching materials

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## Introduction

Fundamental skills necessary for clinical treatment must be acquired during the undergraduate or vocational levels of dental hygiene education. Sufficient education for students to reach a successful level of competency is necessary. Computer-assisted learning (CAL) in dental or dental hygiene education has been proven valuable, favorable, and beneficial when used alongside live patient interactions or lecture curricula.<sup>1-6</sup> The use of CAL is increasing in dental education,<sup>1,7</sup> and CAL could be an effective teaching strategy for subject areas in which few cases are available for clinical instruction or in areas where insufficient contact hours are reported in dental education.<sup>8</sup>

Educators and clinicians have been developing interactive simulation modules using an original authoring tool (SIMTOOL) developed at the Tokyo Medical and Dental University (TMDU; Tokyo, Japan) since 2003,<sup>8-15</sup> and over 100 dental simulation learning modules have been published.<sup>16-18</sup> The use of CAL has recently been investigated on domestic and international levels, and the feedback for the modules and CAL has been shown to be positive (data unpublished).

Computer-assisted learning simulation training modules for dental hygienists and dental hygiene students using SIMTOOL has been developed to provide learning oppor-



tunities in subject areas where case availability is limited since 2005.<sup>11,12</sup> Additional focus areas include situations where clinical education reflecting the current knowledge and trends is required but the number of educators and/or lecture/clinical contact hours are limited.<sup>11,12</sup> In response to this need, a new series has been created to assist dental hygienists and dental hygiene students in acquiring clinical decision-making and communication skills in the English language in preparation for future clinical settings.<sup>10</sup> Proficiency in English will become essential for healthcare professionals to be able to communicate with an increasing number of international patients. Communication skill acquisition in both Japanese and English is an important issue in dental hygiene education in Japan,<sup>8-10,19</sup> yet the materials, training hours, and educators remain limited. This English language communication series has gained positive evaluation from learners in regards to content and system operation,<sup>10</sup> however, the learning outcomes and overall usefulness of the content have not been investigated. The purpose of this study was to evaluate the learning outcomes and practicality of interactive basic English conversation simulation modules developed for a Computer Learning System (CLS) in dental hygiene education.

## Methods

### *Study population*

This study was approved by the Dental Research Ethics Committee of Tokyo Medical and Dental University (TMDU; approval no. 968; Tokyo, Japan). During a five-week period (April 4 - May 9, 2016), all 29 fourth-year undergraduate dental hygiene students from the School of Oral Health Care Sciences at TMDU were given access to five interactive modules (Basic English Conversation Practice for Dental Hygienists) for self-learning via a LMS (WebClass; Data Pacific (Japan) Ltd., Tokyo, Japan). Students were familiar with the function of e-learning modules from previous LMS experiences.

### *Assessment tools*

Baseline English language communication skills were assessed with a pre-test on the first day the learning modules became available (April 4, 2016). A post-test was administered on May 9, 2016, at the conclusion of the five-week study period. The pre- and post-tests consisted of 10 multiple-choice listening-type questions (10 points per question). Questions were based on a case study of an English-speaking patient who called to make an appointment, and subsequently presented to the clinic to learn how to brush and floss. The degree of difficulty between pre- and post-tests was consistent, and both tests covered the same situation. Post-test items were rewritten and re-recorded with slight differences to decrease the possibility of increased score due to memorization.

A questionnaire was also distributed via the LMS at the conclusion of the study period to assess the learners' self-perception of their field of study knowledge, the materials' influence on their learning and their usefulness outside of the classroom, the learners' eagerness and interest in the content, and ease of operation for CAL. Responses to questions (Q1-Q8) were on a four-point Likert scale and the opportunity to provide open-ended comments was provided on Q9. Informed consent was given via the LMS prior to beginning the questionnaire.

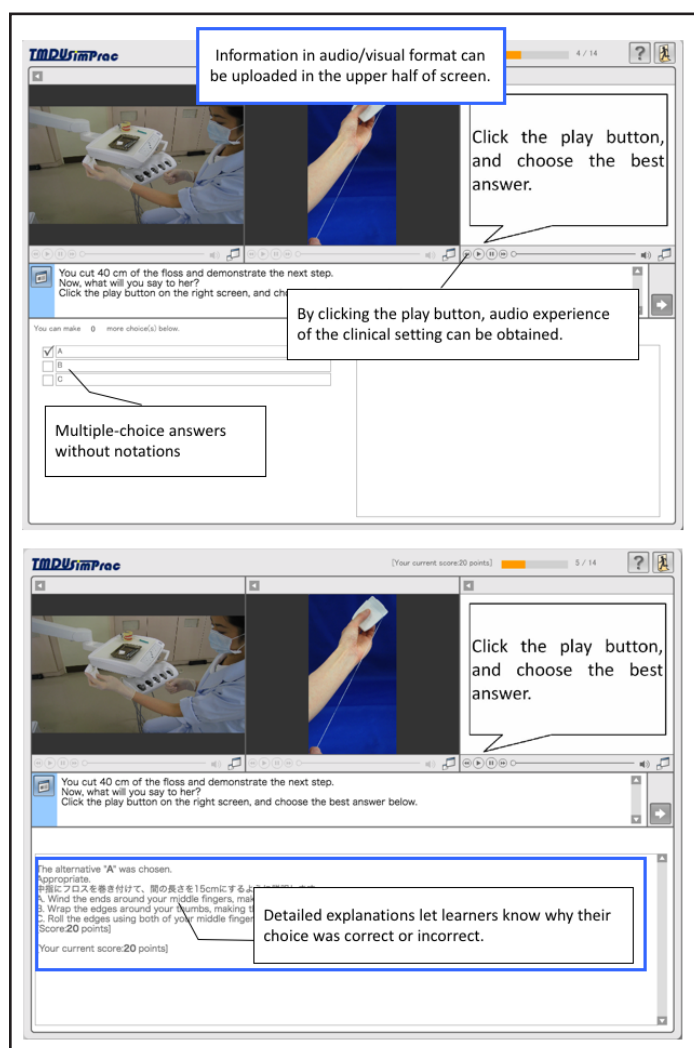
### *Interactive modules and e-learning system*

Five educators who were either native Japanese or English speakers with backgrounds in periodontology, operative dentistry, dental hygiene, dental education, or nursing science, authored the interactive modules using SIMTOOL and Microsoft Moviemaker 2.6 (Microsoft; Redmond, WA, USA). SIMTOOL requires no computer-programming knowledge, making it easy for clinicians or educators to develop interactive learning modules without any Internet technology expertise. Quality of the learning modules was assured in two stages: first, by members of the Educational Simulation Production Subcommittee, consisting of healthcare professionals representing most dental specialties, established under the TMDU Dental Educational Committee and; second, by two reviewers, based on content, interactivity, online user-friendliness, and efficacy of multimedia usage in the scenario.

