

<b>Oral Health (Dental)</b>	<b>Pg</b>
<b>Service Category Definition - Part B</b> Untargeted	<b>1</b>
<b>Service Category Definition - Part A</b> Targeted to Rural (North)	<b>4</b>
<b>PowerPoint: 2022 Oral Health Chart Review Update, TRG</b>	<b>7</b>
<b>FY20 Oral Health Care Rural Target Chart Review, RWGA</b>	<b>9</b>
<b>FY20 Part A Performance Measures Report</b>	<b>12</b>
<b>Postmenopausal Women with HIV have Increased Tooth Loss</b> <b>- BMC Oral Health, 2024</b>	<b>13</b>
<b>Experiences with and Outcomes of Oral Health Care</b> <b>- CareQuest Institute for Oral Health, March 2024</b>	<b>23</b>

Local Service Category:	<b>Oral Health Care</b>
Amount Available:	<b>To be determined</b>
Unit Cost:	
Budget Requirements or Restrictions ( <b>TRG Only</b> ):	Maximum of 10% of budget for Administrative Costs
Local Service Category Definition:	<p>Restorative dental services, oral surgery, root canal therapy, fixed and removable prosthodontics; periodontal services includes subgingival scaling, gingival curettage, osseous surgery, gingivectomy, provisional splinting, laser procedures and maintenance. Oral medication (including pain control) for people living with HIV (PLWH) 15 years of age or older must be based on a comprehensive individual treatment plan.</p> <p>Prosthodontics services to people living with HIV including but not limited to examinations and diagnosis of need for dentures, crowns, bridgework and implants, diagnostic measurements, laboratory services, tooth extraction, relines and denture repairs.</p> <p>Emergency procedures will be treated on a walk-in basis as availability and funding allows. Funded Oral Health Care providers are permitted to provide necessary emergency care regardless of a PLWH's annual benefit balance. If a provider cannot provide adequate services for emergency care, the PLWH should be referred to a hospital emergency room.</p>
Target Population (age, gender, geographic, race, ethnicity, etc.):	People living with HIV residing in the Houston HIV Service Delivery Area (HSDA).
Services to be Provided:	<p>Services must include, but are not limited to: individual comprehensive treatment plan; diagnosis and treatment of HIV-related oral pathology, including oral Kaposi's Sarcoma, CMV ulceration, hairy leukoplakia, xerostomia, lichen planus, aphthous ulcers and herpetic lesions; diffuse infiltrative lymphocytosis; standard oral health education and preventive procedures, including oral hygiene instruction, smoking/tobacco cessation (as indicated), diet counseling and home care program; oral prophylaxis; restorative care; oral surgery including dental implants; root canal therapy; fixed and removable prosthodontics including crowns and bridges; periodontal services, including subgingival scaling, gingival curettage, osseous surgery, gingivectomy, provisional splinting, laser procedures and maintenance. Proposer must have mechanism in place to provide oral pain medication as prescribed for PLWH by the dentist.</p> <p>Limitations:</p> <ul style="list-style-type: none"> <li>• Cosmetic dentistry for cosmetic purposes only is prohibited.</li> <li>• Maximum amount that may be funded by Ryan White/State Services per PLWH is \$3,000/year. <ul style="list-style-type: none"> <li>• In cases of emergency, the maximum amount may exceed the above cap</li> <li>• In cases where there is extensive care needed once the procedure has begun, the maximum amount may exceed the above cap.</li> </ul> </li> <li>• Dental providers must document <i>via approved waiver</i> the reason for exceeding the yearly maximum amount.</li> </ul>
Service Unit Definition(s) ( <b>TRG Only</b> ):	General Dentistry: A unit of service is defined as one (1) dental visit which includes restorative dental services, oral surgery, root canal therapy, fixed and removable prosthodontics; periodontal services includes subgingival scaling, gingival curettage, osseous surgery, gingivectomy, provisional splinting, laser procedures and maintenance. Oral medication

	<p>(including pain control) for PLWH 15 years old or older must be based on a comprehensive individual treatment plan.</p> <p>Prosthodontics: A unit of services is defined as one (1) Prosthodontics visit.</p>
Financial Eligibility:	Income at or below 300% Federal Poverty Guidelines. Maximum amount that may be funded by Ryan White/State Services per PLWH is \$3,000/year.
Eligibility for Services:	Person living with HIV; Adult resident of Houston HSDA
Agency Requirements (TRG Only):	<p><b>To ensure that Ryan White is payer of last resort, Agency and/or dental providers (clinicians) must be Medicaid certified and enrolled in all Dental Plans offered to Texas STAR+PLUS eligible PLWH in the Houston EMA/HSDA.</b> Agency/providers must ensure Medicaid certification and billing capability for STAR+PLUS eligible PLWH remains current throughout the contract term.</p> <p>Agency must document that the primary PLWH care dentist has 2 years prior experience treating HIV disease and/or on-going HIV educational programs that are documented in personnel files and updated regularly. Dental facility and appropriate dental staff must maintain Texas licensure/certification and follow all applicable OSHA requirements for PLWH management and laboratory protocol.</p>
Staff Requirements:	State of Texas dental license; licensed dental hygienist and state radiology certification for dental assistants.
Special Requirements (TRG Only):	<p>Must comply with the Houston EMA/HSDA Standards of Care.</p> <p>The agency must comply with <b>the DSHS Oral Health Care Standards of Care</b>. The agency must have policies and procedures in place that comply with the standards <i>prior</i> to delivery of the service.</p> <p>Oral Health Care services can be delivered via telehealth and must follow applicable federal and State of Texas privacy laws.</p>

***FY 2025 RWPC “How to Best Meet the Need” Decision Process***

<b>Step in Process: Council</b>		Date: <b>06/13/2024</b>
Recommendations:	Approved: Y: _____ No: _____ Approved With Changes: _____	If approved with changes list changes below:
1.		
2.		
3.		
<b>Step in Process: Steering Committee</b>		Date: <b>06/06/2024</b>
Recommendations:	Approved: Y: _____ No: _____ Approved With Changes: _____	If approved with changes list changes below:
1.		
2.		
3.		
<b>Step in Process: Quality Improvement Committee</b>		Date: <b>05/14/2024</b>
Recommendations:	Approved: Y: _____ No: _____ Approved With Changes: _____	If approved with changes list changes below:
2.		
2.		
3.		
<b>Step in Process: HTBMTN Workgroup #2</b>		Date: <b>04/16/2024</b>
Recommendations:	Financial Eligibility:	
1.		
2.		
3.		

FY 2024 Houston EMA/HSDA Ryan White Part A/MAI Service Definition <b>Oral Health/Rural</b> (Last Review/Approval Date: November 2021)	
HRSA Service Category Title: <b>RWGA Only</b>	<b>Oral Health</b>
Local Service Category Title:	<b>Oral Health – <u>Rural (North)</u></b>
Budget Type: <b>RWGA Only</b>	<b>Unit Cost</b>
Budget Requirements or Restrictions: <b>RWGA Only</b>	Not Applicable
HRSA Service Category Definition ( <b>do not change or alter</b> ): <b>RWGA Only</b>	<b>Oral health care</b> includes diagnostic, preventive, and therapeutic services provided by general dental practitioners, dental specialists, dental hygienists and auxiliaries, and other trained primary care providers.
Local Service Category Definition:	Restorative dental services, oral surgery, root canal therapy, fixed and removable prosthodontics; periodontal services includes subgingival scaling, gingival curettage, osseous surgery, gingivectomy, provisional splinting, laser procedures and maintenance. Oral medication (including pain control) for HIV patients 15 years old or older must be based on a comprehensive individual treatment plan. Prosthodontics services to eligible clients including, but not limited to examinations and diagnosis of need for dentures, diagnostic measurements, laboratory services, tooth extractions, relines and denture repairs.
Target Population (age, gender, geographic, race, ethnicity, etc.):	Persons living with HIV residing in Houston Eligible Metropolitan Area (EMA) or Health Service Delivery Area (HSDA) counties other than Harris County. Comprehensive Oral Health services targeted to individuals residing in the northern counties of the EMA/HSDA, including Waller, Walker, Montgomery, Austin, Chambers and Liberty Counties.
Services to be Provided:	Services must include, but are not limited to: individual comprehensive treatment plan; diagnosis and treatment of HIV-related oral pathology, including oral Kaposi's Sarcoma, CMV ulceration, hairy leukoplakia, xerostomia, lichen planus, aphthous ulcers and herpetic lesions; diffuse infiltrative lymphocytosis; standard preventive procedures, including oral hygiene instruction, diet counseling and home care program; oral prophylaxis; restorative care; oral surgery including dental implants; root canal therapy; fixed and removable prosthodontics including crowns, bridges and implants; periodontal services, including subgingival scaling, gingival curettage, osseous surgery, gingivectomy, provisional splinting, laser procedures and maintenance. Proposer must have mechanism in place to provide oral pain medication as prescribed for

	clients by the dentist.
Service Unit Definition(s): <b>RWGA Only</b>	<p>General Dentistry: A unit of service is defined as one (1) dental visit which includes restorative dental services, oral surgery, root canal therapy, fixed and removable prosthodontics; periodontal services includes subgingival scaling, gingival curettage, osseous surgery, gingivectomy, provisional splinting, laser procedures and maintenance. Oral medication (including pain control) for HIV patients 15 years old or older must be based on a comprehensive individual treatment plan.</p> <p>Prosthodontics: A unit of services is defined as one (1) Prosthodontics visit.</p>
Financial Eligibility:	Refer to the RWPC's approved <i>Financial Eligibility for Houston EMA/HSDA Services</i> .
Client Eligibility:	Adult persons with HIV residing in the rural area of Houston EMA/HSDA meeting financial eligibility criteria.
Agency Requirements:	<p>Agency must document that the primary patient care dentist has 2 years prior experience treating HIV disease and/or on-going HIV educational programs that are documented in personnel files and updated regularly.</p> <p>Service delivery site must be located in one of the northern counties of the EMA/HSDA area: Waller, Walker, Montgomery, Austin, Chambers or Liberty Counties</p>
Staff Requirements:	State of Texas dental license; licensed dental hygienist and state radiology certification for dental assistants.
Special Requirements: <b>RWGA Only</b>	<p><u>Agency and/or dental providers (clinicians) must be Medicaid certified and enrolled in all Dental Plans offered to Texas STAR+PLUS eligible clients in the Houston EMA/HSDA. Agency/providers must ensure Medicaid certification and billing capability for STAR+PLUS eligible patients remains current throughout the contract term.</u></p> <p>Must comply with the joint Part A/B standards of care where applicable.</p>

***FY 2025 RWPC “How to Best Meet the Need” Decision Process***

<b>Step in Process: Council</b>		Date: <b>06/13/2024</b>
Recommendations:	Approved: Y: _____ No: _____ Approved With Changes: _____	If approved with changes list changes below:
1.		
2.		
3.		
<b>Step in Process: Steering Committee</b>		Date: <b>06/06/2024</b>
Recommendations:	Approved: Y: _____ No: _____ Approved With Changes: _____	If approved with changes list changes below:
1.		
2.		
3.		
<b>Step in Process: Quality Improvement Committee</b>		Date: <b>05/14/2024</b>
Recommendations:	Approved: Y: _____ No: _____ Approved With Changes: _____	If approved with changes list changes below:
2.		
2.		
3.		
<b>Step in Process: HTBMTN Workgroup #2</b>		Date: <b>04/16/2024</b>
Recommendations:	Financial Eligibility:	
1.		
2.		
3.		

## Modified Monitoring Process

Effective March 13, 2020 TRG enacted emergency response procedures due to COVID-19 pandemic. All monitoring was deferred/suspended in 2020 per DSHS and HRSA guidance.

In 2020, DSHS launched a burden reduction plan to reduce administrative burden by 50% for AA's and Subrecipients.

- This model requires subrecipient monitoring every other year (even years only).
- Per DSHS guidance, TRG is not required to complete monitoring in odd years
- In 2020, subrecipients that didn't have the ability to complete a remote review, were exempted from the 2020 Standards of Care chart review monitoring due to the COVID-19 State of Emergency.

## 2022 Monitoring

This year all subrecipients will be monitored, remotely if possible and in-person if necessary.

The monitoring period will cover calendar year 2021



Special chart review process is being evaluated for the RW Planning Council process during the "odd" years DSHS is not requiring monitoring (requires DSHS approval)



# Oral Healthcare (OHC)

OHC WAS REVIEWED IN 2020. PLEASE NOTE NOT ALL PROVIDERS WERE ASSESSED.

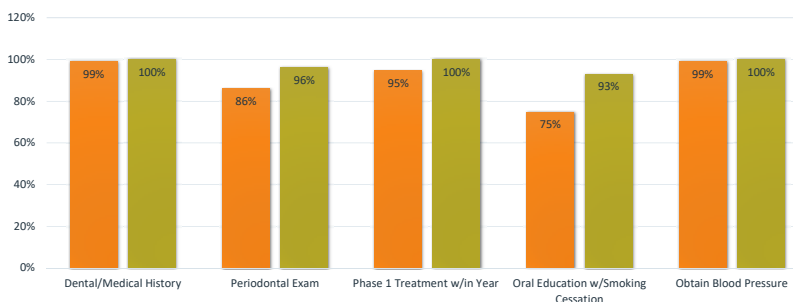
## Description of Service

Restorative dental services, oral surgery, root canal therapy, fixed and removable prosthodontics; periodontal services includes subgingival scaling, gingival curettage, osseous surgery, gingivectomy, provisional splinting, laser procedures and maintenance. Oral medication (including pain control) for HIV patients 15 years old or older must be based on a comprehensive individual treatment plan.

Prosthodontics services to HIV infected individuals including but not limited to examinations and diagnosis of need for dentures, crowns, bridgework and implants, diagnostic measurements, laboratory services, tooth extraction, relines and denture repairs.

Emergency procedures will be treated on a walk-in basis as availability and funding allows. Funded Oral Health Care providers are permitted to provide necessary emergency care regardless of a client's annual benefit balance.

## Chart Review Highlights- 2019-2020





Harris County  
**Public Health**  
Building a Healthy Community

# Ryan White Part A, Houston EMA FY20-21 Clinical Care Chart Review Summary of Findings

Review period was March 1, 2020 - February 28, 2021



Chronic Disease



Food Safety



Emergency Preparedness



Environmental Health



Infectious Diseases



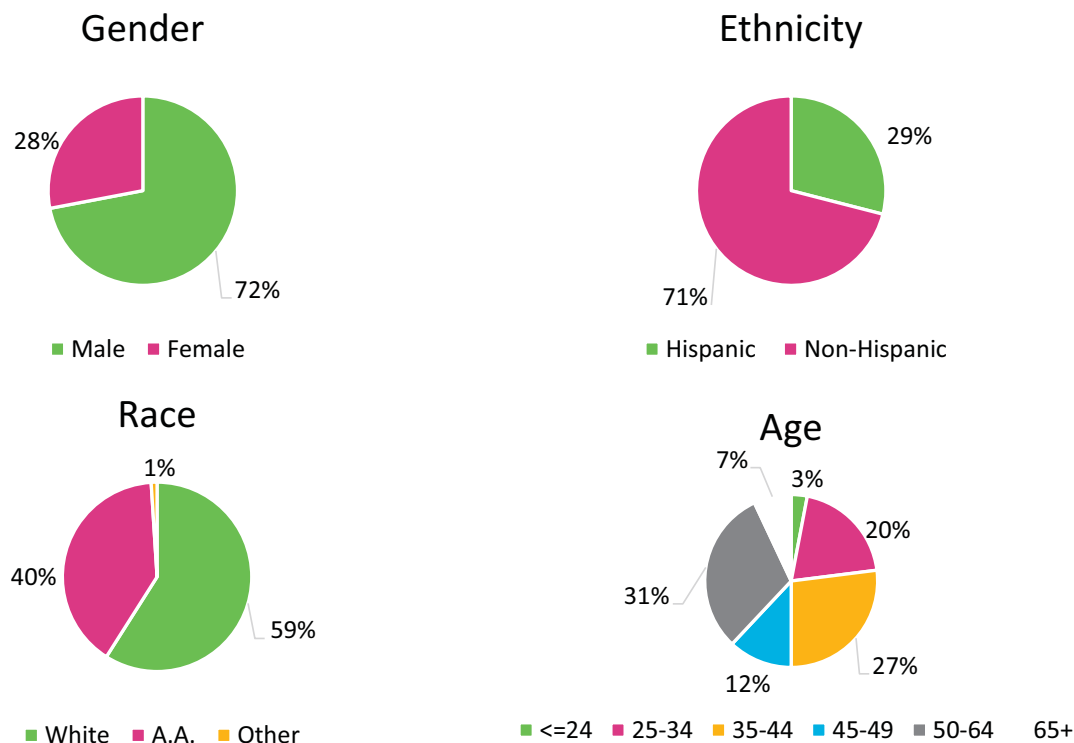
Injury



Social, Mental, and Emotional Wellbeing

# Oral Health-Rural Chart Review

- 75 charts reviewed
- Each sample was determined to be comparable to the racial, ethnic, gender and age demographics of each site's overall vision care population



# Oral Health-Rural Chart Review

Performance Measure	2020	Performance Measure	2020
Primary Care Provider	100%	Oral Health Education*	99%
Medical/Dental Health History*	76%	Hard Tissue Exam	99%
Medical History 6 month update	93%	Soft Tissue Exam	99%
Vital Signs	100%	Periodontal Screening*	99%
Current Medications	100%	X-Rays Present	99%
CBC Documented	96%	Treatment Plan*	100%
Antibiotic Prophylaxis Given	N/A	Phase I Treatment Plan Completed	44%

\*HIV/AIDS Bureau (HAB) Performance Measures



Barbie Robinson, MPP, JD, CHC  
 Executive Director  
 2223 West Loop South | Houston, Texas 77027  
 Tel: (832) 927-7500 | Fax: (832) 927-0237



Michael Ha, MBA  
 Director, Disease Control & Clinical Prevention Division  
 2223 West Loop South | Houston, Texas 77027  
 Tel: (713) 439-6000 | Fax: (713) 439-6199

**FY 2020 PERFORMANCE MEASURES HIGHLIGHTS**

**RYAN WHITE GRANT ADMINISTRATION**

**HARRIS COUNTY PUBLIC HEALTH (HCPH)**

Ryan White Part A  
 HIV Performance Measures  
 FY 2020 Report

**Oral Health Care**  
 All Providers

Clinical Chart Review Measures*	FY 2018	FY 2019
100% of oral health clients will have a dental and medical health history (initial or updated) at least once in the measurement year	100%	99%
90% of oral health clients will have a dental treatment plan developed and/or updated at least once in the measurement year	99%	100%
85% of oral health clients will receive oral health education at least once in the measurement year	99%	99%
90% of oral health clients will have a periodontal screen or examination at least once in the measurement year	97%	94%
50% oral health clients will have a Phase 1 treatment plan that is completed within 12 months	34%	55%

*HCPH is the local public health agency for the Harris County, Texas jurisdiction. It provides a wide variety of public health activities and services aimed at improving the health and well-being of the Harris County community.*

Follow us and stay up-to-date! | @hcphtx    

## RESEARCH

## Open Access



# Postmenopausal women with HIV have increased tooth loss

Sunil Wadhwa<sup>1\*</sup>, Taylor R. Finn<sup>1</sup>, Karolina Kister<sup>1</sup>, Satoko Matsumura<sup>2</sup>, Michael Levit<sup>1</sup>, Anyelina Cantos<sup>3</sup>, Jayesh Shah<sup>3</sup>, Bruno Bohn<sup>4</sup>, Evanthia Lalla<sup>5</sup>, John T. Grbic<sup>6</sup>, Ryan T. Demmer<sup>4</sup> and Michael T. Yin<sup>3</sup>

## Abstract

**Background** With effective antiretroviral therapy, people with HIV (PWH) are living longer and aging; the majority of PWH in the United States are now over the age of 50 and in women have gone through the menopause transition. Menopause potentiates skeletal bone loss at the spine, hip, and radius in PWH. The alveolar bone which surrounds the teeth is different than long bones because it is derived from the neural crest. However, few studies have assessed the oral health and alveolar bone in middle aged and older women with HIV. Therefore, the objective of this study was to evaluate periodontal disease and alveolar bone microarchitecture in postmenopausal women with HIV.

**Methods** 135 self-reported postmenopausal women were recruited (59 HIV-, 76 HIV+ on combination antiretroviral therapy with virological suppression) from a single academic center. The following parameters were measured: cytokine levels (IFN- $\gamma$ , TNF- $\alpha$ , IL-1 $\beta$ , IL-2, IL-5, IL-6, IL-7, IL-8, IL-10, IL-12p70, IL-13, IL-17 A, OPG, and RANKL) in gingival crevicular fluid, bleeding on probing, probing depth, clinical attachment loss, number of teeth present, alveolar crestal height, and alveolar bone microarchitecture.

**Results** The mean age of participants was 57.04 $\pm$ 6.25 years and a greater proportion of women with HIV were black/African American (HIV+ 68.42%, HIV- 23.73%;  $p < 0.001$ ). There was no significant difference in bleeding on probing ( $p = 0.17$ ) and attachment loss ( $p = 0.39$ ) between women who were HIV infected vs. HIV uninfected. Women with HIV had significantly higher RANKL expression in Gingival Crevicular Fluid (HIV+ 3.80 $\pm$ 3.19 pg/ul, HIV- 1.29 $\pm$ 2.14 pg/ul ;  $p < 0.001$ ), fewer teeth present (HIV+ 17.75 $\pm$ 7.62, HIV- 22.79 $\pm$ 5.70;  $p < 0.001$ ), lower trabecular number (HIV+ 0.08 $\pm$ 0.01, HIV- 0.09 $\pm$ 0.02;  $p = 0.004$ ) and greater trabecular separation (HIV+ 9.23 $\pm$ 3.11, HIV- 7.99 $\pm$ 3.23;  $p = 0.04$ ) compared to women without HIV that remained significant in multivariate logistic regression analysis in a sub-cohort after adjusting for age, race/ethnicity, smoking status, and diabetes.

**Conclusion** Postmenopausal women with HIV have deterioration of the alveolar trabecular bone microarchitecture that may contribute to greater tooth loss.

**Keywords** Periodontal disease, Bone biology, Computed tomography, Women's health, Alveolar bone

\*Correspondence:

Sunil Wadhwa

sw2680@cumc.columbia.edu

<sup>1</sup>Division of Orthodontics, Columbia University College of Dental Medicine, New York, NY, USA

<sup>2</sup>Division of Oral and Maxillofacial Radiology, Columbia University College of Dental Medicine, New York, NY, USA

<sup>3</sup>Division of Infectious Diseases, Columbia University College of Physicians and Surgeons, New York, NY, USA

<sup>4</sup>Division of Epidemiology and Community Health, University of Minnesota School of Public Health, Minneapolis, MN, USA

<sup>5</sup>Division of Periodontics, Columbia University College of Dental Medicine, New York, NY, USA

<sup>6</sup>Division of Foundational Sciences, Columbia University College of Dental Medicine, New York, NY, USA



© The Author(s) 2023. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>. The Creative Commons Public Domain Dedication waiver (<http://creativecommons.org/publicdomain/zero/1.0/>) applies to the data made available in this article, unless otherwise stated in a credit line to the data.

## Introduction

Prior to the advent of effective antiretroviral therapy (ART) used to treat HIV (human immunodeficiency virus), people with HIV (PWH) were at risk for greater periodontal disease severity compared to the general population. [1, 2] Proinflammatory cytokines, such as IL-1 $\beta$ , IL-6, and TNF- $\alpha$ , are associated with oral inflammation, periodontitis, and bone resorption, and have previously been found in higher abundance in PWH. [3] However, a review of the current literature indicates widespread use of ART has improved periodontal parameters in PWH, which now better match outcomes people without HIV. [4]

ART has allowed PWH to experience longer life expectancies. [5] With extended life come aging-related risk factors and comorbidities, such as bone loss. [6] According to data from the National Health and Nutrition Examination Survey 2017–2018, older women have a greater prevalence of bone loss and fractures in long bones compared to younger women and men. [7] This can be attributed to menopause and a decrease in estrogen. [8] It is unclear what the role of estrogen loss during menopause plays on the jaw bone. For example, the risk of mandibular fracture does not increase with age in women [9] and the effect of menopause on the jaw bones appears to be site specific. In one study it was shown that the thickness of the cortical crestal bone was thinner in the posterior maxilla but not in the anterior maxilla, anterior mandible and posterior mandible in women over the age of 50 compared to women under the age of 50. [10]

Older PWH who experience menopause have been shown to have greater bone loss than the general population. [11] We previously found that postmenopausal women with HIV have lower bone mineral density than postmenopausal women without HIV, and greater longitudinal bone loss [12, 13] In a separate study, we confirmed that menopause and HIV infection are independently associated with lower bone mineral density and have an additive effect on the lumbar spine and total hip bone mineral density. [14] However the role of HIV infection and menopause on the Jaw bone microarchitecture is unknown.

A recent meta-analysis concluded that postmenopausal osteoporosis patients are more likely to suffer from markers of periodontal disease including increased clinical attachment loss, increased pocket depth and increased bleeding on probing. [15] Since postmenopausal women with HIV have accelerated skeletal long bone loss, it may be possible that they also experience greater alveolar bone loss leading to increased severity of periodontal disease. Therefore, this study aims to evaluate alveolar bone microarchitecture and periodontal disease in the postmenopausal women with and without HIV.

## Materials and methods

### Study population

This study was approved by the Columbia University Irving Medical Center Institutional Review Board (IRB-AAA5233). Written informed consent was obtained from all study subjects. As part of an ongoing study examining the mandibular bone microarchitecture in PLWH. Our primary outcome was changes in Alveolar crestal height levels. Based upon our preliminary data [16], with a sample size of 120, we will have >90% power to detect the observed effect size of a difference of 0.4 mm between HIV+ and HIV- postmenopausal women in ACH. 135 patients were recruited from the dental clinic and Comprehensive Health Program clinic at Columbia University Irving Medical Center from September 2017 to December 2022; 76 were women with HIV and 59 without HIV. Inclusion criteria for the PWH cohort were: (a) self-reported menopause status, defined as the absence of menstrual bleeding for greater than 12 months; (b) 35–70 years old; (c) HIV-infected as defined by documentation of a positive antibody test or detectable HIV-1 RNA level any time prior to enrollment. In addition, women with HIV had to be on combination ART for at least one year with virological suppression, have a CD4 count >100 cells/ $\mu$ L at time of enrollment, and no opportunistic infections within the last six months prior to enrollment.

Inclusion criteria for women without HIV were: (a) self-reported menopause status; (b) 35–70 years old; (c) a negative HIV antibody test. Exclusion criteria for both groups included: (a) current chemo- or immunotherapy; (b) antibiotic use in the preceding three months other than prophylaxis for opportunistic infections; (c) history of bisphosphonate or other osteoporosis therapy; (d) current oral contraceptive, hormone therapy (HT), or testosterone supplementation.

Blood samples were collected using serum separator tubes, separated into serum aliquots, stored at  $-80^{\circ}\text{C}$ , then thawed and batch-analyzed at the Irving Columbia University Irving Medical Center Biomarker Laboratory. Circulating estrogen levels were measured by Estradiol ELISA (Siemens Cat# LKE21).

### Periodontal examination

A full-mouth periodontal examination was performed on all study participants by calibrated dental examiners using a UNC 15 probe. Probing depth (PD), clinical attachment level (CAL), and bleeding on probing (BOP) were recorded on all teeth excluding third molars at six sites per tooth: mesio-buccal, mid-buccal, disto-buccal, mesio-lingual, mid-lingual, and disto-lingual. Periodontal status was classified according to the Centers for Disease Control and Prevention/American Academy of Periodontology (CDC/AAP) definitions [17]: (1) no/mild periodontitis: neither “moderate” nor “severe” periodontitis;

(2) moderate periodontitis:  $\geq 2$  interproximal sites with CAL  $\geq 4$  mm (not on same tooth) or  $\geq 2$  interproximal sites with PD  $\geq 5$  mm (not on same tooth); (3) severe periodontitis:  $\geq 2$  interproximal sites with CAL  $\geq 6$  mm (not on same tooth) and  $\geq 1$  interproximal site with PD  $\geq 5$  mm. BOP was recorded as present or absent. All missing teeth, excluding third molars, were recorded.

#### Gingival crevicular fluid (GCF) collection

Gingival crevicular fluid (GCF) samples were collected from the distal site of six index teeth: two molars, two premolars, and two incisors. The selected teeth included the maxillary right first molar (#3), the maxillary left central incisor (#9), the maxillary left first premolar (#12), the mandibular left first molar (#19), the mandibular right central incisor (#25), and the mandibular right first premolar (#28). If any of these teeth were missing, the next most anterior tooth in the same quadrant was selected and recorded. Supragingival plaque was removed, and the gingiva was dried with cotton and an air syringe. Pre-cut periopaper strips (Oraflow, Smithtown, NY, USA) were introduced into the periodontal pocket until mild resistance was felt, angled to meet the midpoint of the distal surface, and held in place for 30 s. The strips were then placed in a single microcentrifuge tube containing 500  $\mu$ L of sterile phosphate buffered saline (0.02 M phosphate, 0.15 M NaCl, pH 7.5, containing 0.05% Tween 20 [PBST; Fisher Scientific Co., Fair Lawn, NJ, USA]) and the GCF was eluted by centrifugation.

#### Inflammatory cytokine assays in GCF

Samples were assayed for GCF cytokines (IFN- $\gamma$ , TNF- $\alpha$ , IL-1 $\beta$ , IL-2, IL-5, IL-6, IL-7, IL-8, IL-10, IL-12p70, IL-13, IL-17 A, OPG, and RANKL) in pg/ml and in duplicate at the Salimetrics SalivaLab (Carlsbad, CA) using an electrochemiluminescence method developed and validated for GCF by Salimetrics for all assays except OPG (abcam OPG ELISA Kit (ab100617)). Calibration curves were generated to determine analyte concentration using a mix of standards for assays run in multiplex (IL-1 beta, IL-6, IL-8, TNF- $\alpha$ , IFN- $\gamma$ , IL-2, IL-7, IL-10, IL-12p70). The average coefficient of variation for all samples tested was <15%. Sample test volume was 25  $\mu$ L of GCF per determination.

#### Intraoral radiographs

Study subjects were exposed to a full mouth series of up to 11 standardized intraoral radiographs (seven anterior periapical radiographs and four posterior bitewing radiographs), taken on the Progeny Preva Unfors-XI (Midmark Corporation, Lincolnshire, Illinois, USA) at 60 kV, 7.0 mA and time range 0.10–0.16 s at a 20 cm source-to-skin distance. Alveolar crestal height (ACH) is defined as the distance in millimeters between the cemento-enamel

junction (CEJ) and the most coronal part of the alveolar crest directly adjacent to the root surface along the long axis of the tooth, and measured according to published methods. [18] ACH was measured by blinded investigators in up to 24 teeth at two sites per tooth (mesial and distal), excluding third molars and canines. Whole-mouth mean ACH was calculated by averaging the ACH levels in all teeth measured as previously described. [19]

#### Cone beam computed tomography (CBCT) acquisition

High resolution cone beam computed tomography (CBCT) images of the alveolar bone were obtained by a Planmeca ProMax 3D Classic CBCT scanner (Planmeca Inc., Hoffman Estates, Illinois, USA) at 84 kVp, 8 mA, and 15 s scan time. The manufacturer's standard high-resolution scanning protocol was used to acquire an 80 $\times$ 42 $\times$ 68 mm region at a nominal isotropic resolution of 100  $\mu$ m. Participants were positioned in the scanner and secured using a temporal bone support and chin rest to reduce motion artifacts, and instructed to occlude on the posterior dentition in the position that provided the best fit. The aim was to obtain maximum occlusion.

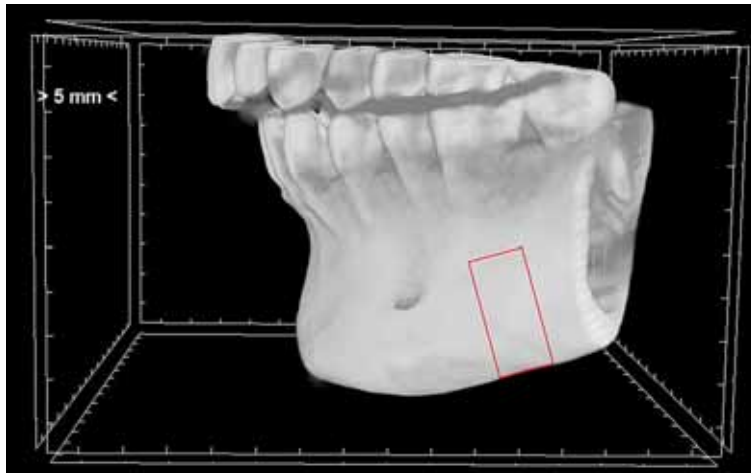
To analyze the alveolar bone, 60 consecutive sections without intersection gaps were stacked after skipping the first 40 consecutive sections posterior to the opening of the mental foramen (Fig. 1). The region of interest included the trabecular and cortical bone, taken as the negative ROI from isolated trabecular bone. Skyscan Ctan Software (Bruker Corporation, Billerica, MA, USA) was used to isolate the ROI, convert to binary image form via local thresholding, and perform 3D microstructure evaluation. Parameters of interest included trabecular bone volume fraction (BV/TV), trabecular thickness, trabecular number, trabecular separation, cortical BV/TV, cortical thickness, and cortical porosity as previously described. [20]

#### Statistical methods

Statistical analyses were conducted in R (4.2.2). Participant demographics and clinical characteristics were summarized for the study cohort and by HIV status. Variation in participant characteristics across HIV status were tested with F-statistics from type III ANOVA models or Chi Squared tests, as appropriate.

Univariable and multivariable linear regression models were used to investigate differences in odds of periodontitis across HIV status. All regression models were adjusted for participant age, race/ethnicity (black/Hispanic), smoking status, and history of type 2 diabetes. Adjusted analyses were only conducted in a subset of the cohort, excluding those with missing co variates and of white race, due to no HIV cases among participants who were white. We have complied with the STROBE guidelines for human observational studies.





**Fig. 1** 3-Dimensional cone beam reconstruction of lateral view of the mandible depicting the region of interest boundaries

## Results

The rationale of this cross sectional study was to examine periodontal disease activity and alveolar bone microarchitecture in postmenopausal women with and without HIV. A total of 135 postmenopausal women were recruited for the study (76 HIV+, 59 HIV-) with an average age of 57.04+/-6.25 years old (HIV+ 56.95+/-5.06 yrs/old, HIV- 57.15+/-7.56 years/old;  $p=0.85$ ). Postmenopausal women with HIV had been on cART for an average of 17.79 +/- 7.4 years. There were significantly more black women (HIV+68.42%, HIV-23.73%) and no white women (HIV+0%, HIV- 20.34%) in the group with HIV ( $p<0.001$ ) (Table 1).

### PWH have fewer teeth but similar periodontal disease activity

Postmenopausal women with HIV had significantly fewer teeth (HIV+17.75+/-7.62 teeth, HIV- 22.79+/-5.70 teeth;  $p<0.001$ ) than postmenopausal women without HIV, with a maximum of 28 teeth present, excluding third molars. However, there was no significant differences in mean PD, CAL, or % BOP between HIV groups (Table 1).

### PWH have increased GCF markers of bone resorption

GCF levels of IFN- $\gamma$ , TNF- $\alpha$ , IL-1 $\beta$ , IL-2, IL-5, IL-6, IL-7, IL-8, IL-10, IL-12p70, IL-13, IL-17 A (pg/ml), and OPG were similar in the two groups. GCF RANKL expression was significantly higher in women with HIV (HIV+3.80+/-3.19 pg/ml, HIV- 1.29+/-2.14 pg/ml;  $p=0.0002$ ) (Table 1).

### PWH have increased alveolar bone loss and microarchitectural alterations

Two-dimensional intraoral radiographs revealed that mean ACH was greater in women with HIV (HIV+3.26+/-1.28 mm, HIV- 2.72+/-1.01 mm;  $p=0.01$ )

than women without HIV, where higher values indicate greater alveolar bone loss (Table 1).

Three-dimensional CBCT analysis of the microarchitecture of the alveolar bone surrounding the mental foramen region of the mandible revealed that women with HIV had significantly greater trabecular thickness (HIV+7.25+/-1.25, HIV- 6.24+/-1.78;  $p<0.001$ ), lower trabecular number (HIV+0.08+/-0.01, HIV- 0.09+/-0.02;  $p=0.004$ ), greater trabecular separation (HIV+9.23+/-3.11, HIV- 7.99+/-3.23;  $p=0.04$ ), greater cortical BV/TV (HIV+99.18+/-1.38, HIV- 98.53+/-1.8;  $p=0.04$ ), and lower cortical porosity (HIV+0.82+/-1.38, HIV- 1.47+/-1.8;  $p=0.04$ ) compared to women without HIV (Table 1; Fig. 2).

### Multivariate logistic regression analysis on sub-cohort

Multivariate logistic regression was performed on a sub-cohort. The 12 white participants without HIV and nine other participants with missing diabetes and/ or smoking status were not included in this analysis, resulting in a total of 114 sub-cohort participants from 135 total participants. In an unadjusted analysis of the sub-cohort, RANKL ( $p=0.001$ ), mean PD ( $p=0.045$ ), number of teeth present ( $p=0.002$ ), trabecular thickness ( $p=0.024$ ), trabecular number ( $p=0.015$ ), cortical BV/TV ( $p=0.038$ ), and cortical porosity ( $p=0.038$ ) were significantly all different between women with and without HIV (Fig. 3). After adjusting for age, race/ethnicity (black/Hispanic), smoking status, and diabetes, RANKL ( $p<0.0001$ ), mean PD ( $p=0.017$ ), number of teeth present ( $p=0.012$ ), trabecular number ( $p=0.009$ ), and trabecular separation ( $p=0.044$ ) remained significant.