The interactive modules provided learners a self-paced, independent learning opportunity to practice with cases covering telephone requests for regular and emergency treatment appointments (modules 1-3), tooth brushing (module 4) and flossing instruction (module 5). The modules provided virtual clinical settings or experiences to take learners through decision-making processes for making appointments and for explaining procedures and treatments by having them choose the correct answer from multiple-choice questions in English. An example of the learner's view is shown in Figure 1. Instructors were able to insert situations or other information in audio/visual format into the three windows on the upper half of the screen. Photos or video clips from actual clinical scenes, X-rays, explanatory notes, dental formulae, and/or recorded voices/sounds could be uploaded to these windows. Each window could also be enlarged by selecting an icon at the bottom right corner. Learners could listen to conversations or sounds related to the situation by clicking the "play" button at the bottom left corner of the window. Instructions and multiple-choice questions could be found on the lower half of the screen. To assist learners' in practicing listening skills on simulated real-life situations,

the multiple-choice answers for the conversations were not displayed. Once the learners selected and confirmed their choice, the next page would display their answer and explanatory notes as to the appropriateness of that choice (Figure 1). All multiple-choice answers and explanatory notes were shown in this area. It was possible for learners to review all questions, and correct answers with explanations after completing the module (Figure 2). The authors were able to assign a score for each question, based on the difficulty level, with a maximum score of 100 for each module.

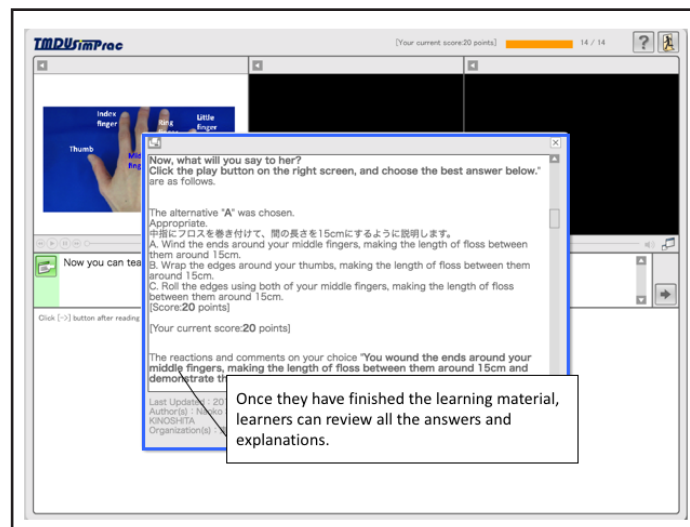
**Figure 1. Screen examples show learners' view. Lower screen illustrates what appears after the learner selects an answer. The answer and explanatory notes show either why the choice is correct or in error.**



### Utilization of modules

Students' self-study times were recorded via the LMS; data included their access period, access number, and score for each material. Based on this data, participants were classified into

**Figure 2. Screen examples show learners' view. After finishing the learning module, it is possible to review all questions with the correct answers, including explanations**



two groups (study group and non-study group), based on their use/non-use of the modules within the five-week access period. Inclusion criteria for the study group was that they accessed all modules for more than one minute each; the remaining students were categorized into the non-study group.

### Statistical analysis

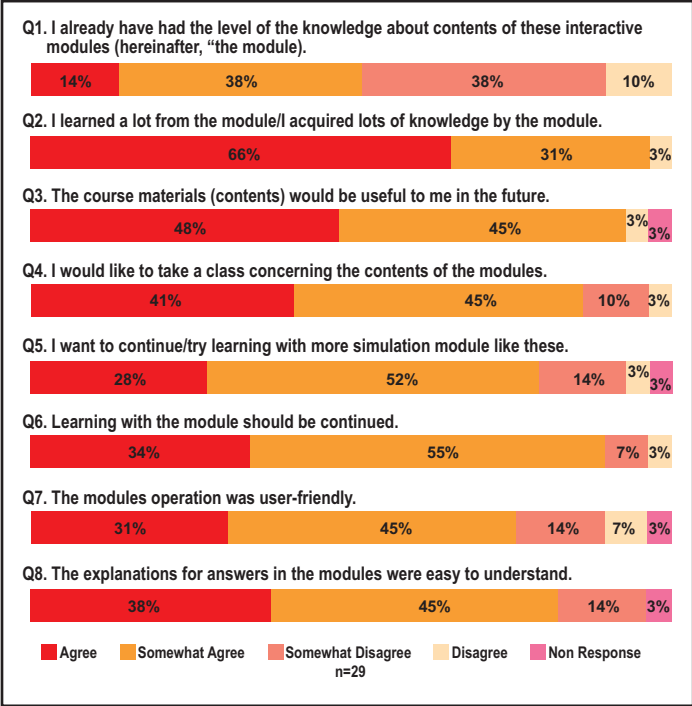
The pre- and post-examination scores and the differences in score for each student were analyzed by the Mann–Whitney U test and the Wilcoxon signed-rank test, respectively, using SPSS Statistics for Windows, Version 23.0 (IBM Corp.; Armonk, NY). In the study group, the number of self-study access times for each module, between participants whose scores increased and participants whose scores either remained the same or decreased, were analyzed based on the Mann–Whitney U test.

## Results

### Questionnaire

Twenty-nine students used the modules and all 29 answered the post-questionnaire for a response rate of 100% (Figure 3). Of the respondents, 97% agreed/somewhat agreed that they learned a lot from the modules (Q2), 93% considered that the module content would be useful/somewhat useful for them in the future (Q3), and 52% responded they had the level of professional knowledge contained in the modules (Q1). Ninety percent of respondents answered favorably to continuing learning with the modules (Q6), 79% of respondents expressed a desire to continue learning with more simulation modules (Q5), and 86% of respondents expressed

**Figure 3. Results for questions 1–8 (Q1–Q8) for the interactive modules of the Basic English Conversation Practice for Dental Hygienists (n = 29). The original questionnaire is written in Japanese.**



a desire to take a class on the content covered in the modules (Q4). Respondents' general comments are shown in Table I.

**Pre- and post-test results**

A total of 28 of the 29 students took the post-test. Out of a possible score of 100 points, the average pre-test score was 45 points with a median of 40 points and the average post-test score was 66 points with a median of 75 points. The study group (n = 22), participants who accessed all of the modules over the five-week period, had an average score of 48 points and a median of 40 points on the pre-test, whereas the post-test average score was 71 points with a median score of 80 points.

The non-study group (n = 6), participants who chose not to use the modules, had an average pre-test score of 33 points and a median score of 40 points, and the post-test average and median scores were 47 points and 35 points, respectively.