## Discussion

The effects of HIV infection on the alveolar bone and periodontal disease in women who have undergone the menopause transition is unknown. Therefore in this

**Table 1** Demographics, Gingival crevicular fluid biomarker cytokine levels, Periodontal and X-ray and CBCT Variables for the Full cohort of post-menopausal women with and without HIV. Biomarkers were performed for Interferon Gamma (IFN $\gamma$ ), Tumor Necrosis Factor Alpha (TNF $\alpha$ ), Interleukin (IL) 1 alpha, 2, 5, 6, 7, 8, 10, 12p70, 13, and 17 alpha, Osteoprotegerin (OPG) and Receptor Activator of Nuclear Factor Kappa Beta (RANKL). Abbreviations used are Trabecular (Trab.), Bone Volume (BV), Total Volume (TV), Cortical (Cort.) and Alveolar Crestal Height (ACH)

Full Cohort					
Variable	# Missing	All	HIV -	HIV +	p-value
N	135	59	76		
Age	0	57.04 (6.25)	57.15 (7.56)	56.95 (5.06)	0.8507
Race/Ethn	0				< 0.0001
Black		66 (48.89%)	14 (23.73%)	52 (68.42%)	
Hispanic		57 (42.22%)	33 (55.93%)	24 (31.58%)	
White		12 (8.89%)	12 (20.34%)	0 (0%)	
Smoking	7				0.3730
No		90 (70.31%)	42 (72.41%)	48 (63.16%)	
Yes		38 (29.69%)	14 (24.14%)	24 (31.58%)	
Diabetes	5				0.1014
No		104 (80.0%)	49 (83.05%)	55 (72.37%)	
Yes		26 (20.00%)	7 (11.86%)	19 (25%)	
<b>Biomarkers</b>	<b># Not Detectable</b>				
<b>pg/ml</b>					
Estadiol	20	38.29 (38.05)	43.0 (51.85)	35.16 (24.97)	0.2809
IFN g	23	1.42 (0.93)	1.44 (1.03)	1.4 (0.85)	0.8079
TNF a	20	1.32 (1.24)	1.35 (1.44)	1.3 (1.07)	0.8044
IL1 b	17	60.56 (65.58)	48.57 (56.31)	70 (71.05)	0.0780
IL2	20	0.56 (0.54)	0.5 (0.6)	0.6 (0.5)	0.3075
IL5	114	0.04 (0.03)	0.05 (0.05)	0.03 (0.01)	0.1627
IL6	21	0.71 (1.1)	0.54 (0.57)	0.85 (1.38)	0.1347
IL7	123	0.07 (0.05)	0.09 (0.05)	0.04 (0.02)	0.0749
IL8	17	586.87 (667.96)	514.26 (656.93)	644.07 (675.98)	0.2966
IL10	19	0.28 (0.25)	0.26 (0.24)	0.29 (0.25)	0.5288
IL12p70	75	0.26 (0.22)	0.31 (0.26)	0.23 (0.19)	0.2332
IL13	23	5.28 (3.35)	4.99 (3.58)	5.5 (3.18)	0.4245
IL17 a	56	0.58 (0.7)	0.6 (0.91)	0.57 (0.58)	0.8630
OPG	43	31.21 (28.55)	37.58 (42.88)	27.64 (15.12)	0.1099
RANKL	61	2.65 (3.02)	1.29 (2.14)	3.8 (3.19)	<b>0.0002</b>
<b>Periodontal Variables</b>	<b># Missing</b>				
Periodontitis	8				
Mild		7 (5.51%)	3 (5.08%)	4 (5.26%)	0.9966
Moderate		45 (35.43%)	20 (33.90%)	25 (32.89%)	
Severe		75 (59.06%)	33 (55.93%)	42 (55.26%)	
Mean AL (mm)	10	3.49 (1.13)	3.58 (1.17)	3.41 (1.1)	0.3913

**Table 1** (continued)

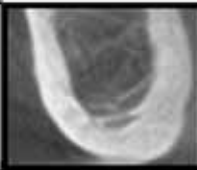
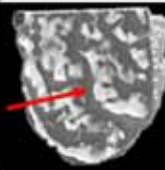
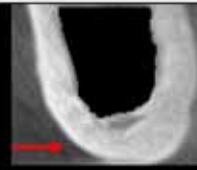
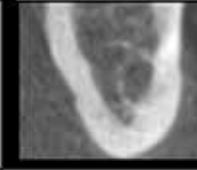
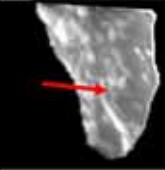
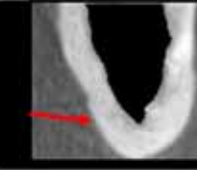
Full Cohort Variable	# Missing	All	HIV -	HIV +	p-value
<b>N</b>		<b>135</b>	<b>59</b>	<b>76</b>	
Mean PD (mm)	10	3.12 (0.92)	3.25 (1.01)	3.02 (0.83)	0.1657
% BOP	9	0.29 (0.26)	0.25 (0.23)	0.32 (0.28)	0.1680
# Teeth present	2	19.91 (7.28)	22.79 (5.7)	17.75 (7.62)	<0.0001
<b>X-ray and CBCT Variables</b>	<b># Missing</b>				
Trab BV/TV %	25	54.26 (15.74)	52.22 (16.32)	55.68 (15.29)	0.2596
Thickness (Pixels)	25	6.85 (1.57)	6.24 (1.78)	7.27 (1.25)	<b>0.0006</b>
Number (1/Pixels)	25	0.08 (0.02)	0.09 (0.02)	0.08 (0.01)	<b>0.0042</b>
Separation (Pixels)	25	8.73 (3.21)	7.99 (3.23)	9.23 (3.11)	<b>0.0450</b>
Cort BV/TV %	25	98.91 (1.59)	98.53 (1.8)	99.18 (1.38)	<b>0.0350</b>
Cort % Porosity	25	1.09 (1.59)	1.47 (1.8)	0.82 (1.38)	<b>0.0350</b>
Mean ACH (mm)	7	3.03 (1.12)	2.72 (1.01)	3.26 (1.28)	<b>0.0112</b>

study we examined the alveolar bone microarchitecture by cone beam tomography, assessed gingival crevicular fluid cytokines and performed a periodontal examination in postmenopausal women with and without HIV. We found similar to other studies [4] that there was no difference in periodontal disease activity (BOP and CAL) in postmenopausal women with and without HIV. However, we did find that postmenopausal women with HIV in our study have on average four to five fewer teeth present than women without HIV.

In contrast, in an older oral substudy of the Women's Interagency HIV Study (WIHS), they found that women with HIV had increased attachment loss, increased pocket depth and one fewer tooth present compared to women without HIV. [21, 22] The difference in the results between our study and the WIHS-Oral substudy could be attributed to age and menopausal status. The average age of participants in our study was 55 years old, whereas the average age in the WIHS-oral substudy was 37 years old at baseline. [22] Since the average age of menopause is 50 years old [23], it could be suggested that the menopause transition potentiates periodontal disease [24] in PWH. This may cause the teeth with periodontal disease to be extracted during the menopause transition in women with HIV resulting in less teeth present but better average attachment loss in postmenopausal women with HIV.

[14] After an adjusted analysis in our study, we found that postmenopausal women with HIV had a decrease in trabecular number and an increase in trabecular spacing compared to postmenopausal women without HIV. Although the association between alveolar bone microarchitecture and tooth loss, periodontal disease, or dental implant survival is not well-defined [25–27], decreased trabecular number and increased trabecular spacing at the spine and radius have been shown to increase fracture risk. [28] It can be suggested that these parameters produce a similar mechanism in alveolar bone, but future longitudinal studies are needed to determine any such relationships.

This study found that after an adjusted analysis, GCF RANKL levels remained significantly higher among in women with HIV. RANKL is the major cytokine involved in periodontal disease-associated alveolar bone resorption. [29] We have previously found that the oral microbiome in postmenopausal women with HIV with severe periodontal disease was enriched with bacteria harboring lipopolysaccharides (LPS) compared to postmenopausal women with HIV without severe periodontal disease. [30] LPS are believed to play a major role in mediating periodontal disease-associated alveolar bone loss by in part increasing RANKL expression. [31] Therefore, it could be suggested that the increased RANKL levels seen in HIV infection contribute to alveolar bone deterioration seen in PWH.

<b>2:</b> Microstructure ROI Postmenopausal Alveolar Bone	Original	Trabecular Isolation	Cortical Isolation
HIV-			
% BV/TV		52.22	98.53
HIV+			
% BV/TV		55.68	99.18
<b>BV/TV for representative samples, with arrows depicting Trabeculae and Cortical bone.</b>			

**Fig. 2** Representative Cone Beam 3-D images of the original mandibular alveolar bone and the trabecular and cortical compartments from people with HIV (PWH) and HIV-negative controls

Another explanation for fewer teeth among PWH is decreased dental care utilization, 19% of women with HIV in the US reported unmet dental needs [32] as a result of bias and/or barriers felt in seeking oral health-care. Recent studies have shown that the majority of dentists are still uncomfortable providing dental care PWH, which may delay care and treatment. [33] PWH also continue to report high levels of stigmatizing and discriminatory attitudes and behavior in the dental setting, which were strongly associated with the avoidance of dental care. [34] The results of this study add to the literature a better understanding of the impact of aging and menopause on PWH, and effects on alveolar bone. It brings to light the need for PWH to have greater access to regular dental care in order for this vulnerable population to be better served by the medical community.

The World Health Organization has identified that keeping a functional, esthetic, and natural dentition of 21 or more teeth during one's lifetime should be oral health treatment goal for everyone. [35] In our study we found that middle aged women with HIV living in New York city had on average <18 teeth present. It is generally accepted that People living with HIV on Antiretroviral therapy have accelerated biological aging. [36, 37] In a recent review, it has been suggested that the characteristics of biological aging-cellular senescence, stem cell exhaustion and immunoaging are also involved in maintaining periodontal homeostasis leading to increased tooth loss in subjects whose biological age at baseline is higher than their chronological age. [38] Other studies have shown that as people with HIV get older they are more likely to develop moderate to severe periodontal disease [39] and have increased tooth loss. [40] Therefore

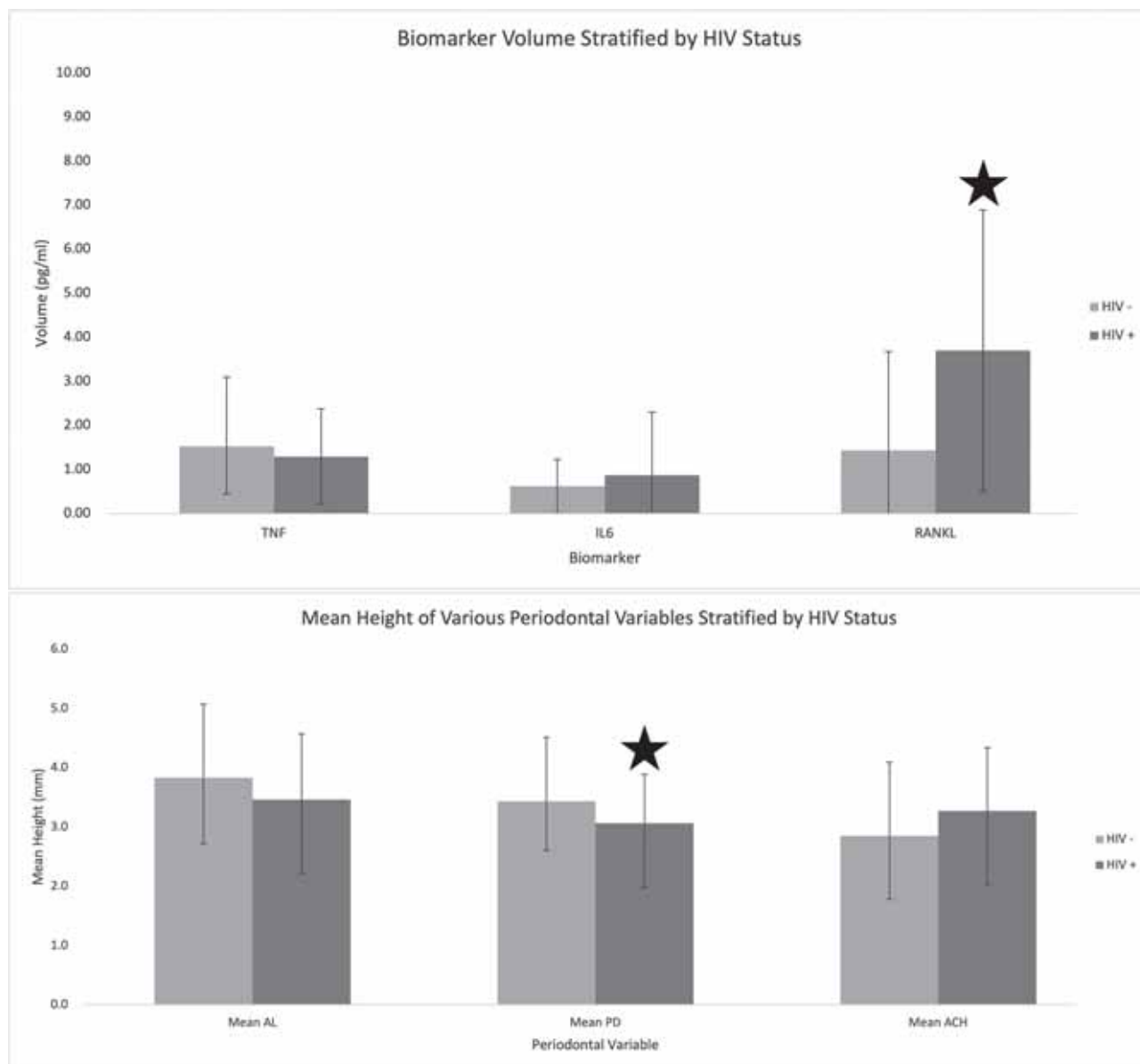
in order to maintain a functional dentition (>20 teeth present) in people with HIV throughout their lifetime, it is important to aggressively treat periodontal disease earlier to prevent future tooth loss as they potentially undergo accelerated biological cellular aging in the periodontal complex.

### Conclusion

Postmenopausal women with HIV have higher GCF RANKL levels and deterioration of the alveolar trabecular bone microarchitecture that may contribute to the observed greater tooth loss.

### Limitations

The sample size of the study was small which makes it difficult to extrapolate our data to the entire PWH population. Postmenopausal status was self-reported and not confirmed by longitudinal estradiol levels, so there is a chance of misclassification, especially in people under the age of 40. The race/ethnicity of recruited participants was biased and more representative of people attending a New York City HIV clinic and dental clinic than the general population.



**Fig. 3** Gingival crevicular fluid biomarker of bone resorption cytokine levels (TNF  $\alpha$ , IL-6, and RANKL), and Periodontal (Attachment Loss (AL), Probing Depth (PD) and Alveolar Crestal Height (ACH)) Variables on the subcohort of post-menopausal women with and without HIV ( $n=114$ ) excluding 12 white participants and 9 participants missing smoking and/or diabetes status from the full cohort. \* Significant difference  $p < 0.05$  between HIV+ vs. HIV-negative controls

#### Acknowledgements

We would like to thank Michelle Skelton DDS for technical editing and proofreading.

#### Author contributions

SW- Contributed to conception, design, data acquisition analysis and interpretation, drafted and critically revised the manuscript, T.F.- Contributed to data acquisition and interpretation, drafted and critically revised the manuscript, K.K- Contributed to data acquisition and critically revised the manuscript, S.M-Contributed to data acquisition and interpretation and critically revised the manuscript, M.L.- Contributed to data acquisition and interpretation and critically revised the manuscript, A.C.- Contributed to data acquisition and critically revised the manuscript, J.S.-Contributed to data acquisition and critically revised the manuscript, B.B.- Contributed to data analysis and critically revised the manuscript, E.L- Contributed to conception, design, and critically revised the manuscript, J.G. - Contributed to conception, design, and critically revised the manuscript,

R.D.-Contributed to data analysis and critically revised the manuscript and M.Y.- Contributed to conception, design, data acquisition analysis and interpretation, and critically revised the manuscript. All authors gave their final approval and agree to be accountable for all aspects of the work.

#### Funding

This work was supported by the National Institute of Dental and Craniofacial Research R01-DE026924 (MPI-MTY and SW)

#### Data availability

The datasets generated and/or analysed during the current study are not publicly available due to protected health information but de-identified data are available from the corresponding author on reasonable request.

## Declarations

### Ethical approval

This study was approved by the Columbia University Irving Medical Center Institutional Review Board (IRB-AA5233) and was carried out in accordance with relevant guidelines. Written informed consent was obtained from all study participants.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

Received: 4 September 2023 / Accepted: 7 December 2023

Published online: 08 January 2024

## References

- Winkler JR, Robertson PB. Periodontal Disease associated with HIV Infection. *Oral Surg Oral Med Oral Pathol.* 1992;73(2):145–50.
- Yeung SC, Stewart GJ, Cooper DA, Sindhusake D. Progression of periodontal Disease in HIV seropositive patients. *J Periodontol.* 1993;64(7):651–7.
- Baqui AA, Meiller TF, Jabra-Rizk MA, Zhang M, Kelley J, Falkler WA Jr. Enhanced interleukin 1 beta, interleukin 6 and Tumor necrosis factor alpha in gingival crevicular fluid from periodontal pockets of patients infected with human immunodeficiency virus 1. *Oral Microbiol Immunol.* 2000;15(2):67–73.
- Ntolou P, Pani P, Panis V, Madianos P, Vassilopoulos S. The effect of antiretroviral therapy on the periodontal conditions of patients with HIV Infection: a systematic review and meta-analysis. *J Clin Periodontol.* 2023;50(2):170–82.
- Wandeler G, Johnson LF, Egger M. Trends in life expectancy of HIV-positive adults on antiretroviral therapy across the globe: comparisons with general population. *Curr Opin HIV AIDS.* 2016;11(5):492–500.
- Raffe S, Sabin C, Gilheee Y. Women against viruses in Europe EACS: Comorbidities in women living with HIV: a systematic review. *HIV Med.* 2022;23(4):331–61.
- Sarafrazi N, Wambogo EA, Shepherd JA. Osteoporosis or Low Bone Mass in older adults: United States, 2017–2018. *NCHS Data Brief* 2021;(405):1–8.
- Greendale GA, Sowers M, Han W, Huang MH, Finkelstein JS, Crandall CJ, Lee JS, Karlamangla AS. Bone mineral density loss in relation to the final menstrual period in a multiethnic cohort: results from the study of women's Health across the Nation (SWAN). *J Bone Miner Res.* 2012;27(1):111–8.
- Enezei HH, Khalil AA, Naif TN. A clinical analysis of surgically managed Mandibular fractures: Epidemiology, Clinical Profile, patterns, treatments, and outcomes. *Int Med J.* 2020;27(4):1–4.
- Ko YC, Tsai MT, Fuh LJ, Tsai MJ, Wang XH, Huang HL, Hsu JT. Association between Age of Menopause and Thickness of Crestal cortical bone at Dental Implant Site: a cross-sectional observational study. *Int J Environ Res Public Health* 2020, 17(16).
- Hileman CO, Eckard AR, McComsey GA. Bone loss in HIV: a contemporary review. *Curr Opin Endocrinol Diabetes Obes.* 2015;22(6):446–51.
- Yin MT, McMahon DJ, Ferris DC, Zhang CA, Shu A, Staron R, Colon I, Laurence J, Dobkin JF, Hammer SM, et al. Low bone mass and high bone turnover in postmenopausal human immunodeficiency virus-infected women. *J Clin Endocrinol Metab.* 2010;95(2):620–9.
- Yin MT, Zhang CA, McMahon DJ, Ferris DC, Irani D, Colon I, Cremers S, Shane E. Higher rates of bone loss in postmenopausal HIV-infected women: a longitudinal study. *J Clin Endocrinol Metab.* 2012;97(2):554–62.
- Sharma A, Hoover DR, Shi Q, Tien PC, Weber KM, Shah JG, Yin MT. Human immunodeficiency virus (HIV) and menopause are independently Associated with Lower Bone Mineral density: results from the women's interagency HIV Study. *Clin Infect Dis.* 2022;75(1):65–72.
- Qi J, Chen J, Pang Y, Guo Y, Chen G, Liu Y, Wang J, Liu E. Association between periodontal Disease and osteoporosis in postmenopausal women: a systematic review and meta-analysis. *Heliyon.* 2023;9(11):e20922.
- Wadhwa SKG, Reiss S, Finkel A, Yin MT. Increased alveolar crestal bone loss in older HIV-infected women. *NY State Dent J.* 2017;83(5):22–6.
- Page RC, Eke PI. Case definitions for use in population-based surveillance of periodontitis. *J Periodontol.* 2007;78(7 Suppl):1387–99.
- Wactawski-Wende J, Hausmann E, Hovey K, Trevisan M, Grossi S, Genco RJ. The association between osteoporosis and alveolar crestal height in postmenopausal women. *J Periodontol.* 2005;76(11 Suppl):2116–24.
- Wadhwa S, Dave S, Daily ML, Nardone A, Li R, Rosario J, Cantos A, Shah J, Lu HH, McMahon DJ, et al. The role of oral health in the Acquisition and Severity of SARS-CoV-2: a Retrospective Chart Review. *Saudi Dent J.* 2022;34(7):596–603.
- Wadhwa S, Levit M, Matsumura S, Hsieh SJ, Kister K, Silva C, Shah J, Cantos A, Bohn B, Demmer RT et al. Evaluation of the mandibular condylar bone microarchitecture in people living with HIV. *Oral Dis* 2023.
- Alves M, Mulligan R, Passaro D, Gawell S, Navazesh M, Phelan J, Greenspan D, Greenspan JS. Longitudinal evaluation of loss of attachment in HIV-infected women compared to HIV-uninfected women. *J Periodontol.* 2006;77(5):773–9.
- Mulligan R, Phelan JA, Brunelle J, Redford M, Pogoda JM, Nelson E, Seirawan H, Greenspan JS, Navazesh M, Greenspan D, et al. Baseline characteristics of participants in the oral health component of the women's interagency HIV Study. *Community Dent Oral Epidemiol.* 2004;32(2):86–98.
- Cramer DW, Xu H. Predicting age at menopause. *Maturitas.* 1996;23(3):319–26.
- Peng J, Chen J, Liu Y, Lyu J, Zhang B. Association between periodontitis and osteoporosis in United States adults from the National Health and Nutrition Examination Survey: a cross-sectional analysis. *BMC Oral Health.* 2023;23(1):254.
- Monje A, Chan HL, Galindo-Moreno P, Elnayef B, Suarez-Lopez del Amo F, Wang F, Wang HL. Alveolar bone architecture: a systematic review and meta-analysis. *J Periodontol.* 2015;86(11):1231–48.
- Zhu L, Zhou C, Chen S, Huang D, Jiang Y, Lan Y, Zou S, Li Y. Osteoporosis and Alveolar Bone Health in Periodontitis Niche: a predisposing factors-centered review. *Cells.* 2022;11(21):3380.
- Jonasson G, Rythén M. Alveolar bone loss in osteoporosis: a loaded and cellular affair? *Clin Cosmet Invest Dentistry* 2016:95–103.
- Samelson EJ, Broe KE, Xu H, Yang L, Boyd S, Biver E, Szulc P, Adachi J, Amin S, Atkinson E, et al. Cortical and trabecular bone microarchitecture as an Independent predictor of incident fracture risk in older women and men in the bone microarchitecture International Consortium (BoMIC): a prospective study. *Lancet Diabetes Endocrinol.* 2019;7(1):34–43.
- Tsukasaki M. RANKL and osteoimmunology in periodontitis. *J Bone Miner Metab.* 2021;39(1):82–90.
- Annajjala MK, Khan SD, Sullivan SB, Shah J, Pass L, Kister K, Kunen H, Chiang V, Monnot GC, Ricupero CL et al. Oral and gut microbial diversity and Immune Regulation in patients with HIV on antiretroviral therapy. *mSphere* 2020, 5(1).
- Cheng X, Zhou X, Liu C, Xu X. Oral osteomicrobiology: the role of oral microbiota in alveolar bone homeostasis. *Front Cell Infect Microbiol.* 2021;11:751503.
- Parish CL, Feaster DJ, Pereyra MR, Alcaide ML, Weber KM, Cohen M, Levin S, Gustafson D, Merenstein D, Aouizerat BE, et al. Oral health-related quality of life and unmet dental needs among women living with HIV. *J Am Dent Assoc.* 2020;151(7):527–35.
- Yuvaraj A, Mahendra VS, Chakrapani V, Yuniastuti E, Santella AJ, Ranauta A, Doughty J. HIV and stigma in the healthcare setting. *Oral Dis.* 2020;26(Suppl 1):103–11.
- Okala S, Doughty J, Watt RG, Santella AJ, Conway DI, Crenna-Jennings W, Mbewe R, Morton J, Lut I, Thorley L, et al. The people living with HIV STIGMASurvey UK 2015: stigmatising experiences and dental care. *Br Dent J.* 2018;225(2):143–50.
- Hobdell M, Petersen PE, Clarkson J, Johnson N. Global goals for oral Health 2020. *Int Dent J.* 2003;53(5):285–8.
- Akusjarvi SS, Neogi U. Biological aging in people living with HIV on successful antiretroviral therapy: do they age faster? *Curr HIV/AIDS Rep.* 2023;20(2):42–50.
- Faulhaber JR, Baffoe-Bonnie AW, Oursler KK, Vasudeva SS. Update in human immunodeficiency virus and aging. *Infect Dis Clin North Am.* 2023;37(1):153–73.
- Baima G, Romandini M, Citterio F, Romano F, Aimetti M. Periodontitis and Accelerated Biological aging: a Geroscience Approach. *J Dent Res.* 2022;101(2):125–32.
- Pereira LL, Veiga Siqueira Amorim D, Brito Sampaio W, Almeida Cruz Azevêdo T, Bispo Pereira Cardoso V, Barreto Lemos F, Silva Chang A, Machado F, Pereira Lima F, Sampaio Neves F, et al. Factors Associated with Periodontitis in patients with and without HIV. *Int J Dent.* 2023;2023:9929835.

40. Shaghaghian S, Homayooni M, Amin M, Rezazadeh F. Oral health status of patients infected with human immunodeficiency virus and related factors, Iran: a cross-sectional study. *BMC Oral Health*. 2021;21(1):657.

### **Publisher's Note**

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

RESEARCH REPORT

# Experiences with and Outcomes of Oral Health Care

## Perspectives from Nationally Representative Data

SUGGESTED CITATION:

Heaton, Lisa J., Santoro, Morgan, Martin, Paige, and Tranby, Eric P. *Experiences with and Outcomes of Oral Health Care: Perspectives from Nationally Representative Data*. Boston, MA: March 2024. DOI: 10.35565/CQI.2024.2001

Copyright © 2024 CareQuest Institute for Oral Health, Inc.



## Authors

### **Lisa J. Heaton, PhD**

Science Writer, Analytics and Data Insights  
CareQuest Institute for Oral Health

### **Morgan Santoro, MPH**

Biostatistician, Analytics and Data Insights  
CareQuest Institute for Oral Health

### **Paige Martin, BA**

Science Writer, Analytics and Data Insights  
CareQuest Institute for Oral Health

### **Eric P. Tranby, PhD**

Director, Analytics and Data Insights  
CareQuest Institute for Oral Health

## Acknowledgments

### **Kaz Rafia, DDS, MBA, MPH**

Chief Health Equity Officer, Executive Vice President  
CareQuest Institute for Oral Health

### **Lyubov Slashcheva, DDS, MS**

Research Director, Dentist  
Apple Tree Dental

### **Rebekah Mathews, MPA**

Vice President, Health Transformation  
CareQuest Institute for Oral Health

### **Danielle Apostolon, BBA**

Program Manager — Value-Based Care, Health Transformation  
CareQuest Institute for Oral Health

### **Andrea Clark, MS**

Director, Health Care Economics, Health Transformation  
CareQuest Institute for Oral Health

### **Renee J. Clark, BS**

Care Coordination and Interoperability Manager,  
Health Transformation  
CareQuest Institute for Oral Health

### **Christine Kanan, BS**

Senior Manager, Implementation, Health Transformation  
CareQuest Institute for Oral Health

### **Caroline McLeod, MPH**

Value-Based Solutions Manager, Health Transformation  
CareQuest Institute for Oral Health

We would like to acknowledge the Health Transformation team at CareQuest Institute for Oral Health for their thoughtful contributions to this report.



## Introduction

Only 43% of the United States population [had a dental visit in 2021](#). Individuals identifying as Black or Hispanic had the lowest rates of dental visits (32% and 29%, respectively), while those identifying as white had the highest rate (51%). Approximately one in five people with an annual income at or below the federal poverty level (FPL) had a dental visit (26%) in 2021, while more than half (55%) of those at 400% or more of the FPL did. Barriers to oral health care access relate to [cost of care](#), [lack of adequate insurance coverage](#), [discrimination](#), and [geographic factors](#), to name just a few. Understanding individuals' perceptions of the oral health care system and their unique experiences navigating the system's challenges are critical first steps to addressing these disparities. The nationally representative, annual State of Oral Health Equity in America (SOHEA) survey asks adult respondents about their experiences with and attitudes toward oral health care. This report presents findings on the concept of value-based care

**Barriers to oral health care access relate to cost of care, lack of adequate insurance coverage, discrimination, and geographic factors, to name just a few.**

and on key components of an effective and person-centered approach to oral health: medical-dental integration,<sup>1</sup> minimally invasive care,<sup>2</sup> teledentistry,<sup>3</sup> and patient experiences within the oral health care setting.

1 [Medical-dental integration](#) involves integration of medical, dental, and sometimes behavioral care to provide whole-person care for each patient. Medical-dental integration increases access to oral and overall health care, improves patient experiences in the health care setting, and reduces costs.

2 [Minimally invasive care](#) involves techniques such as counseling about oral hygiene habits and the application of topical, noninvasive substances that arrest the caries process without requiring anesthesia or drilling. The goal of minimally invasive care is to prevent and heal dental caries lesions through interventions that do not involve removing any tooth structure.

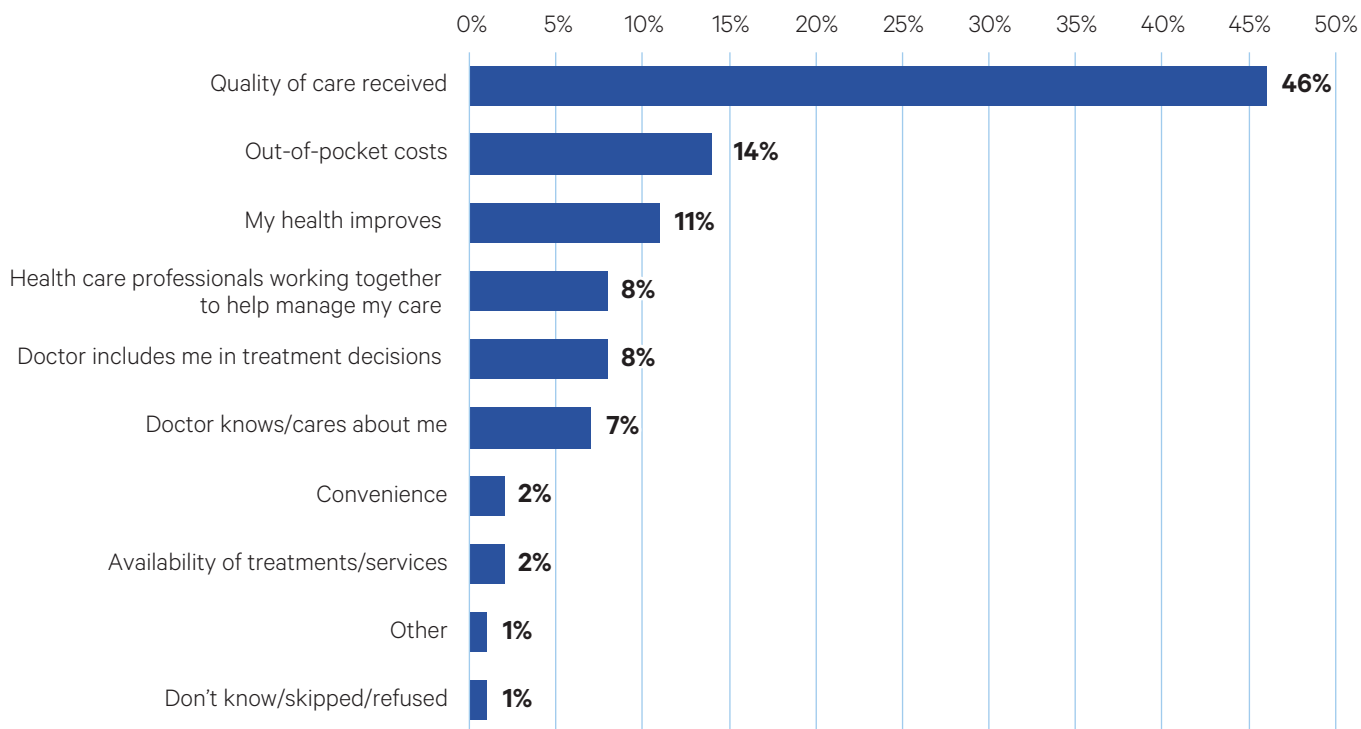
3 [Teledentistry](#) refers to the use of telehealth systems and methodologies that virtually connect individuals with oral health providers. These systems may involve real-time, synchronous discussions between providers and patients using telephone or video technology or asynchronous methods by which photos, videos, or other information is sent to the oral health provider to assist in treatment planning.

# Value and Value-Based Care in Oral Health Care

Value-based care (VBC) is a health care model that [emphasizes and incentivizes the quality of patient health outcomes](#). Value-based care prioritizes quality of patient health care (including preventive care) and outcomes over fee-for-service models, in which reimbursements favor volume over quality of care. More SOHEA respondents believe their oral health provider makes treatment decisions based on what is best for their care (78%) than on what is most profitable for the provider (22%). Respondents are more likely to say that their oral health provider makes decisions based on what is most profitable if they live in urban areas; have not had a dental visit in at least a year; had an oral health symptom in the past year; or do not have a regular source of dental care (i.e., a dental home). See [Appendix A1](#).

Similarly, when respondents were asked what they associate most with value when thinking about their overall health care, the answers were more likely to involve quality of care (46%) than out-of-pocket costs (14%) or health improvement (11%). Adults are more likely to associate quality of care with value if they earn \$30,000 or more annually (compared to \$30,000 or less) or have at least some college education (compared to those with less than a high school education). Those aged 60 or older (compared to those aged 18–29), those who did not have a dental visit in at least a year (compared to those with a dental visit in the last year), and those who do not have a usual source of dental care (compared to those with a dental home) are less likely to associate quality of care with value ([Appendix A2](#)).

## Which do you associate most with value when thinking about your overall health care?

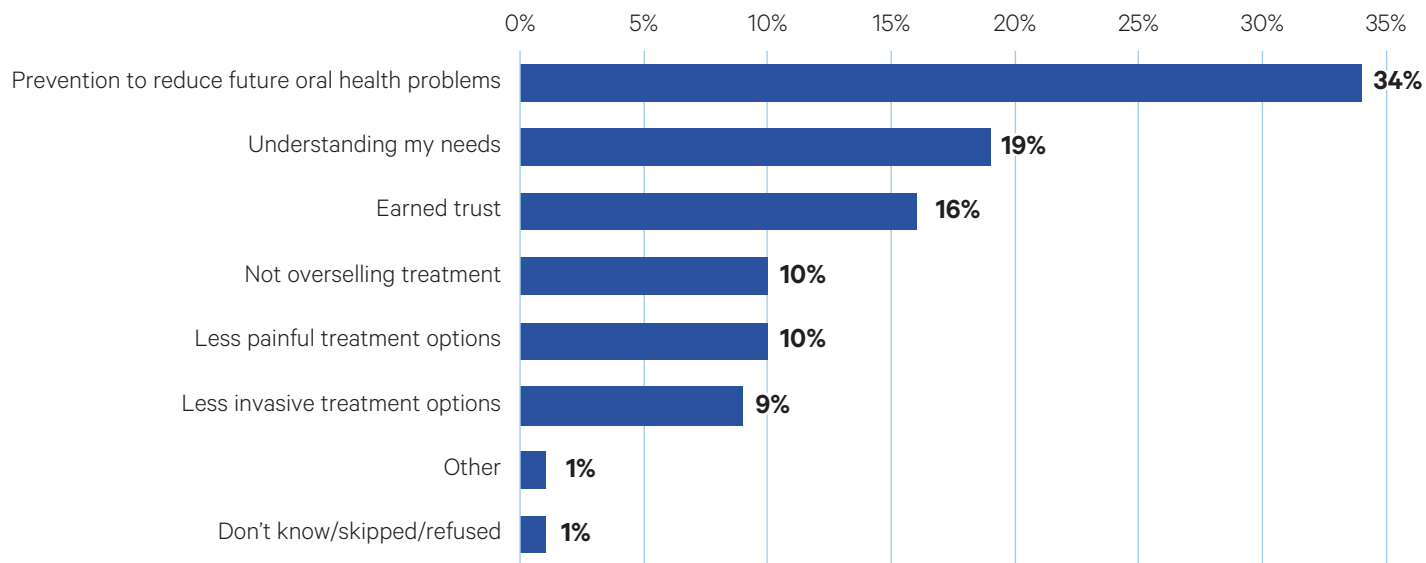


Adults emphasized a desire for prevention-focused, person-centered care from an oral health provider. One-third of adults say that, when receiving oral health care, preventing future oral health problems is most important (34%), followed by the oral health provider understanding their needs (19%) and earning their trust (16%).

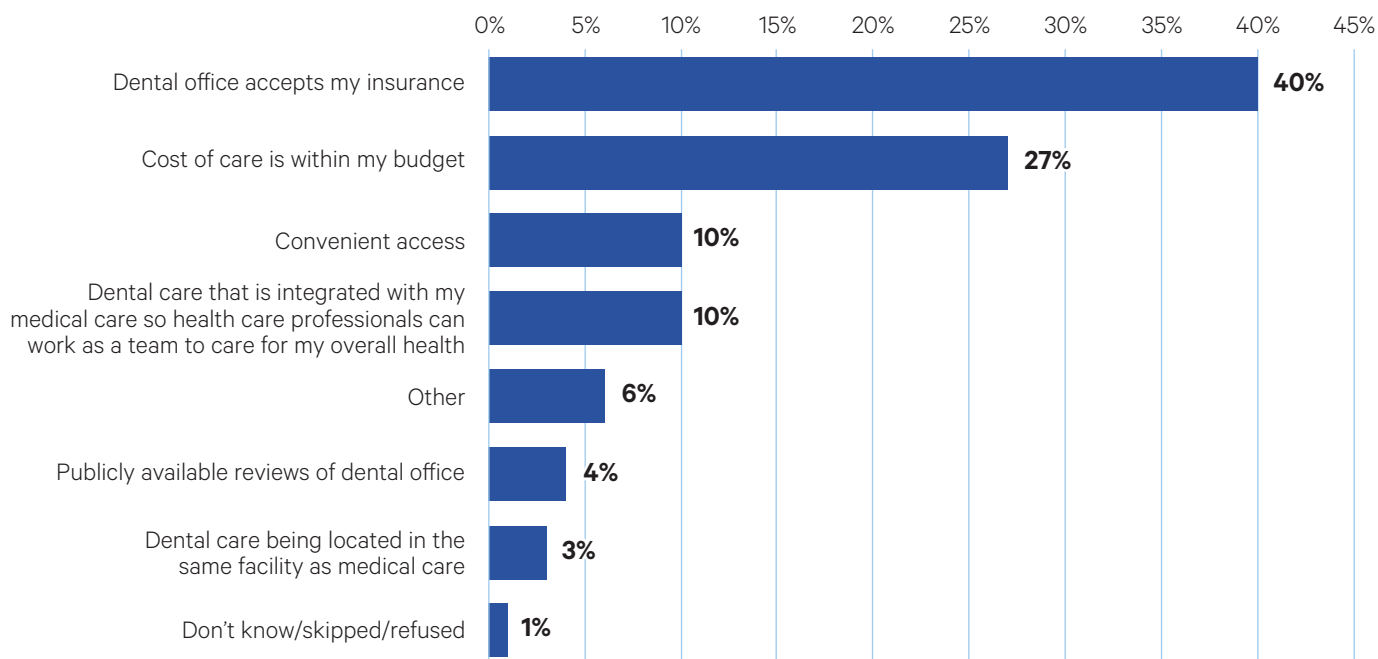
Meanwhile, adults are still concerned about cost when choosing where to seek oral health care. Forty percent of adults say that whether a dental office accepts their insurance

is the most important factor when choosing where to receive dental care, followed by whether the cost of care falls within their budget (27%). Adults are more likely to say that whether the dental office accepts their insurance is the most important factor in choosing where to receive care if they earn \$30,000–\$60,000 annually. They are less likely to say the same if they are 60 years old or older; identify as Black or Asian (as opposed to white); do not have dental insurance; or have a bachelor’s degree ([Appendix A3](#)).

**What is most important to you when you think about receiving dental care from an oral health provider?**

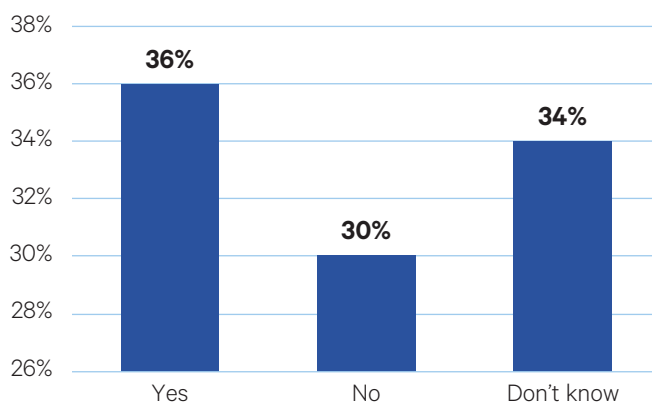


**What is most important to you when you think about choosing where to receive dental care?**



Finally, payment for value-based models of care in oral health is still new for many adult health care consumers who were surveyed. Adults are split on whether they think insurance companies should financially reward oral health providers for good patient health outcomes. Approximately one-third agree with this reimbursement plan (36%), one-third disagree (30%), and one-third are uncertain (34%). Adults are more likely to say that insurance companies should not reward oral health providers for their patients' health if they are female (compared to male); do not have dental insurance; earn \$30,000 or more annually; have a high school education; or do not have a dental home. Adults identifying as Black, Hispanic, or Asian are less likely to say that oral health providers should not be financially rewarded for their patients' health ([Appendix A4](#)).