Post-test questions 7 and 8 had a low percentage of correct answers for both the study and non-study groups (29% and 46%, respectively); question 9 had 54% correct responses. The remaining questions had more than 60% correct answers, regardless of the group (Figure 4).

The post-test scores were significantly higher for participants who utilized the modules to study, compared to participants who did not (*p* = 0.024). Participants in the study

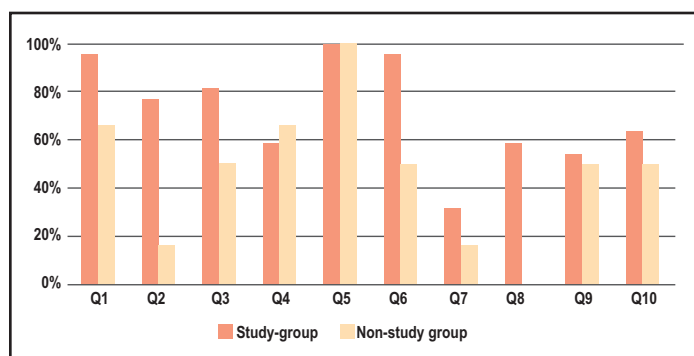
**Table I. General comments for interactive modules of Basic English Conversation Practice for Dental Hygienists\***

Favorable Comments
The sound was clear and it was easy to understand.
The talking speed was appropriate.
It was good that we can check the answer immediately.
As all the meanings of words or translations did not appear, I thought that it would be beneficial for me to look them up myself after.
It was good that we could listen to the questions again in the explanatory page.
It was good to understand the flow of English sentences.
As I could learn while listening, I thought it was realistic and beneficial for studying.
It was easy to understand.
With the listening function included, I could study easier than using a CD and paper medium.
It was good that we could repeat the audio many times.
I could read the words/letters very clearly and it was easy to use.
Pictures helped me to understand easily.
It was particularly good to listen to the conversation repeatedly along with the explanations. I would like to get used to listening to words so I can understand the patients' conversation quickly.
Unfavorable Comments
Not only do I want to improve my listening skill, I also want to be able to speak English. It was a bit difficult to see the appointment chart, as it was blurry.
When using, I couldn't START the program sometimes. I want to have Japanese translations, not only a rough explanation.
On some PCs, it was hard to see the pictures, as their size was very small. I want to have the Japanese translation for every question in the explanatory page. In addition, I want to have more direct explanations for non-correct answers.
I want to have the explanations in Japanese.
I thought that it was better if the explanations were more detailed.
The sound in the first parts was low.
Other
As it is difficult to study English by myself, it was nice to have them as a study subject.
Nine no answer/nothing particular

group scored significantly higher on the post-test than they scored in the pre-test (*p* = 0.001). There were no significant differences between the post- and pre-test scores for the non-study group.

There were no significant differences in the study group on the number of times each module was accessed between

**Figure 4. Percentage of correct answers in the post-test for the study and non-study groups.**



Questions 1–4 (Q1–Q4) assess how to respond when making appointments by telephone: (Q1) greetings and patient confirmation; (Q2) request for regular cleaning; and (Q3 and Q4) after checking the patient’s treatment history and deciding the appointment date. Questions 5–9 (Q5–Q9) assess instructions on dental health guidance: (Q5) how to grip a toothbrush; (Q6) brushing method; (Q7) how to use dental floss (including the name of fingers, verb usage, distinguishing pronunciation); (Q8) how to use floss (distinguishing pronunciation); and (Q9) how to use floss. Question 10 (Q10) instructions after flossing.

those participants whose scores increased ( $n=18$ ) and participants whose scores remained the same or decreased ( $n=4$ ), based on the Mann–Whitney  $U$  test ( $p = 0.03$ ,  $p = 0.5$ ,  $p = 0.185$ ,  $p = 0.823$ , and  $p = 0.65$  for modules 1–5, respectively).

## Discussion

In this study, it was found that undergraduate dental hygiene students considered the modules developed with SIMTOOL and made available via the LMS for self-study were beneficial for acquiring skills and knowledge. The questionnaire results, revealed that the learners considered the interactive modules, as well as the operating system, to be convenient and beneficial, findings in accordance with previous studies.<sup>8–13</sup> However, in previous studies, learning outcomes, were not investigated.

Participants who studied the materials presented in the simulation module over the course of the five-week study period, had significant score increases, which seems to demonstrate the value of self-study with e-learning modules ( $p = 0.001$ ). On the other hand, there were no significant differences in learning outcomes for those participants who did not utilize the modules. This finding indicates that CAL simulation learning has a positive impact on improving the necessary skills for dental hygienists in a clinical setting.

The lack of change in the scores for participants who did not utilize the study modules negated the possibility that

the pre-test activity itself could be considered practice and improved the students’ skills. The pre- and post-tests had been re-written and re-recorded, to cover the same clinical situations with slight differences while maintaining the same level of difficulty in anticipation of the possible effect of the test activity alone influencing the outcome. In addition, the test results suggest that the learners are not able to maintain their skills or knowledge for more than 6 months, as these simulation modules were made available to five of the 28 students one year earlier (August 2015). Following that session, no access was recorded until the beginning of the current study. Even with the prior exposure to the modules, no significant differences in the pre-test scores were demonstrated between participants with previous experience (Mann–Whitney  $U$  test;  $p > 0.05$ ). This finding indicates that previous experience without continuous use, had no effect on test scores. This short-term outcome may be derived from the study style and the subject itself. Students did not have many opportunities to study dental English at the university level and have stopped studying the language before acquiring competence. Some reports indicate that dental hygiene students in Japan consider English as difficult to learn.<sup>20</sup> While 98% of the participants who responded that they considered the ability to communicate in English as important for dental hygienists, English has been noted as a problem or concern in slowing down international exchanges.<sup>21</sup> This factor was one reason behind the development of this series of modules.

The low percentage of correct answers to pre- and post-test questions 7 and 8 also reflected participant’s difficulty in understanding English. For these questions, participants had to distinguish between English pronunciations that sounded the same as if they were printed in Japanese *kana* characters and included the usage or choice of verbs that are always difficult for non-native speakers.

English is indispensable for healthcare professionals and is the most frequently used language in the clinical setting when the patients’ native language differs from that of the dental hygienist. However, English language education for healthcare workers in Japan is still in the improvement stage<sup>19,21–23</sup> making communication skill acquisition in English an urgent challenge.<sup>8,19</sup> Therefore, aspects of English as a second language (ESL) should be included in CAL simulation modules. In addition to emphasizing proficiency in various aspects of English, this series also emphasized the clinical decision-making process. The modules had components requiring clinical knowledge, experience, and decision-making skills (e.g. tooth brushing instruction) similar to other clinical simulation modules, with the added



bonus of learning the instructions in English.