**Do you think oral health providers should be financially rewarded by insurance companies for how healthy their patients are?**



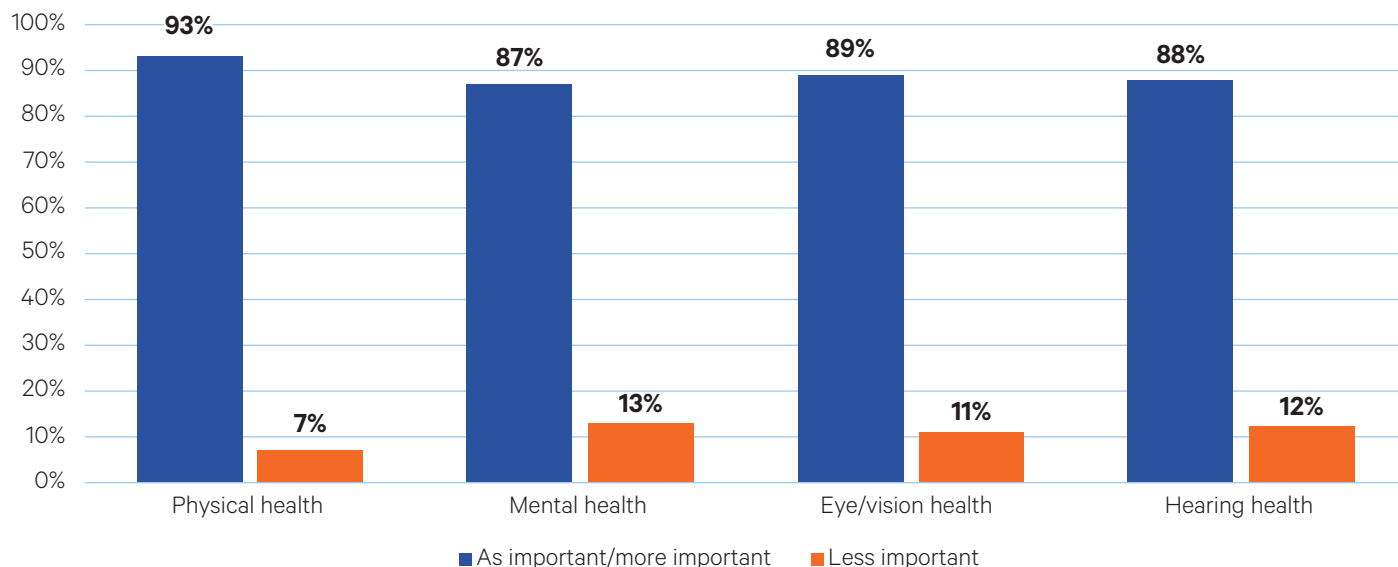
## Medical-Dental Integration

The [integration of medical and dental care](#) increases access to oral and overall health care, improves patient experiences in the health care setting, and reduces costs. Comprehensive health care involves integration of medical, dental, and behavioral care to provide whole-person care for each patient. This can involve [medical and dental care colocated in the same clinic](#), integrated electronic health records (EHRs) that allow medical and dental providers to access each other's clinical notes for their shared patients, and bidirectional referrals between medical and dental providers to ensure comprehensive care for their patients. As [oral health is inextricably linked to overall health](#), oral health

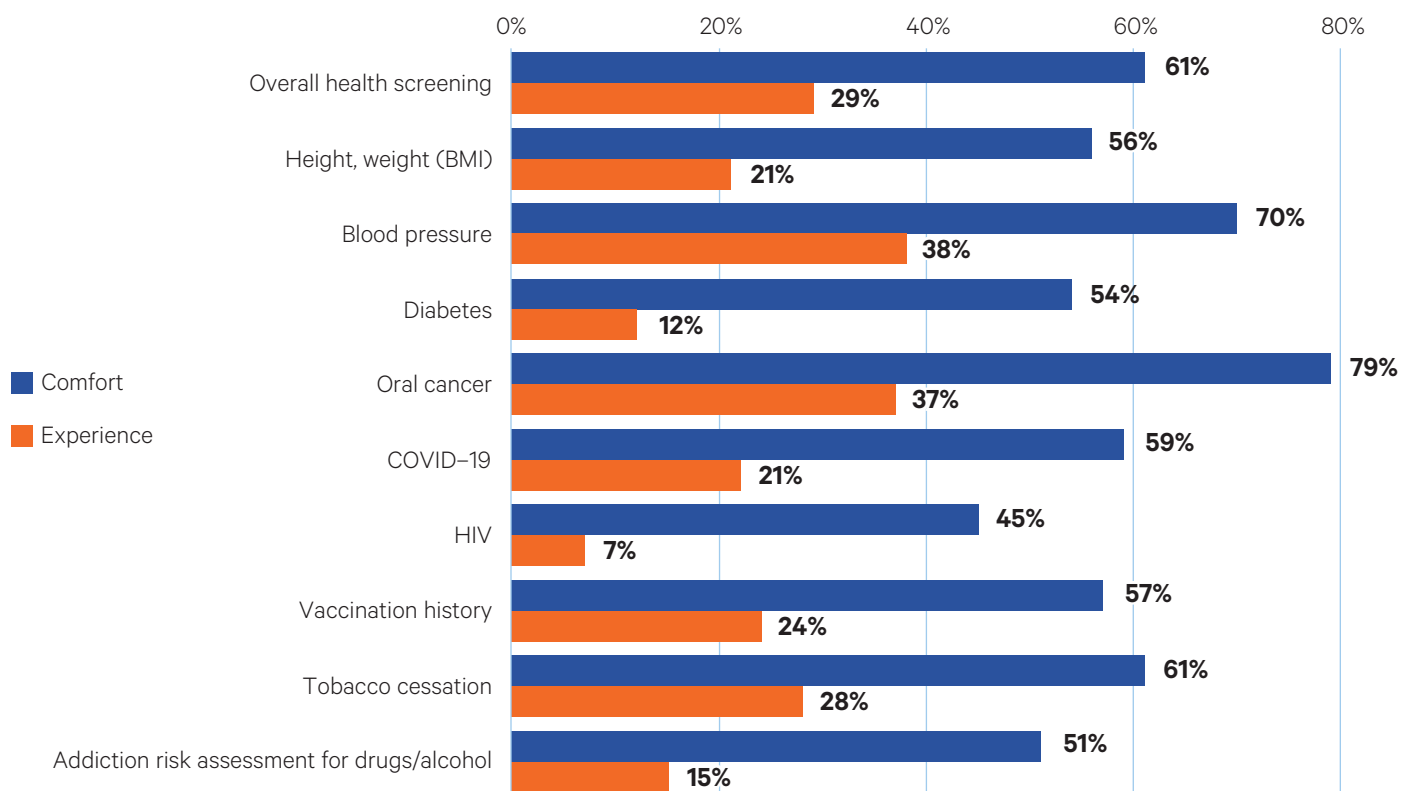
care should be provided as a part of comprehensive health care, whether the physical practice settings are colocated or separate.

Adults understand the significance of oral health within the context of overall health and see the two as equal in importance. Most adults say that oral health is at least as important to the overall health of a person as physical health (93%), mental health (87%), eye/vision health (89%), and hearing health (88%).

**Compared to the following types of personal health, how important is oral health to the overall health of a person?**



### Experience / Comfort with Health Screenings in the Dental Setting (Yes)



### Screening for Systemic Health Conditions in the Oral Health Setting

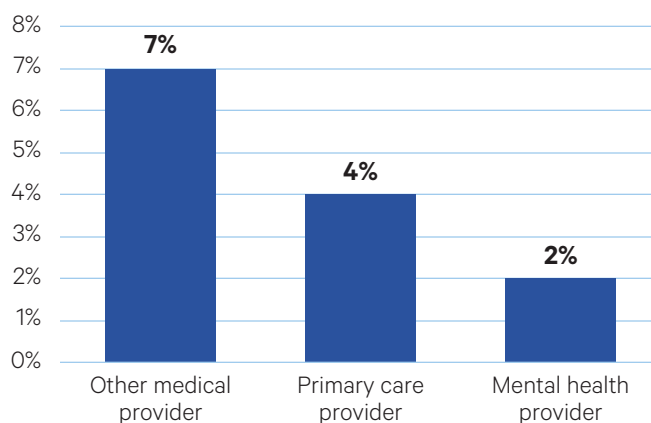
As evidence of adults' understanding of the links between oral and overall health, at least half of adults say they are comfortable with their oral health provider screening them for various systemic health conditions in the dental setting. Comfort with screenings in the dental setting ranged from 79% for oral cancer and 70% for blood pressure to 45% for HIV and 54% for diabetes. It may be that adults are less comfortable with HIV and diabetes screenings in the dental setting as these blood tests are somewhat more invasive than other types of health screenings.

Although many adults say they are comfortable with their oral health provider screening them for systemic health conditions, most say they have not experienced such screenings in the dental office. Just over one-third of adults say they have had their blood pressure taken (38%) and have been screened for oral cancer (37%) by their oral health provider. Only about 1 in 10 adults have been screened for diabetes (12%), and only 7% have been screened for HIV. Screening patients at risk for diabetes in the dental office can [identify previously undiagnosed disease](#), and screening for HIV can [increase access to testing in underserved communities](#).

### Referrals from Oral Health Care Providers to Other Health Care Providers

Although adults are aware of the connection between oral and overall health, referrals between oral health providers and other types of health care providers rarely occur. Only 4% of adults say they have been referred to a primary care provider by their oral health provider. In comparison, 7% say they have received a referral to another health care professional. Only 2% say their oral health provider has referred them to a mental health provider.

### Has your dentist ever referred you to any of the following?



Adults aged 45 years or older are more likely to say their oral health provider has not referred them to a *primary care provider*. Individuals are less likely to say their oral health provider has not referred them to a primary care provider if they identify as Black, Hispanic, or Asian, or if they had at least one oral health problem in the past year (compared to those who did not have an oral health problem in the past year; [Appendix B1](#)). Females and adults earning \$60,000 or more annually are more likely to say their oral health provider has not referred them to a *mental health provider*. Adults are less likely to report this type of referral if they identify as Black or Hispanic or if they had at least one oral health problem in the past year ([Appendix B2](#)). Adults are more likely to say their dentist did not refer them to *another type of medical provider* if they are female; identify as Hispanic; earn \$30,000 to \$60,000 annually; have a high school education or some college/associate’s degree; or did not have a dental visit in the last year (compared to those with a dental visit in the last year; see [Appendix B3](#)). Adults are less likely to report that they were referred to another type of medical provider if they live in suburban or urban areas (compared to rural areas) and had at least one oral health problem in the past year.

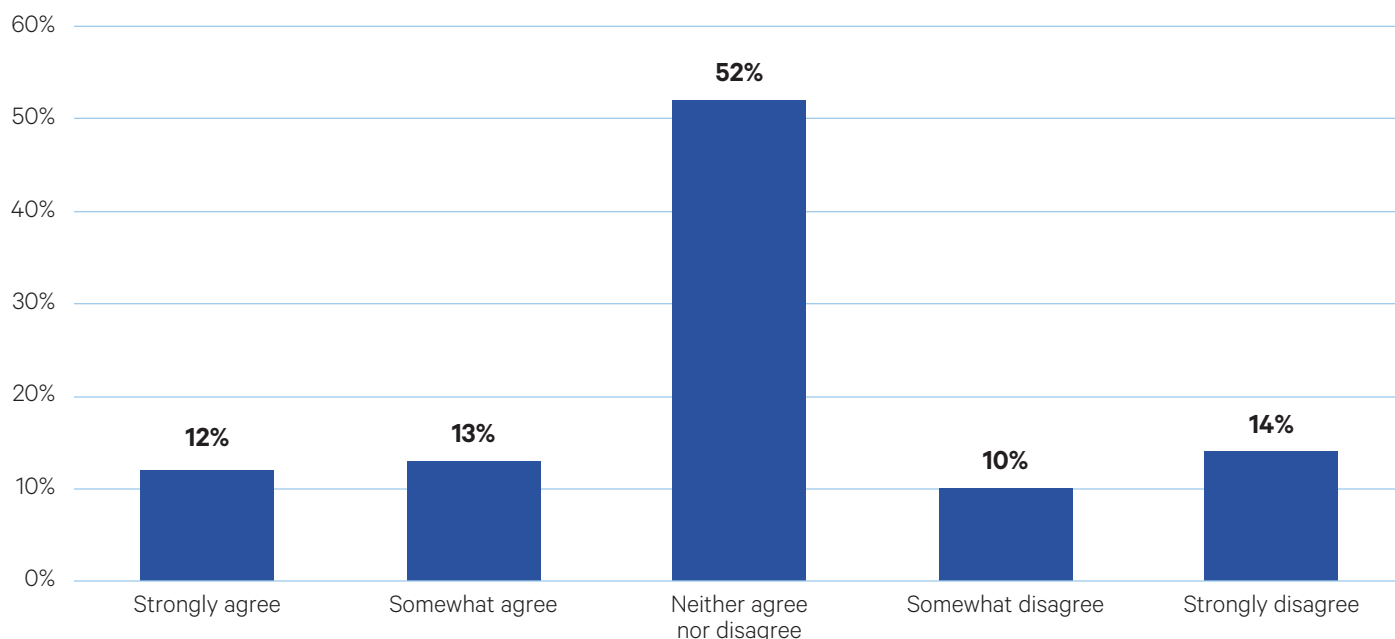
Adults have mixed feelings about whether they would be more likely to seek oral health care if their oral health provider and primary care physician were in the same office. While 25%

agree or strongly agree such colocation would improve their likelihood of receiving oral health care, and 24% disagree or strongly disagree with this statement, more than half neither agree nor disagree with this idea (52%).

When asked whether they agree with the statement, “*I would be more likely to seek dental care if my dentist and doctor were located in the same office,*” adults are less likely to agree if they are 60 years of age or older; female; earn \$30,000 or more annually; or have a high school education or more. Adults are more likely to agree with this idea if they identify their race/ethnicity as Black, Hispanic, Asian, or “other”; live in suburban or urban areas; have not seen a dentist in a year or more; or had at least one oral health problem in the last year ([Appendix B4](#)).

Although adults are mixed on whether their oral health care and overall health care should be co-located, most say they would prefer their medical and dental insurance to be provided through the same insurance company (70%). Adults are less likely to prefer these two types of insurance to be provided through the same company if they identify their race/ethnicity as Black, Hispanic, or Asian; do not have dental insurance; earn \$100,000 or more; or do not have a dental home. Individuals are more likely to want this shared insurance scenario if they have not seen a dentist in at least a year ([Appendix B5](#)).

**I would be more likely to seek dental care if my dentist and doctor were located in the same office**



### Vaccinations in the Oral Health Care Setting

Oral health providers, primarily dentists, have been allowed to give certain vaccinations (e.g., influenza, human papillomavirus [HPV]) in several states and under limited circumstances. In early 2021, the US Department of Health and Human Services [authorized dentists and dental students to provide COVID-19 vaccinations](#) in order to boost the number of health care professionals available to administer the vaccine. This authorization expired with the end of the federal public health emergency in April 2023. As of 2023, the [number of states allowing dentists to provide vaccinations has increased](#), and additional legislation is pending.

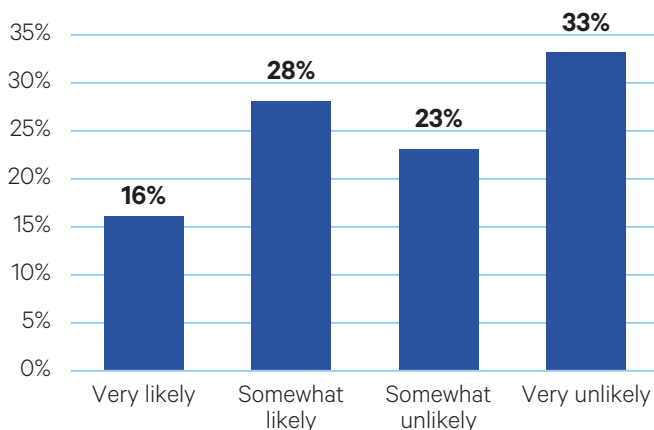
Adults’ opinions about receiving vaccinations from their oral health providers are mixed. While 44% of adults say they receive a seasonal flu vaccine every year, only 26% say they would consider accepting the flu vaccine from their dentist. Adults are less likely to consider obtaining a flu vaccine from their oral health provider if they are female; did not have a dental visit in the last year; or do not have a dental home. Adults aged 60 or above, those earning \$100,000 or more annually, and adults with at least some college are more likely to consider receiving a flu vaccine from their oral health provider ([Appendix B6](#)).

HPV is linked to approximately 70% of cases of oropharyngeal cancer in the US, and the [HPV vaccine protects against the HPV types that cause oropharyngeal cancers](#). Three-quarters of adults think that the HPV vaccine is very or somewhat important for preventing oral and throat cancer (75%). However, only 6% of adults say their oral health provider has ever mentioned the HPV vaccine to them, and only 8% say an oral health provider has mentioned vaccinating their child for HPV.

Adults are less likely to consider oral health providers as qualified to educate patients about HPV if they are between 30–59 years of age; are female; or identify as Hispanic. Adults aged 60 or older and those who have a bachelor’s degree or higher are more likely to say oral health providers are qualified to educate patients about HPV ([Appendix B7](#)). While 50% of adults believe that oral health providers are qualified to educate patients about HPV, 56% are somewhat or very unlikely to consent to having their child receive the HPV vaccination if their oral health provider recommends it. There were no significant differences among demographic groups in terms of likelihood to consent to this ([Appendix B8](#)).

## Adults’ opinions about receiving vaccinations from their oral health providers are mixed.

How likely are you to consent to HPV vaccine for your child if an oral health care provider recommends it?





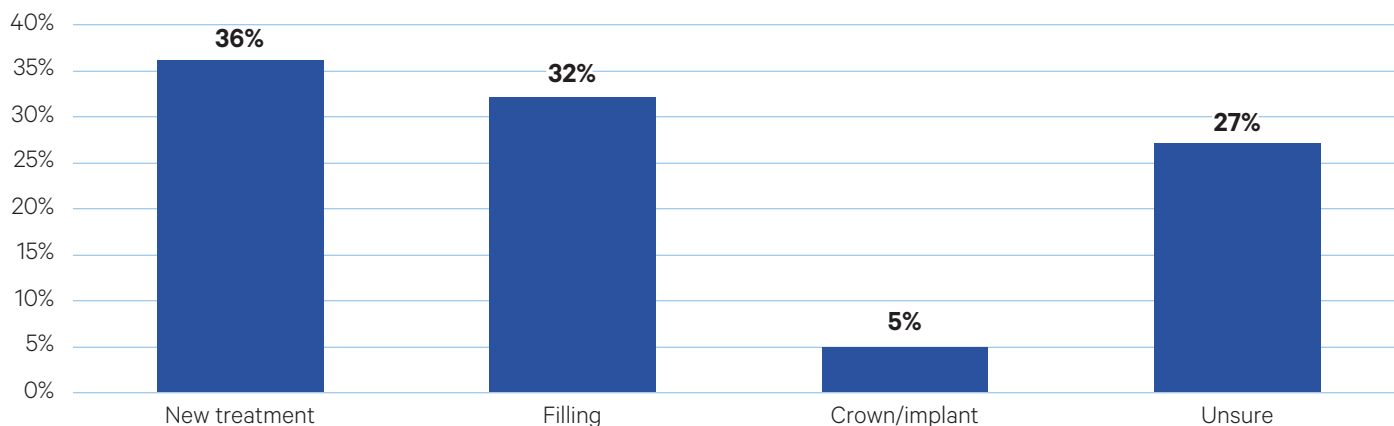


## Minimally Invasive Care

The [goal of minimally invasive care](#) is to prevent and heal dental caries lesions through interventions that do not involve removing any tooth structure. Minimally invasive care involves techniques such as counseling about oral hygiene habits and the application of topical, noninvasive substances that arrest the caries process without requiring anesthesia or drilling. Adults' perceptions of a minimally invasive treatment for dental decay, such as [silver diamine fluoride](#), are mixed. The concept of minimally invasive care was described this way to survey respondents: "Cavities are caused by germs that produce

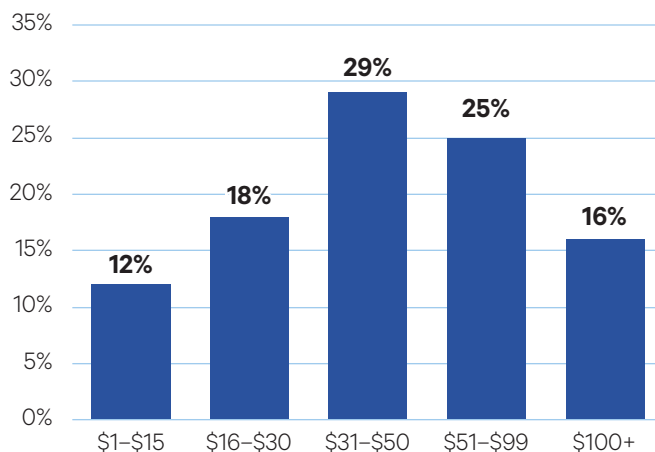
acid that breaks down the teeth. There is a new way to treat cavities, by painting liquid on the cavity to stop it from getting worse. However, in some cases, you may need to have a filling at a later date if the cavity does not stop getting worse. If you had cavities on your teeth, would you choose this new treatment, a filling, or a crown/implant?" In response to this question, 36% of adults say they would opt for the minimally invasive treatment to stop or arrest the caries (decay) process, 32% would choose a filling, 27% are unsure, and 5% would choose a crown or implant.