Virtual patient simulations have been designed for the acquisition or promotion of critical reasoning skills as a part of the development of treatment competencies when the number of live patient encounters is insufficient.<sup>24</sup> The use of patient simulation is especially beneficial in fields that require many hours of study or that have manpower shortages, which can occur in dental hygiene education. Decision-making skills in English for dental professionals is a good example where self-study with computer-assisted simulation modules might be a solution strategy.<sup>8</sup>

Communication skills are very important for the dental hygiene profession; especially for professionals employed in hospitals or clinics with a high number of international patients. The nature of dental hygienists' responsibilities may require them to use a wider range of communication skills, as compared to other dental professionals. Therefore, acquiring communication skills in English is indispensable. However, opportunities for acquiring these skills are limited in Japan and the logistics of providing them is problematic for many educational institutions.<sup>21</sup> Additional advantages of CAL simulation modules includes instant feedback and the ability for students to study independently on their own schedule from wherever they have a computer and Internet access. The learning modules used in this study conform to the Sharable Content Object Reference Model (SCORM) 1.2 standards; thus, they can be directly incorporated into the LMS of any commercially available e-learning platform at any educational institution.

Acquiring the level of technical knowledge and dental English necessary for use in a clinical setting takes ongoing practice. Before reaching that level, maintaining the skill and knowledge may be difficult without any supporting tools or study opportunities. Further research is needed to investigate learning outcomes in actual clinical settings after a designated period of use of simulated instruction. Limitations of this study include its small cohort. Future studies should use a larger cohort, and collaborate with other universities over a longer period of time. In addition, the pre- post-test focused on evaluating the acquired knowledge; another examination method should be included for skill and attitude acquisition.

## Conclusion

Competence in fundamental clinical skills must be acquired during undergraduate dental hygiene education. CAL simulation modules can be designed into the curricula to assist students in acquiring specific skills that are a part of their competencies. Modules made available through a LMS were shown to be beneficial for Japanese undergraduate

dental hygiene students in the acquisition of knowledge and skills for clinical decision-making in the English language.

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## Oral Health of Older Adults in Washington State

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### Abstract

**Purpose:** An aging population, combined with increasing tooth retention, could significantly impact the dental care delivery system. The purpose of this study was to assess self-reported oral health and the factors associated with oral health outcomes among a random sample of older adults in Washington State.

**Methods:** A telephone survey of adults 55+ years was used to collect information on factors associated with oral health, plus four outcome variables; substantial tooth loss (6+ teeth lost), oral problems, oral pain, and poor health of teeth. Data were weighted to reflect the state's age and gender statistics.

**Results:** A total of 2,988 older adults completed the survey during 2017. Substantial tooth loss (18%), oral problems (17%) and oral pain (13%) were the most frequently reported issues. Of the adults with teeth, 17% reported fair/poor health of teeth. Compared to adults with an income of \$75,000 or more, adults with an income less than \$25,000 were twice as likely to have substantial tooth loss and oral problems (OR=2.1 and 2.2, respectively) and were three times more likely to report oral pain and poor health of teeth (OR=3.1 and 3.3, respectively). The oldest old (adults 75+ years), as compared to those 55-64 years, were significantly more likely to have substantial tooth loss (OR=2.6) but were less likely to report oral problems (OR=0.6), pain (OR=0.3), or poor health of teeth (OR=0.5).

**Conclusions:** Although the majority of Washington's older adults report having good oral health, a small subgroup has oral problems which may have a negative impact on quality of life.

**Keywords:** oral health, older adults, oral pain, tooth loss, dental disease, quality of life

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### Introduction

Following World War II, the United States (U.S.) experienced a dramatic increase in birth rates. The population born between 1946 and 1964, commonly referred to as the Baby Boom generation, is now considered to be the largest generation in US history. The aging of the Baby Boom generation in combination with increasing life expectancy is shifting the nation's demographic profile; about 12% of the population was 65 years or older in 2000 but is expected to increase to 20% by 2029.<sup>1</sup> The 85 and older population is projected to triple from 6.3 million in 2015 to 14.6 million in 2040.<sup>2</sup>

The oral health profile of older adults is also changing with an ongoing decrease in the prevalence of complete edentulism nationally among adults 65+ years; dropping to 34% in 1988-1994, 27% in 1999-2004 and 23% in 2005-2008.<sup>3-4</sup> This trend is likely to continue as only 14% of older adults reported being

edentulous in the 2016 Behavioral Risk Factor Surveillance System (BRFSS).<sup>5</sup> As older adults retire, many lose employer paid dental benefits coverage and regular dental care is not a covered service under Medicare. Even without the coverage of dental services by Medicare, dental care utilization among older adults has been rising, in spite of higher out of pocket expenses.<sup>6,7</sup> This increase in dental care utilization may be partially due to the changing demographic profile of older Americans; compared to previous generations, a higher percent of today's older adults have college degrees and a higher median income. Even with increasing incomes, 9% of older adults live in poverty while 14% are considered poor.<sup>2</sup>

The aging of America, combined with increasing tooth retention, could significantly impact the dental care delivery system, as more older adults will be at risk for both dental caries and periodontal disease. In the United States, the dental care

delivery system is dominated by stand alone, in-office, fee-for-service private and corporate practices with dentists and dental hygienists as the primary care providers. While this delivery system works well for community-dwelling individuals with dental insurance or the financial means to pay for care, it is problematic for those that live in poverty, have difficulty with ambulation, have low health literacy, or are institutionalized. To improve the oral health of older adults, the Association of State and Territorial Dental Directors (ASTDD) recommends seven public health strategies: 1) assess and monitor the oral health of older adults, 2) enhance dental care infrastructure and build partnerships, 3) educate older adults and their caregivers to improve their oral health and empower them to advocate for the services they need, 4) prepare all members of the dental workforce to better serve older adults, including frail elders, 5) promote expanded private and public insurance coverage for dental services needed by older adults and frail elders, 6) integrate dental and medical into comprehensive health homes, and 7) collaborate with State and Federal organizations involved with regulation of long-term care facilities to assure that oral health requirements are being addressed.<sup>8</sup>

As outlined by ASTDD, the first step in the process of developing plans for oral disease prevention and intervention programs targeted toward older adults, is to identify state-level data which can be used for identifying high-risk populations, program planning and evaluation. While BRFSS provides data on the prevalence of tooth loss and dental visits, there is limited data on oral health status or dental insurance coverage among older adults. The data that do exist are generally for specific sub-groups, such as senior center and congregate meal site participants, nursing facility residents, dental clinic users, or a combination of these groups.<sup>9-11</sup> These sub-groups, however, are not representative of the general older adult population.

The purpose of this paper is to present information on self-reported oral health status, dental benefits coverage, time since last dental visit, and factors associated with oral health among a representative sample of older adults throughout Washington State and in addition, the authors outline ways in which dental hygienists could impact the oral health of older adults.

## Methods

Arcora Foundation, a non-profit organization, contracted with a market research firm to conduct a survey of adults age 55 and older in Washington State in 2017. The sample was selected by targeting an equal representation from seven geographic regions; 384 surveys per region. The regions were based on Washington's classification for Accountable

Communities of Health (ACH), regional coalitions of stakeholders, collaborating to address health issues through community and healthcare transformation. Although there are nine ACH regions in Washington, several are very rural. These very rural ACHs were merged resulting in a total of seven geographic regions covering the entire state. Washingtonians aged 55 and older were surveyed by phone using random digit dialing on landline phone numbers with a wireless augment (30% of the surveys). Quotas were placed by geographic region, age and gender to follow U.S. Census data for Washington State. In addition, certain demographic groups were intentionally over-sampled in order to ensure enough data to evaluate the oral health of African Americans and Hispanics. To reflect the state's population demographics, sample weights were derived based upon respondents' age, gender and race to bring the survey data back in alignment with the most recent U.S. Census projections for Washington.

The survey collected information on age, gender, race, ethnicity, education, income, usual frequency of dental care, time since last dental visit, reasons for not visiting a dentist, dental insurance coverage, self-perceived oral health status, and self-reported oral health outcomes. Questions were adapted from those previously used and validated in the National Health and Nutrition Examination Survey (NHANES), BRFSS, the Pregnancy Risk Assessment Monitoring System (PRAMS) and the employed adult survey conducted by the National Institute of Dental Research (NIDR), now known as the National Institute of Dental and Craniofacial Research.

This manuscript focuses on four self-rated oral health outcomes: substantial tooth loss, oral problems, oral pain, and poor health of teeth (dentate participants only). Information on tooth loss was obtained using the tooth loss question from BRFSS with substantial tooth loss defined as having lost six or more teeth including those reporting having lost all their teeth. Those that responded yes to the modified NIDR question "Do you have any dental problems that need to be addressed in the next month?" were classified as having oral problems. Responding very often or occasionally to the NHANES question "How often during the last year have you had painful aching anywhere in your mouth?" was used to classify oral pain. Self-rated health of teeth was based on the NHANES question "How would you describe the condition of your teeth?" Those who responded fair or poor were classified as having poor health of teeth while those who responded excellent, very good, or good were grouped into the good health category. Self-rated health of teeth was only obtained from dentate participants.



All analyses were completed using SAS version 9.3 (SAS; Cary, NC, USA) and the appropriate sampling weights. Unweighted frequencies and weighted percentages are presented for the categorical variables. Logistic regression models were used to assess the association between the oral health outcomes and the demographic and individual characteristics of the population. Respondents with missing values for one or more explanatory variables were excluded. Because of the large number of missing values for household income, respondents who either refused to provide information or indicated that they did not know were classified into a fifth 'unknown' income category. A *p*-value of < 0.05 was considered statistically significant and only statistically significant associations are noted in the presentation of the logistic regression results.

An Institutional Review Board (IRB) exemption to conduct the phone interviews and compile the data was obtained from Western Institutional Review Board (WIRB), an independent IRB firm, under Regulatory Opinion 45 CFR §46.101(b)(2) criteria.

## Results

A total of 2,988 adults participated. Nearly one-half of the respondents (47%) were 55-64 years of age, 53% were female, 83% were non-Hispanic white, 47% had a college degree, and 32% had a household income of \$75,000 or more. Most of the respondents (83%) reported having a dental visit in the past year and 61% had insurance

**Table I. Socio-demographic characteristics of participating adults by age group (n=2,988)**

Characteristic	55-64 Years n=1,482		65-74 Years n=731		75+ Years n=775		Overall 55+ Years n=2,988	
	# with data	%	# with data	%	# with data	%	# with data	%
<b>Sex</b>								
Male	680	48.9	355	48.3	338	43.2	1,373	47.5
Female	802	51.1	376	51.7	437	56.8	1,615	52.5
<b>Race/Ethnicity</b>								
Non-Hispanic White	1,115	80.3	575	83.8	650	86.0	2,340	82.6
Hispanic or Minority	320	16.4	138	14.4	100	10.1	558	14.5
Unknown/refused	47	3.3	18	1.8	25	3.8	90	2.9
<b>Education</b>								
High school or less	338	21.0	136	15.9	248	30.0	722	21.3
Some college	502	33.9	219	29.0	220	28.0	941	31.1
College graduate	628	44.2	366	54.0	294	40.5	1,288	46.5
Unknown/refused	14	0.9	10	1.1	13	1.4	37	1.1
<b>Household income</b>								
< \$25,000	237	14.6	113	13.6	132	17.2	482	14.9
\$25,000-\$49,999	279	18.1	128	17.0	175	22.6	582	18.7
\$50,000-\$74,999	260	18.1	154	21.4	119	15.2	533	18.5
≥\$75,000	529	37.4	226	33.7	140	18.9	895	32.3
Unknown/refused	177	11.8	110	14.2	209	26.1	496	15.6
<b>Dental insurance</b>								
Yes	1,012	68.6	429	59.1	348	44.8	1,789	60.5
No	447	29.8	295	40.1	414	53.1	1,156	38.1
Unknown/refused	23	1.6	7	0.8	13	2.1	43	1.5
<b>Dental visit in last year</b>								
Yes	1,235	83.8	603	83.4	611	79.2	2,449	82.7
No	243	15.9	126	16.3	152	19.0	521	16.7
Unknown/refused	4	0.2	2	0.3	12	1.8	18	0.6
<b>Usual visit to dentist</b>								
At least once a year	1,150	77.9	546	75.9	72.1	72.1	2,246	76.1
Less than yearly	317	21.1	172	22.5	26.4	26.4	700	22.7
Unknown/refused	15	1.0	13	1.6	1.5	1.5	42	1.3

coverage that pays for some or all of their routine dental care. Of those who had not been to a dentist in the past year (n=521), the primary reasons for not going were "no reason to go" (n=179) and "cost" (n=142). The percent of adults with household incomes above \$75,000 decreased with age as did the percent with dental insurance coverage. Thirty-seven percent of those 55-64 years reported an annual household income of \$75,000 or more and 69% reported dental insurance coverage compared to 19% and 45%, respectively, for those 75 years or older. Socio-demographic information by age group is shown in Table I.

A large portion of the adults surveyed (53%) had lost at least one permanent tooth due to dental caries or periodontal disease. The prevalence of substantial tooth loss was 17%. Only 6% reported having lost all their teeth. Seventeen percent reported an oral problem that required care within the next month, 13% reported oral pain, and 15% reported avoiding foods because of problems with their mouth. Of the 2,685 dentate participants, 17% self-rated the health of their teeth as fair or poor, 12% think they may have gum disease and 15% think they may have tooth decay. The prevalence of tooth loss increased with age while the prevalence of self-reported oral health problems and oral pain decreased with age (Table II).