**If you had cavities on your teeth, would you choose this new treatment, a filling, or a crown/implant?**



Adults identifying as Asian are more likely to choose a filling over other options. Adults are less likely to select a filling if they are 30 years of age or older; identify as female; earn between \$30,000 and \$60,000 annually; have a high school education or more; did not have a dental visit in at least a year; or had at least one oral health symptom in the past year ([Appendix C1](#)). Adults identifying as Black and those experiencing an oral health problem in the last year are more likely to choose a crown or implant over other options. Adults are less likely to choose a crown or implant over alternatives if they are aged 60 or over; identify as female; earn \$30,000 or more annually; or have a high school education or more ([Appendix C2](#)). For those who would opt for the minimally invasive treatment, more than half would be willing to pay between \$31–\$99 out of pocket for this treatment.

#### How much out of pocket would you be willing to pay for this treatment?



## Teledentistry

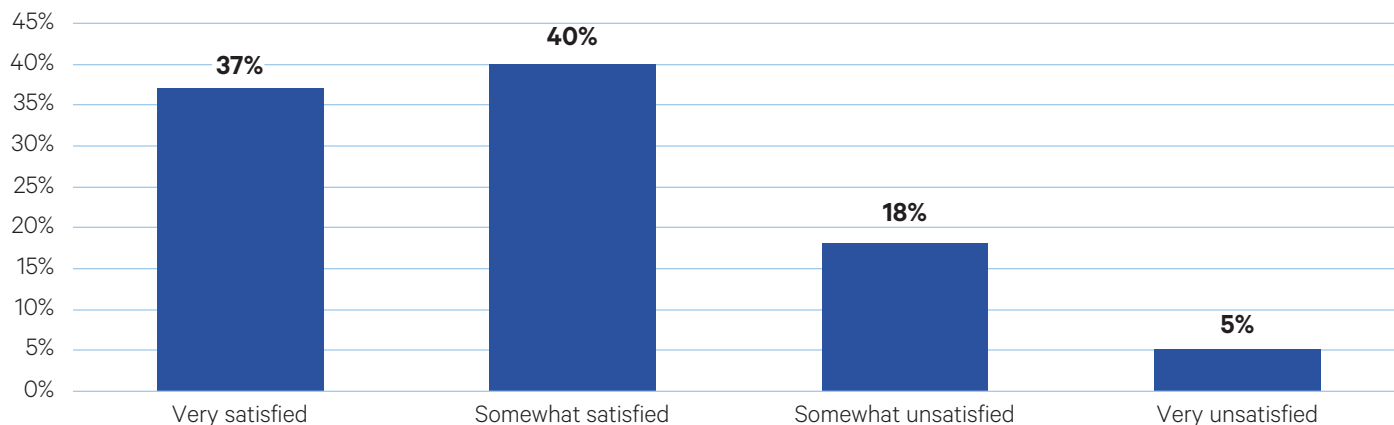
Teledentistry refers to the use of [telehealth systems and methodologies](#) that virtually connect individuals with oral health providers. These systems may involve real-time, synchronous discussions between providers and patients using telephone or video technology or asynchronous methods by which photos, videos, or other information is sent to the oral health provider to assist in treatment planning. The use of [teledentistry increased significantly during the COVID-19 pandemic](#) when dental offices were closed for all but emergent care. Since the pandemic, providers have continued to use this technology to help [reduce barriers to oral health care for underserved populations](#).

Of the adults completing the survey, only 185 (4%) say they have had a teledentistry visit at some point; more than two-thirds say this teledentistry visit occurred in the previous year (69%). One-third had a teledentistry visit via telephone (33%), while 28% saw an oral health provider through a video application (e.g., Zoom). Adults are more likely to have had a teledentistry visit if they are over the age of 45; identify

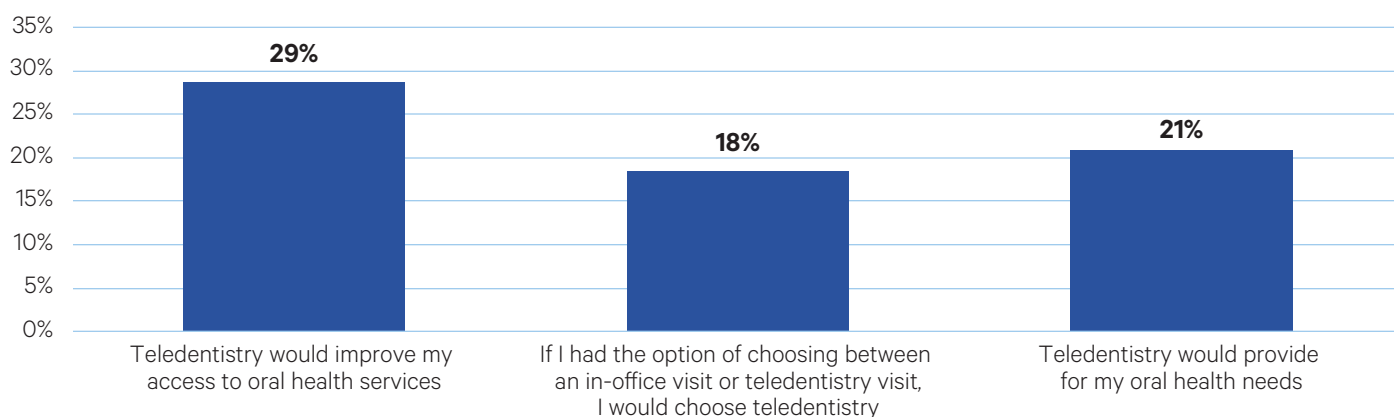
as female; live in nonmetro areas; earn more than \$30,000 annually; have at least some college education; or do not have a dental home. Adults are less likely to have had a teledentistry visit if they identify their race/ethnicity as Black, Hispanic, or Asian; do not have dental insurance; have not seen a dentist in a year or more; or had an oral health problem in the last year ([Appendix D1](#)).

Compared to a face-to-face oral health visit, the majority of adults say their teledentistry visit was the same (46%) or better (35%). Less than one in five adults say they are very or somewhat unsatisfied with their teledentistry experience (23%). Adults earning between \$30,000 and \$100,000 annually and adults without a dental home are more likely to be dissatisfied with their teledentistry experience. Adults identifying as Asian and adults with a high school education, some college/associate's degree, or a bachelor's degree are less likely to be dissatisfied with their teledentistry experience ([Appendix D2](#)). Three-quarters of adults with a teledentistry visit say they would use this technology again if it is offered (71%).

### How would you rate your general experience with teledentistry?



### How much do you agree or disagree with the following statements (strongly/somewhat agree)?



More adults strongly or somewhat agree that teledentistry would improve their access to oral health care services (29%) compared to those who strongly or somewhat agree that they would choose a teledentistry visit over an office visit (18%) or say that teledentistry provides for their oral health needs (21%).

Adults are more likely to strongly or somewhat disagree with the statement, “Teledentistry would improve my access to oral health services,” if they are 30 years of age or older; are female; earn \$60,000 or more annually, and have at least some amount of college education. Adults who identify their race/ethnicity as Black, Hispanic, Asian, or “other,” those who did not have a dental visit in at least a year, those who had an oral health problem in the past year, and those who do not have a dental home are less likely to disagree with this statement ([Appendix D3](#)). Adults are more likely to disagree that they would choose teledentistry over an in-person visit if they are aged 60 or

older; are female; earn \$30,000 or more annually; or have some college, an associate’s degree, or more. Those who are less likely to disagree that they would choose teledentistry over an in-person visit identify their race/ethnicity as Black, Hispanic, Asian, or “other”; did not have a dental visit in the past year; had an oral health problem in the last year; or do not have a dental home ([Appendix D4](#)). Adults aged 30 years or older, females, adults earning at least \$30,000 annually, and adults with some college education or more are more likely to disagree that teledentistry would provide for their oral health needs. Meanwhile, adults identifying their race/ethnicity as Black, Hispanic, Asian, or “other,” adults without a dental visit in the last year, those with an oral health problem in the previous year, and adults without a dental home are less likely to disagree that teledentistry would provide for their oral health needs ([Appendix D5](#)).



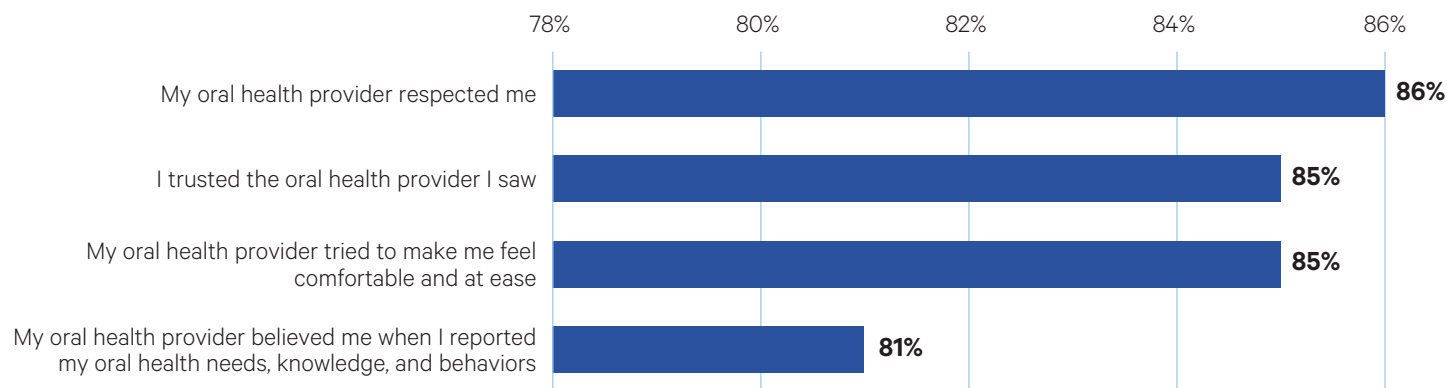
# Discrimination and Dignity in Oral Health Care

Experiencing discrimination on a regular basis is linked to [health disparities and increased stress levels](#). Structural racism at the state level (i.e., racism in state-level domains such as education, economics, politics, judicial systems, and segregation) is linked with an [increased incidence of tooth loss](#) among non-Hispanic Black individuals. [Discrimination and disrespectful treatment in the dental setting](#) are associated with poorer oral health and avoidance of dental care.

A majority of adults say they were treated with respect by their oral health care team at their last dental visit (strongly or somewhat agreed; 86%). Similar percentages of adults say they trusted the oral health provider they saw (85%) and that this provider tried to make them feel comfortable and at ease during the visit (85%). Most adults somewhat or strongly agree with the statement, “*At my last oral health visit, my oral health provider believed me when I reported my oral health needs, knowledge, and behaviors*” (81%).

**Discrimination and disrespectful treatment in the dental setting are associated with poorer oral health and avoidance of dental care.**

**How much do you agree with the following statements about your last oral health visit (strongly/somewhat agree)?**



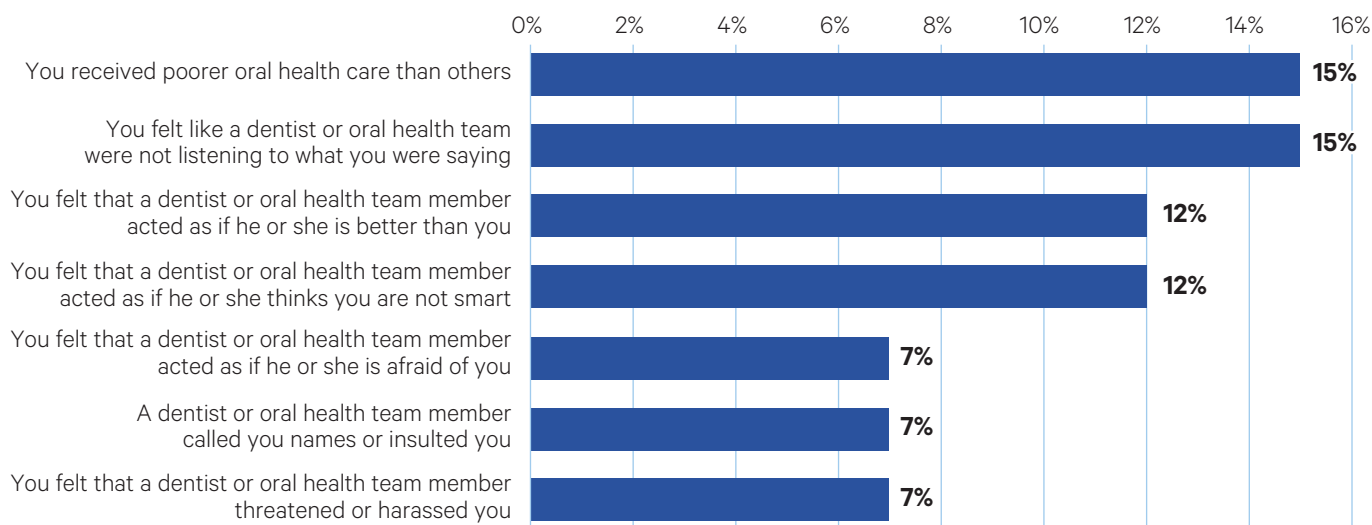
Adults are more likely to disagree with the statement, “My oral health provider respected me,” at their last dental visit if they identify as Hispanic; live in a suburban area; did not have a dental visit in the past year; had an oral health problem in the last year; or do not have a dental home. Conversely, adults aged 60 and above and those earning \$100,000 annually are less likely to disagree with this statement (Appendix E1). Similarly, adults are more likely to disagree with the statement, “I trusted the oral health provider I saw,” at the last dental visit if they identify as Hispanic; did not have a dental visit in the past year; had an oral health problem in the previous year; or do not have a dental home. Meanwhile, adults aged 60 and above and those earning \$60,000 annually are less likely to disagree with this statement (Appendix E2).

Adults are more likely to disagree with the statement, “My oral health provider tried to make me feel comfortable and at ease,” at their last dental visit if they identify as Black or Hispanic; did not have a dental visit in the past year; had an oral health problem in the previous year; or do not have a dental home. Adults aged 60 and above and those earning \$100,000 annually are less likely to disagree with this

statement (Appendix E3). Adults are more likely to disagree with the statement, “My oral health provider believed me when I reported my oral health needs, knowledge, and behaviors,” at their last dental visit if they identify as Hispanic; did not have a dental visit in the past year; or do not have a dental home. Conversely, adults earning \$60,000 annually or more are less likely to disagree with this statement (Appendix E4).

In addition to positive experiences, survey respondents were also asked how often in the last year they experienced different negative interactions with oral health care staff. Fifteen percent of adults say they received poorer oral health care than others. The same percentage (15%) say they felt their oral health team was not listening to what they were saying. Slightly fewer adults (12%) say they felt a member of their oral health team acted as if the team member was better than they were (12%) or thought they were not smart (12%). Seven percent say a member of the oral health team acted as if they were afraid of them, and the same percentage say an oral health team member called them names or insulted them (7%) or threatened or harassed them (7%).

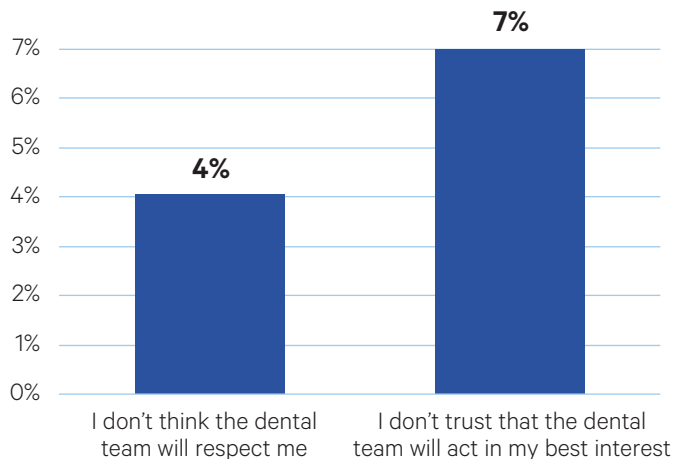
**How often have any of the following things happened to you in the last year (sometimes/most of the time/always)?**



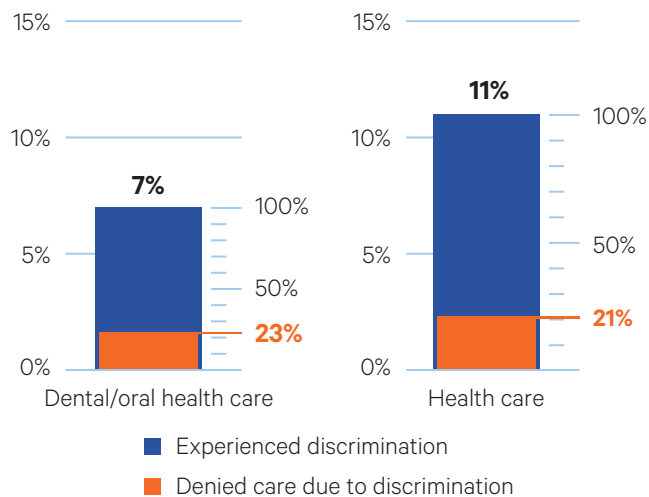
In addition to adults experiencing disrespectful treatment in the oral health setting, 7% of adults say they have experienced discrimination in the oral health care setting. Of those experiencing this discrimination, 23% say they have been denied oral health care due to discrimination. Slightly more adults say they have experienced discrimination in health care (for example, in a primary care physician’s office; 11%) compared to oral health care. And, of those, 21% say they have been denied health care due to discrimination.

Discriminatory or disrespectful treatment by the oral health care team may affect whether individuals seek routine or preventive oral health care. Four percent of adults who say they do not plan to seek such care in the coming year say they plan to avoid the oral health care setting because they do not think the oral health team will respect them. Even more adults who do not intend to seek care say they do not believe the oral health team will act in their best interest (7%).

**Which of the following reasons explain why you do not plan on seeing an oral health care provider in the next year for routine or preventive care?**



**Have you ever experienced discrimination in dental or health care/ been denied dental or health care due to discrimination (yes)?**



**Discriminatory or disrespectful treatment by the oral health care team may affect whether individuals seek routine or preventive oral health care.**



## Summary

A key to understanding how best to address such disparities is determining how individuals perceive the oral health care system and their experiences within it. Adults surveyed, overall, feel that their oral health providers treat them with respect, consider their best interests when creating treatment plans, and provide high-value oral health care. Adults surveyed are focused on preventing future oral health problems, minimizing costs, and receiving care from oral health teams that understand their needs. They are not very familiar with value-based approaches. This lack of knowledge presents a significant opportunity for further education, particularly as [patient-reported outcomes](#) are used more often to assess the value of oral health care.

Adults are knowledgeable about the link between oral and overall health but do not feel that having colocated oral health and primary care would increase their access to oral health care. They are comfortable with oral health providers screening for systemic conditions but have yet to generally experience these types of screenings or referrals to other health care providers in large numbers. Opinions are mixed regarding oral health providers administering vaccinations, such as those for the flu and HPV. Providing [integrated dental and medical care across the life span](#), as noted earlier, can help increase access to health screenings in underserved communities and improve overall health outcomes for patients.

Minimally invasive care is a new concept for individuals who were surveyed, with only one-third saying they would opt for a brush-on treatment (such as silver diamine fluoride [SDF]) to treat caries lesions. Adults are also mixed as to whether to opt for a more invasive, more conclusive treatment (e.g., a filling or crown) or a less invasive, less certain treatment (e.g., SDF). As more health care professionals make use of the [American Medical Association–approved billing code for SDF](#), more individuals will become familiar with this treatment and likely begin asking about it on their own.

**Adults surveyed, overall, feel that their oral health providers treat them with respect, consider their best interests when creating treatment plans, and provide high-value oral health care.**

Few adults surveyed have had a previous teledentistry visit, so it is challenging to draw representative conclusions from these results. Among the small number of individuals who have had a teledentistry visit, however, most are somewhat or very satisfied with their experience. They say their teledentistry visit was the same as or better than a face-to-face oral health visit. Less than a third of respondents, though, felt that teledentistry would provide for their oral health needs, improve their access to oral health services, or replace an office visit. The use of teledentistry increased exponentially during the COVID-19 pandemic, and more than 1 in 10 dentists say they [plan to continue using teledentistry in the future](#). Oral health providers can continue to use teledentistry for screenings, examinations, information sharing, emergency triage, and follow-up visits. Teledentistry is key to [reaching underserved communities](#), including individuals with barriers to care, such as those living in rural areas, by removing the need to travel for oral health care for certain types of visits. Oral health providers' use of teledentistry is influenced by reimbursement or lack thereof; [policy changes by states and payors](#) have the potential to significantly improve access to this technology for patients and providers.