The percentage of participants with substantial tooth loss, oral health problems, oral pain and poor health of teeth by selected characteristics is presented in Table III. In the bivariate analyses, race/ethnicity, income, education, and dental visit in the last year, were significantly associated with all the oral health outcome variables. Racial/ethnic minorities, compared to non-Hispanic whites, were more likely to report substantial tooth loss (23% vs.17%), oral problems (22% vs.16%), oral pain (16% vs.12%) and poor health of teeth (31% vs.14%).

Adults with an income < \$25,000 compared to their peers with an annual income > \$75,000, were significantly more likely to report substantial tooth loss (36% vs. 9%), oral problems (31% vs. 13%), oral pain (26% vs. 8%) and poor health of teeth (37% vs. 8%). Similar trends were seen when adults with a high school education or less, were compared to those with a college degree; and when those without a dental visit in the last year, were compared to those with a dental visit in the last year (Table III). There was a positive association between age and substantial tooth loss, however associations between age and oral health problems and oral pain were negative. Adults without dental insurance coverage as compared to those with coverage, were more likely to have substantial tooth loss (21% vs. 15%), oral health problems (19% vs. 16%) and poor health of teeth (19% vs. 15%).

It should be noted that many of the risk factors are highly correlated, for example adults with a college degree were more likely to have a higher annual income and younger adults were more likely to have dental insurance than their older peers. In order to determine the independent contribution of each of the risk factors to the oral health outcomes, multivariable analyses were performed, and the results are presented in Table IV. Age and income were significantly associated with all the outcome variables. When compared to adults 55-64 years of age, adults 75+ years of age were more than twice as likely to have substantial tooth loss (OR=2.6) but were significantly

less likely to report oral health problems (OR=0.6), oral pain (OR=0.3), and poor health of teeth (OR=0.5). Adults with an income less than \$25,000, compared to those with an income of \$75,000 or more, were twice as likely to have substantial tooth loss (OR=2.1) and oral problems (OR= 2.2), and were three times more likely to report oral pain (OR=3.1) and poor health of teeth (OR= 3.3). Compared to individuals with a full dentition, adults who had lost some but not all their teeth, were more likely to report poor outcomes. Edentulous adults, on the other hand, were less likely to report oral problems. Race/ethnicity, education and dental visit within the last year were associated with some but not all the outcome variables. Sex and dental insurance coverage were not associated with any of the outcomes.

## Discussion

This is the first published survey of self-reported oral health for a statewide sample of older adults. The survey findings indicate a high prevalence of tooth loss (53%) but a relatively low prevalence (6%) of edentulism, which is slightly better than the 2016 Washington State BRFSS results for adults 55+ years (56% and 8%, respectively).<sup>12</sup> The adults sampled in the current survey were more likely than those in the BRFSS sample to report a dental visit in the last year (83% vs. 71%), to have dental insurance (61% vs. 56%) and to have an income of \$50,000 or more (51% vs. 44%).<sup>12</sup> There was no difference in the percent with painful aching in the mouth between this sample and BRFSS (13% vs. 13% respectively).<sup>12</sup> Given that the current sample findings were slightly better than those obtained by the Washington State BRFSS, it is possible that higher income adults with teeth, were more likely to participate in the telephone survey. In addition, the survey has other limitations. First, it relied on self-reported data which has inherent problems including recall bias and potential over-reporting of behaviors considered desirable (regular dental visits). Second, the survey excluded institutionalized adults, the most vulnerable older adult population group.

Regardless of these limitations, the results provide important information on the oral health of older adults. Most older adults in Washington State have regular dental visits, report no oral pain and have good, self-reported oral health. Compared to the overall older adult U.S. population, a substantially higher proportion of Washington's older adults report having visited the dentist in the past year. It should be noted that, due to differences in data collection methods, the percent of older Americans (> 65) reporting a dental visit in the last year varies by data source; 55% for NHANES 1999-2004,<sup>3</sup> 47% for the 2015 Medical Expenditure Panel Survey

**Table II. Self-reported oral health status of participating adults by age group (n=2,988)**

Oral Health Variable	55-64 Years n=1,482		65-74 Years n=731		75+ Years n=775		Overall 55+ Years n=2,988	
	# with data	Percent	# with data	Percent	# with data	Percent	# with data	Percent
<b>Number of teeth lost</b>								
None	741	51.0	306	43.0	204	28.6	1,251	43.7
1 to 5	502	33.5	273	38.3	287	36.0	1,062	35.6
6 or more but not all	146	9.7	86	10.0	140	17.7	372	11.5
All	64	4.0	41	5.2	88	10.3	193	5.7
Unknown/refused	29	1.7	25	3.4	56	7.4	110	3.5
<b>Health of teeth (dentate only*)</b>								
Excellent/very good/good	1,121	81.1	559	84.9	537	85.1	2,217	83.1
Fair/poor	264	18.6	105	14.9	90	14.6	459	16.6
Unknown/refused	4	0.3	1	0.2	4	0.3	9	0.3
<b>Health of gums</b>								
Excellent/very good/good	1,222	82.6	626	85.7	681	87.4	2,529	84.6
Fair/poor	251	16.9	101	13.7	85	11.1	437	14.7
Unknown/refused	9	0.6	4	0.6	9	1.5	22	0.8
<b>Dental problems</b>								
Yes	297	19.1	123	15.7	112	13.6	532	16.8
No	1,161	79.2	588	81.7	650	84.6	2,399	81.2
Unknown/refused	24	1.7	20	2.6	13	1.8	57	2.0
<b>Think has gum disease (dentate only*)</b>								
Yes	188	13.5	90	13.2	49	8.2	327	12.4
No	1,151	82.8	550	82.4	563	88.5	2,264	83.8
Unknown/refused	50	3.7	25	4.4	19	3.2	94	3.8
<b>Think has tooth decay (dentate only*)</b>								
Yes	271	19.1	95	13.3	66	8.9	432	15.3
No	1,064	76.8	537	81.0	542	87.2	2,143	80.2
Unknown/refused	54	4.0	33	5.8	23	3.8	110	4.5
<b>Avoids foods</b>								
Never/hardly ever	1,212	81.8	629	86.1	677	88.3	2,518	84.6
Very often/occasionally	265	17.9	96	13.2	86	10.3	447	14.8
Unknown/refused	5	0.2	6	0.7	12	1.4	23	0.6
<b>Oral pain</b>								
Never/hardly ever	1,237	84.0	630	87.5	698	91.0	2,565	86.6
Very often/occasionally	243	15.8	96	11.9	73	8.6	412	13.0
Unknown/refused	2	0.1	5	0.6	4	0.4	11	0.4

\* Limited to the respondents with at least one tooth (n=2,685)

**Table III. Prevalence of substantial tooth loss, oral health problems and oral pain for all participants plus prevalence of poor health of teeth for dentate participants by selected characteristics**

	Substantial Tooth Loss			Oral Health Problems			Oral Pain			Poor Health of Teeth (Dentate Only)		
	# with data	% Yes	<i>p-value</i> chi-square	# with data	% Yes	<i>p-value</i> chi-square	# with data	% Yes	<i>p-value</i> chi-square	# with data	% Yes	<i>p-value</i> chi-square
All respondents	2,878	17.9	NA	2,931	17.2		2,977	13.1		2,676	16.7	
<b>Age group (years)</b>												
55 to 64	1,453	14.0		1,458	19.4		1,480	15.8		1,385	18.6	
65 to 74	706	15.7		711	16.1		726	11.9		664	14.9	
75 or older	719	30.3	<0.001	762	13.9	0.011	771	8.6	<0.001	627	14.7	NS
<b>Sex</b>												
Male	1,322	16.8		1,343	16.5		1,367	12.3		1,238	17.3	
Female	1,556	18.8	NS	1,588	17.8	NS	1,610	13.7	NS	1,438	16.2	NS
<b>Race/Ethnicity</b>												
Non-Hispanic White	2,258	16.7		2,296	16.1		2,331	12.2		2,113	14.0	
Hispanic or Minority	535	23.2	0.005	548	22.3	0.007	556	16.0	0.047	486	30.5	<0.001
<b>Education</b>												
High school or less	686	33.4		710	22.3		720	18.5		577	27.5	
Some college	902	19.6		923	19.4		933	13.7		846	18.2	
College graduate	1256	9.7	<0.001	1,261	13.3	<0.001	1,287	10.1	<0.001	1,226	11.4	<0.001
<b>Income</b>												
< \$25,000	469	36.3		470	31.4		480	26.3		388	36.8	
\$25,000-\$49,999	560	20.2		571	18.6		579	11.8		523	20.3	
\$50,000-\$74,999	508	14.9		521	17.8		532	11.6		490	16.0	
≥\$75,000	879	9.1		882	12.9		892	8.3		859	8.1	
Unknown/refused	462	19.3	<0.001	487	10.3	<0.001	496	13.6	<0.001	416	15.0	<0.001
<b>Dental insurance</b>												
Yes	1,727	15.1		1,760	15.8		1,781	12.0		1,629	14.8	
No	1,114	21.0	<0.001	1,131	19.2	0.023	1,154	14.2	NS	1,016	18.8	0.016
<b>Dental visit in last year</b>												
Yes	2,370	12.6		2,410	15.4		2,440	11.2		2,301	11.8	
No	492	43.3	<0.001	494	26.6	<0.001	510	22.5	<0.001	363	47.8	<0.001
<b>Number of teeth lost</b>												
None	NA	NA		1,235	12.0		1,251	6.9		1,247	7.3	
1 to 5	NA	NA		1,041	19.6		1,062	14.2		1,059	18.7	
6 or more but not all	NA	NA		358	32.0		372	28.2		370	46.1	
All	NA	NA	NA	192	10.9	<0.001	193	21.0	<0.001	NA	NA	<0.001

NA=not applicable, NS=not significant ( $p \geq 0.05$ , Pearson chi-square)



(MEPS),<sup>13</sup> and 67% for 2016 national BRFSS.<sup>5</sup> Higher utilization in Washington State may be partially explained by socioeconomic factors. The percent of residents with a college degree and median household income are higher in Washington State than for the nation.<sup>14</sup>

Although the majority of Washington's older adults report having good oral health, low-income older adults have oral problems which impact quality of life. More than 1 in 4 of Washington's low-income seniors reported oral pain. To improve the oral health of low-income adults, public health policies must address the ability of older adults to afford dental care or access lower cost preventive and restorative services. Unfortunately, Medicare is not a source of comprehensive dental coverage; it only provides coverage for limited hospital-based oral surgeries required in conjunction with other medical treatments. Yet oral health status is closely connected to overall health and wellbeing. Academic research and medical studies have identified a link between periodontal disease and a number of chronic health conditions, including coronary artery disease (heart disease), cerebrovascular disease (stroke) and diabetes. Additionally, researchers have found a link between gum inflammation and a decline in cognitive function among Alzheimer's disease patients.<sup>15-16</sup> Treating older adults' oral disease could yield financial benefits in addition to overall health improvements. A 2016 study found that providing periodontal treatment for all Medicare beneficiaries with heart disease, stroke or diabetes, is estimated to cost approximately \$7.2 billion. However, it would produce a savings of \$63.5 billion over a 9-year period, largely as a result of a decline in hospitalizations and emergency room visits.<sup>17</sup>

While state Medicaid programs are required to cover comprehensive dental services for children, coverage for adult dental services is optional. Because of this, states often decide to offer adults no Medicaid dental coverage or a very limited set of covered services, especially during difficult financial times. As of January 2018, three states offered no dental benefits for adults, 14 had emergency only (relief of pain), 17 had limited benefits (fewer than 100 procedures, annual per person expenditure <\$1,000), while 17 offered comprehensive benefits (100+ procedures, annual per person expenditure >\$1,000). At the time this survey was conducted, Washington's Medicaid program offered extensive dental benefits for eligible adults.<sup>18</sup>

Federally Qualified Health Centers (FQHC) and other non-profit community health centers may be a source of lower-cost dental care for older adults without Medicaid or private dental benefits. In 2017, more than 6.1 million Americans

received dental services at FQHCs which represents 23% of all patients served by FQHCs.<sup>19</sup> In Washington State, 36% of FQHC patients received a dental service in 2017. Unfortunately, older adults are underrepresented within the population served by FQHCs. Sixteen percent of the U.S. population was 65 years or older in 2017, but only 9% of the patients seen by FQHCs in 2017 were 65+ years.<sup>19-20</sup> In Washington State, 14% of the population was 65 years or older in 2017, but only 8% of patients seen by Washington's FQHCs in 2017 were 65+ years. Informing older adults about the lower cost dental services provided by FQHCs may raise awareness and increase use of this valuable service by older Americans.

Allowing dental hygienists to provide preventive dental services at community-based locations such as senior centers, congregate meal sites and long-term care facilities through either direct access or teledentistry would also improve access to affordable care. According to the American Dental Hygienists' Association, direct access to dental hygienists for the provision of preventive dental care to vulnerable populations in some form, is now part of the practice act in 42 states, although not all states identify older adults as a vulnerable population.<sup>21</sup> The use of teledentistry to improve access to oral health services is emerging as a practical solution, especially for treatment planning and specialty consultations. Under both systems, dental hygienists could provide a wide range of services including screening, referral, patient education, topical fluorides (including silver diamine fluoride), interim therapeutic restorations, and prophylaxis. For these models to be sustainable, however, Medicaid and private insurance providers must allow dental hygienists to bill for services provided in non-traditional settings.