## Methodology

[The State of Oral Health Equity in America \(SOHEA\)](#) survey is a nationally representative survey of consumer and patient attitudes, experiences, and behaviors related to oral health. It was designed by CareQuest Institute for Oral Health. The survey was administered in January and February 2023 to adults aged 18 and older by NORC at the University of Chicago as part of the AmeriSpeak panel. AmeriSpeak is a probability-based panel designed to be representative of the US household population. Randomly selected US households were sampled using area probability and address-based sampling, with a known, nonzero probability of selection from the NORC National Sample Frame. Sampled households were contacted by US mail, telephone, and field interviewers. A sampling unit of 18,521 was used, with a final sample size of 5,240 for a survey completion rate of 28.3% and a final weighted cumulative response rate (through all phases of panel recruitment and retention and survey completion) of 4.4%. All data presented account for appropriate sample weights.

When possible, data from 2023 were combined with the [2021 \(N=5,320\)](#) and [2022 \(N=5,682\)](#) SOHEA rounds. Crosstab analyses were used to determine significant differences in frequencies between groups. We presented regression analysis results for outcomes of interest controlling for demographics such as age, gender (male/female); race/ethnicity (Asian, Black, Hispanic, white, other); dental insurance (yes/no); geographic

location (urban, rural, suburban); household income (under \$30,000, \$30,000–\$60,000, \$60,000–\$100,000, \$100,000 or above); level of education (less than high school, high school graduate or equivalent, some college/associate's degree, bachelor's degree, postgraduate/professional degree); whether they had a dental visit in the last year (yes/no); whether they had at least one oral health problem in the previous year (yes/no); and whether they have a dental home or usual source of dental care (yes/no). For the sake of clarity, the results of statistically significant ( $p < 0.05$ ) regression analyses are phrased as respondents being "more/less likely" to give a specific response. All results presented are statistically significant ( $p < 0.05$ ).

While most respondents report being treated with respect by their oral health team, a small percentage of respondents say they experienced discriminatory and disrespectful treatment by the oral health team, including being denied care due to discrimination. Experiencing [discrimination in the oral health care setting](#) is associated with fair to poor self-rated oral health and irregular dental attendance. This highlights the need for [increasing representation of underrepresented minority individuals in oral health care](#), as well as raising awareness of and addressing [implicit bias among oral health providers](#).

This report emphasizes the need for patient-focused outcomes within oral health care. Not all individuals participating in the survey were regular consumers of oral health care, and examining the responses of those who either did not have a dental visit in the last year or do not have a dental home can help increase understanding of barriers to care. Addressing these barriers holds the promise of improving access and equity within oral health care.

The restricted response options for demographic questions in this survey and report (particularly for race and ethnicity) represent a current limitation of the data. Future data analyses and reports from the SOHEA survey will employ equitable data collection methods, focused on questions that allow more granular reporting of such factors as race, ethnicity, language, disability, sexual orientation, and gender identity (REALD-SOGI) by respondents. By collecting data in this manner, we will be able to more accurately detect and describe oral health inequities, which is a key step in creating a health care system that is accessible, equitable, and integrated for all.



## Appendix A1

## Value-Based Care Regression Analysis Results: On What Are Your Oral Health Provider's Treatment Decisions Based?

Question	Variable	Categories	OR	95% CI	P value
Are the treatment decisions your oral health provider makes based more often on the best care for you or more often on what is most profitable for the provider? <i>Most profitable</i>	Age	18–29 years	<i>ref</i>	<i>ref</i>	<i>ref</i>
		30–44 years	0.96	0.77–1.21	0.7
		45–59 years	1.17	0.94–1.46	0.2
		60+ years	0.88	0.70–1.10	0.3
	Gender	Male	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Female	1.01	0.87–1.17	0.9
	Race/ethnicity	White	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Black	0.81	0.63–1.02	0.082
		Hispanic	1.07	0.88–1.31	0.5
		Asian	0.87	0.64–1.19	0.4
		Other	1.42	0.93–2.13	0.10
	Dental insurance	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>
		No	0.96	0.81–1.14	0.7
	Urbanicity	Rural	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Suburban	1.20	0.97–1.48	0.10
		<b>Urban</b>	<b>1.40</b>	<b>1.12–1.76</b>	<b>0.004</b>
	Income	Less than \$30,000	<i>ref</i>	<i>ref</i>	<i>ref</i>
		\$30,000–under \$60,000	0.97	0.79–1.20	0.8
		<b>\$60,000–under \$100,000</b>	<b>0.79</b>	<b>0.63–0.98</b>	<b>0.036</b>
		<b>\$100,000 or more</b>	<b>0.72</b>	<b>0.57–0.91</b>	<b>0.007</b>
	Education	Less than high school	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>High school graduate or equivalent</b>	<b>0.73</b>	<b>0.55–0.96</b>	<b>0.023</b>
		Some college/associate's degree	0.93	0.70–1.23	0.6
Bachelor's degree		1.15	0.85–1.55	0.4	
Postgraduate study/professional degree		1.13	0.81–1.58	0.5	
Last dental visit	Within the last year	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	<b>More than a year ago</b>	<b>1.59</b>	<b>1.33–1.90</b>	<b>&lt;0.001</b>	
Oral health symptom in the last year	No	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	<b>Yes</b>	<b>1.62</b>	<b>1.40–1.88</b>	<b>&lt;0.001</b>	
Dental home	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	<b>No</b>	<b>1.95</b>	<b>1.61–2.37</b>	<b>&lt;0.001</b>	

OR = odds ratio; 95% CI = 95% confidence interval; *ref* = variable reference level; **bold** = significant at  $p < 0.05$

## Appendix A2

## Value-Based Care Regression Analysis Results: Quality of Care Associated with Value

Question	Variable	Categories	OR	95% CI	P value
<b>Which do you associate most with value when thinking about your overall health care?</b> <i>Quality of care</i>	Age	18–29 years	<i>ref</i>	<i>ref</i>	<i>ref</i>
		30–44 years	0.83	0.69–1.01	0.061
		45–59 years	0.89	0.73–1.07	0.2
		<b>60+ years</b>	<b>0.81</b>	<b>0.67–0.97</b>	<b>0.023</b>
	Gender	Male	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Female	0.98	0.88–1.11	0.8
	Race/ethnicity	White	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Black	0.86	0.71–1.04	0.11
		Hispanic	0.92	0.78–1.09	0.3
		Asian	0.93	0.73–1.19	0.6
		Other	1.23	0.84–1.80	0.3
	Dental insurance	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>
		No	0.98	0.85–1.13	0.8
	Urbanicity	Rural	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Suburban	0.93	0.79–1.10	0.4
		Urban	0.92	0.76–1.10	0.4
	Income	Less than \$30,000	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>\$30,000–under \$60,000</b>	<b>1.22</b>	<b>1.02–1.46</b>	<b>0.026</b>
		<b>\$60,000–under \$100,000</b>	<b>1.28</b>	<b>1.06–1.54</b>	<b>0.011</b>
		<b>\$100,000 or more</b>	<b>1.61</b>	<b>1.32–1.96</b>	<b>&lt;0.001</b>
	Education	Less than high school	<i>ref</i>	<i>ref</i>	<i>ref</i>
		High school graduate or equivalent	1.03	0.81–1.31	0.8
		<b>Some college/associate’s degree</b>	<b>1.30</b>	<b>1.02–1.66</b>	<b>0.035</b>
		<b>Bachelor’s degree</b>	<b>1.40</b>	<b>1.08–1.81</b>	<b>0.011</b>
		<b>Postgraduate study/professional degree</b>	<b>1.49</b>	<b>1.12–1.97</b>	<b>0.005</b>
	Last dental visit	Within the last year	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>More than a year ago</b>	<b>0.69</b>	<b>0.59–0.80</b>	<b>&lt;0.001</b>
	Oral health symptom in the last year	No	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Yes	0.91	0.81–1.03	0.13
Dental home	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	<b>No</b>	<b>0.71</b>	<b>0.59–0.84</b>	<b>&lt;0.001</b>	

OR = odds ratio; 95% CI = 95% confidence interval; ref = variable reference level; **bold = significant at p<0.05**

## Appendix A3

## Value-Based Care Regression Analysis Results: Importance of Dental Office Accepting My Insurance

Question	Variable	Categories	OR	95% CI	P value
<b>What is most important to you when you think about choosing where to receive dental care?</b> <i>Dental office accepts my insurance</i>	Age	18–29 years	<i>ref</i>	<i>ref</i>	<i>ref</i>
		30–44 years	1.14	0.93–1.41	0.2
		45–59 years	0.98	0.80–1.20	0.9
		<b>60+ years</b>	<b>0.74</b>	<b>0.61–0.90</b>	<b>0.002</b>
	Gender	Male	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Female	1.05	0.93–1.19	0.4
	Race/ethnicity	White	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Black</b>	<b>0.74</b>	<b>0.61–0.91</b>	<b>0.003</b>
		Hispanic	0.91	0.76–1.09	0.3
		<b>Asian</b>	<b>0.77</b>	<b>0.60–1.00</b>	<b>0.047</b>
	Other		1.08	0.71–1.67	0.7
	Dental insurance	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>No</b>	<b>0.57</b>	<b>0.49–0.66</b>	<b>&lt;0.001</b>
	Urbanicity	Rural	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Suburban	1.01	0.85–1.21	>0.9
		Urban	1.06	0.87–1.29	0.6
	Income	Less than \$30,000	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>\$30,000–under \$60,000</b>	<b>1.37</b>	<b>1.13–1.65</b>	<b>0.001</b>
		\$60,000–under \$100,000	1.14	0.93–1.39	0.2
		\$100,000 or more	0.83	0.68–1.02	0.085
	Education	Less than high school	<i>ref</i>	<i>ref</i>	<i>ref</i>
		High school graduate or equivalent	0.91	0.70–1.18	0.5
		Some college/associate's degree	0.91	0.70–1.18	0.5
		<b>Bachelor's degree</b>	<b>0.75</b>	<b>0.56–0.98</b>	<b>0.038</b>
		Postgraduate study/professional degree	0.76	0.57–1.03	0.077
	Last dental visit	Within the last year	<i>ref</i>	<i>ref</i>	<i>ref</i>
More than a year ago		1.07	0.91–1.26	0.4	
Oral health symptom in the last year	No	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	Yes	1.05	0.93–1.19	0.4	
Dental home	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	No	1.16	0.96–1.40	0.12	

OR = odds ratio; 95% CI = 95% confidence interval; ref = variable reference level; **bold = significant at p<0.05**

## Appendix A4

## Value-Based Care Regression Analysis Results: Should Oral Health Providers Be Financially Rewarded for Patients' Health?

Question	Variable	Categories	OR	95% CI	P value
Do you think oral health providers should be financially rewarded by insurance companies for how healthy their patients are? No	Age	18–29 years	<i>ref</i>	<i>ref</i>	<i>ref</i>
		30–44 years	1.03	0.81–1.29	0.8
		45–59 years	1.20	0.95–1.52	0.12
		60+ years	1.13	0.90–1.42	0.3
	Gender	Male	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Female</b>	<b>1.95</b>	<b>1.69–2.26</b>	<b>&lt;0.001</b>
	Race/ethnicity	White	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Black</b>	<b>0.72</b>	<b>0.57–0.90</b>	<b>0.005</b>
		<b>Hispanic</b>	<b>0.59</b>	<b>0.48–0.72</b>	<b>&lt;0.001</b>
		<b>Asian</b>	<b>0.48</b>	<b>0.35–0.65</b>	<b>&lt;0.001</b>
		Other	0.87	0.54–1.39	0.6
	Dental insurance	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>No</b>	<b>1.20</b>	<b>1.01–1.43</b>	<b>0.035</b>
	Urbanicity	Rural	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Suburban	0.92	0.75–1.13	0.4
		Urban	0.93	0.74–1.17	0.5
	Income	Less than \$30,000	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>\$30,000–under \$60,000</b>	<b>1.47</b>	<b>1.19–1.83</b>	<b>&lt;0.001</b>
		<b>\$60,000–under \$100,000</b>	<b>1.62</b>	<b>1.29–2.05</b>	<b>&lt;0.001</b>
		<b>\$100,000 or more</b>	<b>1.32</b>	<b>1.04–1.69</b>	<b>0.025</b>
	Education	Less than high school	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>High school graduate or equivalent</b>	<b>1.42</b>	<b>1.06–1.91</b>	<b>0.020</b>
		Some college/associate's degree	1.10	0.81–1.48	0.5
		Bachelor's degree	1.20	0.88–1.66	0.3
		Postgraduate study/professional degree	1.23	0.87–1.73	0.2
	Last dental visit	Within the last year	<i>ref</i>	<i>ref</i>	<i>ref</i>
		More than a year ago	1.11	0.92–1.34	0.3
Oral health symptom in the last year	No	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	Yes	0.97	0.84–1.12	0.7	
Dental home	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	<b>No</b>	<b>1.27</b>	<b>1.02–1.58</b>	<b>0.030</b>	

OR = odds ratio; 95% CI = 95% confidence interval; ref = variable reference level; **bold = significant at p<0.05**

## Appendix B1

## Medical-Dental Integration Regression Analysis Results: Referral to Primary Care Provider

Question	Variable	Categories	OR	95% CI	P value
<b>Has your dentist ever referred you to any of the following? Primary Care Provider</b> No	Age	18–29 years	<i>ref</i>	<i>ref</i>	<i>ref</i>
		30–44 years	0.98	0.64–1.49	>0.9
		45–59 years	1.70	1.05–2.77	0.031
		<b>60+ years</b>	<b>2.33</b>	<b>1.43–3.86</b>	<b>&lt;0.001</b>
	Gender	Male	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Female	1.26	0.91–1.73	0.2
	Race/ethnicity	White	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Black</b>	<b>0.26</b>	<b>0.17–0.39</b>	<b>&lt;0.001</b>
		<b>Hispanic</b>	<b>0.43</b>	<b>0.28–0.66</b>	<b>&lt;0.001</b>
		<b>Asian</b>	<b>0.36</b>	<b>0.20–0.70</b>	<b>0.001</b>
		Other	0.48	0.21–1.34	0.11
	Dental insurance	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>
		No	1.14	0.78–1.69	0.5
	Urbanicity	Rural	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Suburban	0.84	0.51–1.34	0.5
		Urban	1.07	0.63–1.77	0.8
	Income	Less than \$30,000	<i>ref</i>	<i>ref</i>	<i>ref</i>
		\$30,000–under \$60,000	0.87	0.58–1.31	0.5
		\$60,000–under \$100,000	1.25	0.76–2.07	0.4
		\$100,000 or more	1.40	0.81–2.43	0.2
	Education	Less than high school	<i>ref</i>	<i>ref</i>	<i>ref</i>
		High school graduate or equivalent	0.74	0.44–1.22	0.3
		Some college/associate's degree	1.19	0.68–2.05	0.5
		Bachelor's degree	1.91	0.98–3.77	0.057
		Postgraduate study/professional degree	1.59	0.75–3.49	0.2
	Last dental visit	Within the last year	<i>ref</i>	<i>ref</i>	<i>ref</i>
		More than a year ago	1.44	0.98–2.15	0.071
	Oral health symptom in the last year	No	<i>ref</i>	<i>ref</i>	<i>ref</i>
<b>Yes</b>		<b>0.49</b>	<b>0.34–0.68</b>	<b>&lt;0.001</b>	
Dental home	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	No	0.80	0.53–1.23	0.3	

OR = odds ratio; 95% CI = 95% confidence interval; ref = variable reference level; **bold = significant at p<0.05**

## Appendix B2

## Medical-Dental Integration Regression Analysis Results: Referral to Mental Health Provider

Question	Variable	Categories	OR	95% CI	P value
<b>Has your dentist ever referred you to any of the following? Mental Health Provider</b> No	Age	18–29 years	<i>ref</i>	<i>ref</i>	<i>ref</i>
		30–44 years	0.74	0.46–1.18	0.2
		45–59 years	1.36	0.81–2.32	0.2
		60+ years	1.44	0.88–2.36	0.15
	Gender	Male	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Female</b>	<b>1.83</b>	<b>1.32–2.55</b>	<b>&lt;0.001</b>
	Race/ethnicity	White	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Black</b>	<b>0.32</b>	<b>0.21–0.48</b>	<b>&lt;0.001</b>
		<b>Hispanic</b>	<b>0.59</b>	<b>0.38–0.93</b>	<b>0.021</b>
		Asian	0.62	0.32–1.33	0.2
		Other	0.47	0.21–1.23	0.085
	Dental insurance	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>
		No	1.26	0.84–1.95	0.3
	Urbanicity	Rural	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Suburban	0.86	0.53–1.33	0.5
		Urban	1.22	0.73–2.00	0.4
	Income	Less than \$30,000	<i>ref</i>	<i>ref</i>	<i>ref</i>
		\$30,000–under \$60,000	1.31	0.86–2.00	0.2
		<b>\$60,000–under \$100,000</b>	<b>1.71</b>	<b>1.06–2.80</b>	<b>0.028</b>
		<b>\$100,000 or more</b>	<b>3.46</b>	<b>1.95–6.30</b>	<b>&lt;0.001</b>
	Education	Less than high school	<i>ref</i>	<i>ref</i>	<i>ref</i>
		High school graduate or equivalent	0.92	0.52–1.57	0.8
		Some college/associate's degree	1.33	0.72–2.37	0.3
		Bachelor's degree	1.85	0.92–3.71	0.082
		Postgraduate study/professional degree	1.23	0.58–2.63	0.6
	Last dental visit	Within the last year	<i>ref</i>	<i>ref</i>	<i>ref</i>
		More than a year ago	1.05	0.71–1.56	0.8
	Oral health symptom in the last year	No	<i>ref</i>	<i>ref</i>	<i>ref</i>
<b>Yes</b>		<b>0.60</b>	<b>0.43–0.84</b>	<b>0.003</b>	
Dental home	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	No	1.37	0.86–2.24	0.2	

OR = odds ratio; 95% CI = 95% confidence interval; *ref* = variable reference level; **bold = significant at p<0.05**

## Appendix B3

## Medical-Dental Integration Regression Analysis Results: Referral to Other Medical Provider

Question	Variable	Categories	OR	95% CI	P value
<b>Has your dentist ever referred you to any of the following? Other Medical Provider</b> No	Age	18–29 years	<i>ref</i>	<i>ref</i>	<i>ref</i>
		30–44 years	0.95	0.66–1.36	0.8
		45–59 years	1.33	0.91–1.94	0.14
		60+ years	0.82	0.58–1.15	0.3
	Gender	Male	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Female</b>	<b>1.54</b>	<b>1.23–1.93</b>	<b>&lt;0.001</b>
	Race/ethnicity	White	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Black	1.06	0.75–1.52	0.7
		<b>Hispanic</b>	<b>2.14</b>	<b>1.47–3.19</b>	<b>&lt;0.001</b>
		Asian	1.16	0.76–1.83	0.5
		Other	1.22	0.61–2.79	0.6
	Dental insurance	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>
		No	1.13	0.86–1.50	0.4
	Urbanicity	Rural	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Suburban</b>	<b>0.63</b>	<b>0.44–0.89</b>	<b>0.012</b>
		<b>Urban</b>	<b>0.56</b>	<b>0.38–0.81</b>	<b>0.002</b>
	Income	Less than \$30,000	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>\$30,000–under \$60,000</b>	<b>1.67</b>	<b>1.19–2.36</b>	<b>0.003</b>
		\$60,000–under \$100,000	1.35	0.95–1.90	0.094
		\$100,000 or more	1.42	0.99–2.02	0.056
	Education	Less than high school	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>High school graduate or equivalent</b>	<b>1.77</b>	<b>1.16–2.68</b>	<b>0.007</b>
		<b>Some college/associate’s degree</b>	<b>1.79</b>	<b>1.16–2.74</b>	<b>0.007</b>
		Bachelor’s degree	1.35	0.87–2.09	0.2
		Postgraduate study/ professional degree	1.04	0.65–1.66	0.9
		Last dental visit	Within the last year	<i>ref</i>	<i>ref</i>
	<b>More than a year ago</b>		<b>2.27</b>	<b>1.64–3.19</b>	<b>&lt;0.001</b>
	Oral health symptom in the last year	No	<i>ref</i>	<i>ref</i>	<i>ref</i>
<b>Yes</b>		<b>0.49</b>	<b>0.39–0.62</b>	<b>&lt;0.001</b>	
Dental home	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	No	0.81	0.58–1.15	0.2	

OR = odds ratio; 95% CI = 95% confidence interval; ref = variable reference level; **bold = significant at p<0.05**