Developing and implementing strategies to improve the oral health of older adults will require coordination with health care providers, pharmacists and the social service system. In 2016, approximately 95% of older adults reported visiting a physician or other health care professional within the last year.<sup>22</sup> However, 70% of our respondents stated that their physician did not address oral health during these encounters. This is a missed opportunity to address oral health issues with older adults. Many practical aspects of preventive care can be reinforced or initiated in the medical office. In addition, given the increasing prevalence of diabetes and the association between periodontal disease and elevated hemoglobin A1c's, a closer working relationship between medicine and dentistry will evolve.<sup>23-24</sup> As ongoing medical research continues to establish associations between periodontal disease and heart disease, and the risk of systemic infections, the need to

**Table IV. Logistic regression results for substantial tooth loss, oral health problems, oral pain, and poor health of teeth**

	Substantial Tooth Loss				Oral Health Problems				Oral Pain				Poor Health of Teeth (Dentate Only)			
	Odds Ratio	Lower 95% CL	Upper 95% CL	<i>p</i> -value chi-square	Odds Ratio	Lower 95% CL	Upper 95% CL	<i>p</i> -value chi-square	Odds Ratio	Lower 95% CL	Upper 95% CL	<i>p</i> -value chi-square	Odds Ratio	Lower 95% CL	Upper 95% CL	<i>p</i> -value chi-square
<b>Age group (years)</b>																
65- 74 vs. 55-64	1.3	1.0	1.7	NS	0.8	0.6	1.1	NS	0.7	0.5	0.9	0.010	0.7	0.5	1.0	NS
75+ vs. 55-64	2.6	2.0	3.5	<0.001	0.6	0.4	0.8	0.001	0.3	0.2	0.5	<0.001	0.5	0.4	0.8	0.001
<b>Sex</b>																
Female vs. male	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
<b>Race/Ethnicity</b>																
Minority vs. White	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	2.4	1.6	3.5	<0.001
<b>Education</b>																
Some college vs. college grad.	2.0	1.4	2.6	<0.001	1.3	1.0	1.7	0.040	NS	NS	NS	NS	NS	NS	NS	NS
High school or less vs. college grad.	3.0	2.2	4.1	<0.001	1.5	1.1	2.1	0.021	NS	NS	NS	NS	NS	NS	NS	NS
<b>Income</b>																
\$50,000-\$74,999 vs. \$75,000+	1.3	0.9	1.8	NS	1.2	0.9	1.8	NS	1.5	1.0	2.2	NS	1.8	1.2	2.8	0.005
\$25,000-\$49,999 vs. \$75,000+	1.3	0.9	1.9	NS	1.2	0.8	1.7	NS	1.3	0.9	1.9	NS	1.9	1.2	2.9	0.003
< \$25,000 vs. \$75,000+	2.1	1.4	3.1	<0.001	2.2	1.6	3.2	<0.001	3.1	2.2	4.5	<0.001	3.3	2.2	5.1	<0.001
Missing vs. \$75,000+	1.3	0.9	2.0	NS	0.6	0.4	1.0	0.037	1.8	1.1	2.8	0.018	1.8	1.1	2.9	0.026
<b>Dental insurance</b>																
No vs. yes	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
<b>Dental visit in last year</b>																
No vs. yes	3.6	2.8	4.8	3.6	1.5	1.1	2.1	0.012	NS	NS	NS	NS	4.2	3.0	5.8	<0.001
<b>Number of teeth lost</b>																
1 to 5 vs. none	NA	NA	NA	NA	1.7	1.3	2.2	<0.001	2.3	1.7	3.2	<0.001	2.9	2.1	4.0	<0.001
6 or more but not all vs. none	NA	NA	NA	NA	2.7	1.9	3.9	<0.001	5.4	3.7	7.8	<0.001	9.2	6.2	13.6	<0.001
All vs. none	NA	NA	NA	NA	0.5	0.3	1.0	NS	3.1	1.8	5.1	<0.001	NA	NA	NA	NA

CL=confidence limit, NS=not significant ( $p \geq 0.05$ , Wald chi-square), NA=not applicable

include oral health assessment in routine primary care grows more compelling. Engaging pharmacists to address the oral health impacts of drug-induced xerostomia may also benefit the population that reports having symptoms of dry mouth.

One approach for improving oral health would be to train and incentivize medical professionals to conduct oral health screenings, deliver oral health services such as education and fluoride varnish, and refer for treatment of oral disease, especially for their medically compromised patients. For

this strategy to work effectively for low-income older adults, financial and logistical barriers to accessing dental care must be reduced or eliminated. Reducing financial barriers may be accomplished through expansion of Medicaid dental benefits, the delivery of preventive services by dental hygienists at senior centers and increased use of FQHCs.

Reducing logistical barriers and improve care transition and case management, will require engagement with the social service agencies that provide services to older Americans,

often referred to as the national aging network. The Older Americans Act (OAA) was signed into law in 1965, creating the Administration on Aging (AoA). Eight years later, the comprehensive services amendment to the OAA, established Area Agencies on Aging (AAA) to develop and administer comprehensive and coordinated systems of aging services at the local level. Services provided by AAAs include, but are not limited to, nutrition, transportation, case management, and in-home services. In Washington, select AAA's have taken the steps to prevent oral disease among their clients. These interventions include providing oral health education during care transition meetings and oral health questions as part of their care assessment protocol. Any initiative focused on improving the oral health of older Americans should include representatives from the aging network.

Given the changing demographics in the older adult population along with increasing tooth retention, state and federal dental public health programs must expand beyond the oral health services provided to children and begin to focus on the preventive oral health needs of high-risk older adults. A comprehensive Medicare dental benefit would improve overall health and wellbeing for older adults, and has the potential to substantially reduce medical costs over time for beneficiaries with periodontal disease and other chronic conditions. National health reform offers a unique opportunity to reconsider a delivery system that separates oral health care from primary medical care services. Developing a model that integrates the evaluation and treatment of all health care needs, including oral, is a worthwhile goal, and has the potential to control costs, enhance the patient experience of care, and measurably improve population health.

## Conclusion

Most older adults in Washington report having good oral health and regular dental care. However, a subgroup, older adults with low-incomes, are at increased risk of oral problems. Improving the oral health of this high-risk population will require continued collection of oral health status data; development and implementation of strategies to reduce financial barriers for dental care; and coordination of treatment with oral health care providers and the aging network.

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