## Appendix B4

## Medical-Dental Integration Regression Analysis Results: Colocation of Dentist and Medical Doctor

Question	Variable	Categories	OR	95% CI	P value
I would be more likely to seek dental care if my dentist and doctor were located in the same office. Somewhat or strongly disagree, neither agree nor disagree	Age	18–29 years	ref	ref	ref
		30–44 years	1.06	0.85–1.30	0.6
		45–59 years	1.24	1.00–1.53	0.053
		<b>60+ years</b>	<b>1.79</b>	<b>1.45–2.23</b>	<b>&lt;0.001</b>
	Gender	Male	ref	ref	ref
		<b>Female</b>	<b>1.15</b>	<b>1.00–1.33</b>	<b>0.049</b>
	Race/ethnicity	White	Ref	Ref	Ref
		<b>Black</b>	<b>0.28</b>	<b>0.23–0.34</b>	<b>&lt;0.001</b>
		<b>Hispanic</b>	<b>0.41</b>	<b>0.34–0.49</b>	<b>&lt;0.001</b>
		<b>Asian</b>	<b>0.30</b>	<b>0.23–0.40</b>	<b>&lt;0.001</b>
		<b>Other</b>	<b>0.42</b>	<b>0.28–0.40</b>	<b>&lt;0.001</b>
	Dental insurance	Yes	ref	ref	ref
		No	1.04	0.88–1.23	0.7
	Urbanicity	Rural	ref	ref	ref
		<b>Suburban</b>	<b>0.74</b>	<b>0.60–0.92</b>	<b>0.007</b>
		<b>Urban</b>	<b>0.74</b>	<b>0.59–0.93</b>	<b>&lt;0.001</b>
	Income	Less than \$30,000	ref	ref	ref
		<b>\$30,000–under \$60,000</b>	<b>1.29</b>	<b>1.06–1.57</b>	<b>0.011</b>
		<b>\$60,000–under \$100,000</b>	<b>1.51</b>	<b>1.21–1.87</b>	<b>&lt;0.001</b>
		<b>\$100,000 or more</b>	<b>1.63</b>	<b>1.29–2.06</b>	<b>&lt;0.001</b>
	Education	Less than high school	ref	ref	ref
		<b>High school graduate or equivalent</b>	<b>1.33</b>	<b>1.03–1.71</b>	<b>0.027</b>
		<b>Some college/associate’s degree</b>	<b>1.57</b>	<b>1.21–2.03</b>	<b>&lt;0.001</b>
		<b>Bachelor’s degree</b>	<b>1.78</b>	<b>1.34–2.36</b>	<b>&lt;0.001</b>
		<b>Post-graduate study/professional degree</b>	<b>2.32</b>	<b>1.66–3.23</b>	<b>&lt;0.001</b>
	Last dental visit	Within the last year	ref	ref	ref
		<b>More than a year ago</b>	<b>0.71</b>	<b>0.60–0.85</b>	<b>&lt;0.001</b>
Oral health symptom in the last year	No	ref	ref	ref	
	<b>Yes</b>	<b>0.86</b>	<b>0.74–0.99</b>	<b>0.037</b>	
Dental home	Yes	ref	ref	ref	
	No	0.95	0.78–1.16	0.6	

OR = odds ratio; 95% CI = 95% confidence interval; ref = variable reference level; **bold = significant at p<0.05**



## Appendix B5

## Medical-Dental Integration Regression Analysis Results: Medical and Dental Insurance Offered Through Same Company

Question	Variable	Categories	OR	95% CI	P value
<b>Would you prefer to have your medical and dental insurance provided through the same insurance company?</b> No	Age	18–29 years	<i>ref</i>	<i>ref</i>	<i>ref</i>
		30–44 years	0.95	0.68–1.35	0.8
		45–59 years	0.95	0.68–1.35	0.8
		60+ years	1.31	0.95–1.83	0.10
	Gender	Male	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Female	1.11	0.90–1.37	0.3
	Race/ethnicity	White	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Black</b>	<b>1.73</b>	<b>1.25–2.36</b>	<b>&lt;0.001</b>
		<b>Hispanic</b>	<b>1.35</b>	<b>1.00–1.80</b>	<b>0.043</b>
		<b>Asian</b>	<b>1.67</b>	<b>1.12–2.46</b>	<b>0.010</b>
		Other	0.77	0.31–1.62	0.5
	Dental insurance	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>No</b>	<b>1.37</b>	<b>1.07–1.74</b>	<b>0.011</b>
	Urbanicity	Rural	<i>Ref</i>	<i>Ref</i>	<i>Ref</i>
		Suburban	1.13	0.83–1.56	0.4
		Urban	0.87	0.62–1.24	0.4
	Income	Less than \$30,000	<i>ref</i>	<i>ref</i>	<i>ref</i>
		\$30,000–under \$60,000	0.79	0.57–1.11	0.2
		\$60,000–under \$100,000	1.13	0.80–1.58	0.5
		<b>\$100,000 or more</b>	<b>1.82</b>	<b>1.29–2.56</b>	<b>&lt;0.001</b>
	Education	Less than high school	<i>ref</i>	<i>ref</i>	<i>ref</i>
		High school graduate or equivalent	0.80	0.54–1.21	0.3
		Some college/associate's degree	0.85	0.57–1.28	0.4
		Bachelor's degree	0.69	0.44–1.08	0.10
		Post-graduate study/professional degree	1.00	0.63–1.60	>0.9
	Last dental visit	Within the last year	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>More than a year ago</b>	<b>0.65</b>	<b>0.49–0.86</b>	<b>0.003</b>
Oral health symptom in the last year	No	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	Yes	1.07	0.86–1.32	0.5	
Dental home	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	<b>No</b>	<b>2.29</b>	<b>1.71–3.08</b>	<b>&lt;0.001</b>	

OR = odds ratio; 95% CI = 95% confidence interval; ref = variable reference level; **bold = significant at p<0.05**

## Appendix B6

## Medical-Dental Integration Regression Analysis Results: Consider Receiving a Flu Vaccine from Your Dentist

Question	Variable	Categories	OR	95% CI	P value
<b>Would you consider receiving a flu vaccine from your dentist?</b> No	Age	18–29 years	<i>ref</i>	<i>ref</i>	<i>ref</i>
		30–44 years	1.15	0.92–1.44	0.2
		45–59 years	1.13	0.90–1.41	0.3
		<b>60+ years</b>	<b>0.80</b>	<b>0.65–0.99</b>	<b>0.042</b>
	Gender	Male	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Female</b>	<b>1.57</b>	<b>1.37–1.79</b>	<b>&lt;0.001</b>
	Race/ethnicity	White	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Black	1.18	0.94–1.48	0.15
		Hispanic	1.12	0.93–1.37	0.2
		Asian	1.12	0.86–1.47	0.4
		Other	1.02	0.66–1.60	>0.9
	Dental insurance	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>
		No	0.99	0.84–1.17	>0.9
	Urbanicity	Rural	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Suburban	0.91	0.74–1.10	0.3
		Urban	0.84	0.68–1.04	0.11
	Income	Less than \$30,000	<i>ref</i>	<i>ref</i>	<i>ref</i>
		\$30,000–under \$60,000	1.02	0.83–1.27	0.8
		\$60,000–under \$100,000	1.11	0.88–1.38	0.4
		<b>\$100,000 or more</b>	<b>0.78</b>	<b>0.62–0.97</b>	<b>0.027</b>
	Education	Less than high school	<i>ref</i>	<i>ref</i>	<i>ref</i>
		High school graduate or equivalent	0.88	0.64–1.19	0.4
		<b>Some college/associate’s degree</b>	<b>0.61</b>	<b>0.45–0.82</b>	<b>0.001</b>
		<b>Bachelor’s degree</b>	<b>0.42</b>	<b>0.31–0.58</b>	<b>&lt;0.001</b>
		<b>Postgraduate study/professional degree</b>	<b>0.31</b>	<b>0.22–0.44</b>	<b>&lt;0.001</b>
	Last dental visit	Within the last year	<i>ref</i>	<i>ref</i>	<i>ref</i>
		More than a year ago	1.25	1.05–1.50	0.014
	Oral health symptom in the last year	No	<i>ref</i>	<i>ref</i>	<i>ref</i>
<b>Yes</b>		<b>0.89</b>	<b>0.78–1.02</b>	<b>0.085</b>	
Dental home	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	<b>No</b>	<b>1.29</b>	<b>1.04–1.59</b>	<b>0.019</b>	

OR = odds ratio; 95% CI = 95% confidence interval; *ref* = variable reference level; **bold** = significant at  $p < 0.05$

## Appendix B7

## Medical-Dental Integration Regression Analysis Results: Oral Health Provider Qualified to Educate Patients about HPV?

Question	Variable	Categories	OR	95% CI	P value
Do you think a dentist or other oral health care provider, such as a dental hygienist, is qualified to educate patients about the HPV vaccine? No	Age	18–29 years	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>30–44 years</b>	<b>1.35</b>	<b>1.12–1.64</b>	<b>0.002</b>
		<b>45–59 years</b>	<b>1.31</b>	<b>1.09–1.58</b>	<b>0.005</b>
		<b>60+ years</b>	<b>0.82</b>	<b>0.68–0.99</b>	<b>0.035</b>
	Gender	Male	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Female</b>	<b>1.42</b>	<b>1.26–1.60</b>	<b>&lt;0.001</b>
	Race/ethnicity	White	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Black	1.11	0.91–1.34	0.3
		<b>Hispanic</b>	<b>1.19</b>	<b>1.00–1.40</b>	<b>0.046</b>
		Asian	0.92	0.71–1.18	0.5
		Other	0.76	0.52–1.12	0.2
	Dental insurance	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>
		No	1.03	0.90–1.19	0.7
	Urbanicity	Rural	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Suburban	1.06	0.90–1.25	0.5
		Urban	0.91	0.76–1.09	0.3
	Income	Less than \$30,000	<i>ref</i>	<i>ref</i>	<i>ref</i>
		\$30,000–under \$60,000	1.11	0.93–1.32	0.3
		\$60,000–under \$100,000	1.03	0.86–1.24	0.7
		\$100,000 or more	0.92	0.75–1.12	0.4
	Education	Less than high school	<i>ref</i>	<i>ref</i>	<i>ref</i>
		High school graduate or equivalent	1.11	0.88–1.41	0.4
		Some college/associate's degree	0.93	0.73–1.18	0.5
		<b>Bachelor's degree</b>	<b>0.69</b>	<b>0.53–0.89</b>	<b>0.004</b>
		<b>Postgraduate study/professional degree</b>	<b>0.61</b>	<b>0.46–0.80</b>	<b>&lt;0.001</b>
	Last dental visit	Within the last year	<i>ref</i>	<i>ref</i>	<i>ref</i>
		More than a year ago	1.10	0.94–1.28	0.2
Oral health symptom in the last year	No	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	Yes	0.92	0.81–1.03	0.15	
Dental home	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	No	1.17	0.98–1.39	0.077	

OR = odds ratio; 95% CI = 95% confidence interval; *ref* = variable reference level; **bold** = significant at  $p < 0.05$

## Appendix B8

## Medical-Dental Integration Regression Analysis Results: Consent to HPV Vaccine for Your Child if Dentist Recommends

Question	Variable	Categories	OR	95% CI	P value
<b>How likely are you to consent to an HPV vaccine for your child if an oral health care provider recommends it?</b> <i>Somewhat/very unlikely</i>	Age	18–29 years	<i>ref</i>	<i>ref</i>	<i>ref</i>
		30–44 years	1.04	0.68–1.61	0.9
		45–59 years	1.17	0.72–1.89	0.5
		60+ years	1.35	0.47–3.67	0.6
	Gender	Male	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Female	1.22	0.91–1.64	0.2
	Race/ethnicity	White	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Black	0.99	0.61–1.57	>0.9
		Hispanic	1.00	0.68–1.47	>0.9
		Asian	0.67	0.35–1.24	0.2
		Other	1.61	0.63–4.00	0.3
	Dental insurance	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>
		No	0.69	0.46–1.04	0.078
	Urbanicity	Rural	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Suburban	0.95	0.63–1.45	0.8
		Urban	0.94	0.60–1.47	0.8
	Income	Less than \$30,000	<i>ref</i>	<i>ref</i>	<i>ref</i>
		\$30,000–under \$60,000	1.15	0.73–1.81	0.5
		\$60,000–under \$100,000	1.17	0.71–1.94	0.5
		\$100,000 or more	0.85	0.48–1.51	0.6
	Education	Less than high school	<i>ref</i>	<i>ref</i>	<i>ref</i>
		High school graduate or equivalent	0.66	0.34–1.28	0.2
		Some college/associate's degree	1.09	0.57–2.11	0.8
		Bachelor's degree	0.62	0.30–1.29	0.2
		Postgraduate study/professional degree	0.57	0.26–1.25	0.2
	Last dental visit	Within the last year	<i>ref</i>	<i>ref</i>	<i>ref</i>
		More than a year ago	1.42	0.98–2.07	0.065
	Oral health symptom in the last year	No	<i>ref</i>	<i>ref</i>	<i>ref</i>
Yes		0.75	0.55–1.01	0.057	
Dental home	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	No	1.26	0.83–1.93	0.3	

OR = odds ratio; 95% CI = 95% confidence interval; *ref* = variable reference level; **bold** = significant at  $p < 0.05$

## Appendix C1

## Minimally Invasive Care Regression Analysis Results: Choose Filling for Cavities over Other Options

Question	Variable	Categories	OR	95% CI	P value
If you had cavities on your teeth, would you choose this new treatment, a filling, or a crown/implant? <i>Filling</i>	Age	18–29 years	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>30–44 years</b>	<b>0.56</b>	<b>0.44–0.70</b>	<b>&lt;0.001</b>
		<b>45–59 years</b>	<b>0.47</b>	<b>0.37–0.59</b>	<b>&lt;0.001</b>
		<b>60+ years</b>	<b>0.53</b>	<b>0.42–0.66</b>	<b>&lt;0.001</b>
	Gender	Male	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Female	0.85	0.74–0.98	0.030
	Race/ethnicity	White	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Black	1.27	1.00–1.61	0.052
		Hispanic	1.15	0.95–1.40	0.2
		<b>Asian</b>	<b>1.82</b>	<b>1.35–2.45</b>	<b>&lt;0.001</b>
	Other		0.74	0.46–1.20	0.2
	Dental insurance	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>
		No	1.03	0.87–1.22	0.7
	Urbanicity	Rural	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Suburban	0.98	0.80–1.19	0.8
		Urban	0.90	0.72–1.12	0.3
	Income	Less than \$30,000	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>\$30,000–under \$60,000</b>	<b>0.76</b>	<b>0.61–0.95</b>	<b>0.017</b>
		\$60,000–under \$100,000	0.93	0.74–1.17	0.5
		\$100,000 or more	0.79	0.62–1.01	0.059
	Education	Less than high school	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>High school graduate or equivalent</b>	<b>0.62</b>	<b>0.46–0.84</b>	<b>0.002</b>
		<b>Some college/associate’s degree</b>	<b>0.62</b>	<b>0.45–0.84</b>	<b>0.002</b>
		<b>Bachelor’s degree</b>	<b>0.46</b>	<b>0.33–0.63</b>	<b>&lt;0.001</b>
		<b>Postgraduate study/professional degree</b>	<b>0.54</b>	<b>0.38–0.76</b>	<b>&lt;0.001</b>
	Last dental visit	Within the last year	<i>ref</i>	<i>ref</i>	<i>ref</i>
<b>More than a year ago</b>		<b>0.77</b>	<b>0.64–0.93</b>	<b>0.007</b>	
Oral health symptom in the last year	No	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	Yes	0.76	0.66–0.88	<0.001	
Dental home	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	No	0.84	0.68–1.04	0.12	

OR = odds ratio; 95% CI = 95% confidence interval; *ref* = variable reference level; **bold** = significant at  $p < 0.05$

## Appendix C2

## Minimally Invasive Care Regression Analysis Results: Choose Crown/Implant for Cavities over Other Options

Question	Variable	Categories	OR	95% CI	P value
If you had cavities on your teeth, would you choose this new treatment, a filling, or a crown/implant? <i>Crown/implant</i>	Age	18–29 years	<i>ref</i>	<i>ref</i>	<i>ref</i>
		30–44 years	0.81	0.52–1.24	0.3
		45–59 years	0.68	0.44–1.06	0.085
		<b>60+ years</b>	<b>0.56</b>	<b>0.36–0.86</b>	<b>0.008</b>
	Gender	Male	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Female</b>	<b>0.61</b>	<b>0.45–0.81</b>	<b>&lt;0.001</b>
	Race/ethnicity	White	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Black</b>	<b>2.68</b>	<b>1.84–3.89</b>	<b>&lt;0.001</b>
		Hispanic	0.91	0.60–1.39	0.7
		Asian	1.07	0.50–2.30	0.9
		Other	0.74	0.27–2.01	0.6
	Dental insurance	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>
		No	1.02	0.73–1.42	>0.9
	Urbanicity	Rural	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Suburban	0.99	0.67–1.47	>0.9
		Urban	1.04	0.68–1.59	0.9
	Income	Less than \$30,000	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>\$30,000–under \$60,000</b>	<b>0.69</b>	<b>0.48–0.99</b>	<b>0.046</b>
		<b>\$60,000–under \$100,000</b>	<b>0.41</b>	<b>0.26–0.64</b>	<b>&lt;0.001</b>
		<b>\$100,000 or more</b>	<b>0.31</b>	<b>0.19–0.51</b>	<b>&lt;0.001</b>
	Education	Less than high school	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>High school graduate or equivalent</b>	<b>0.54</b>	<b>0.34–0.86</b>	<b>0.010</b>
		<b>Some college/associate’s degree</b>	<b>0.51</b>	<b>0.31–0.83</b>	<b>0.007</b>
		<b>Bachelor’s degree</b>	<b>0.23</b>	<b>0.12–0.41</b>	<b>&lt;0.001</b>
		<b>Postgraduate study/professional degree</b>	<b>0.37</b>	<b>0.19–0.72</b>	<b>0.003</b>
	Last dental visit	Within the last year	<i>ref</i>	<i>ref</i>	<i>ref</i>
		More than a year ago	0.76	0.53–1.08	0.12
	Oral health symptom in the last year	No	<i>ref</i>	<i>ref</i>	<i>ref</i>
<b>Yes</b>		<b>1.75</b>	<b>1.29–2.37</b>	<b>&lt;0.001</b>	
Dental home	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	No	0.85	0.57–1.26	0.4	

OR = odds ratio; 95% CI = 95% confidence interval; ref = variable reference level; **bold = significant at p<0.05**

## Appendix D1

## Teledentistry Regression Analysis Results: Have You Ever Been Seen Through Teledentistry?

Question	Variable	Categories	OR	95% CI	P value
Teledentistry is the use of interactive audio, video, or data communications to get dental or oral health care. Have you ever been seen through teledentistry? No	Age	18–29 years	<i>ref</i>	<i>ref</i>	<i>ref</i>
		30–44 years	1.01	0.79–1.30	>0.9
		<b>45–59 years</b>	<b>1.47</b>	<b>1.12–1.94</b>	<b>0.006</b>
		<b>60+ years</b>	<b>2.73</b>	<b>2.01–3.74</b>	<b>&lt;0.001</b>
	Gender	Male	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Female</b>	<b>1.56</b>	<b>1.28–1.89</b>	<b>&lt;0.001</b>
	Race/ethnicity	White	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Black</b>	<b>0.18</b>	<b>0.14–0.24</b>	<b>&lt;0.001</b>
		<b>Hispanic</b>	<b>0.30</b>	<b>0.23–0.39</b>	<b>&lt;0.001</b>
		<b>Asian</b>	<b>0.12</b>	<b>0.09–0.17</b>	<b>&lt;0.001</b>
		Other	1.15	0.54–3.00	0.7
	Dental insurance	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>
		No	0.79	0.64–0.99	0.037
	Urbanicity	Nonmetro area	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Metro area</b>	<b>1.41</b>	<b>1.07–1.83</b>	<b>0.012</b>
	Income	Less than \$30,000	<i>ref</i>	<i>ref</i>	<i>ref</i>
		\$30,000–under \$60,000	1.47	1.16–1.88	0.002
		\$60,000–under \$100,000	1.90	1.42–2.56	<0.001
		\$100,000 or more	1.82	1.34–2.50	<0.001
	Education	Less than high school	<i>ref</i>	<i>ref</i>	<i>ref</i>
		High school graduate or equivalent	1.29	0.98–1.68	0.063
		<b>Some college/associate’s degree</b>	<b>2.00</b>	<b>1.49–2.69</b>	<b>&lt;0.001</b>
		<b>Bachelor’s degree</b>	<b>2.82</b>	<b>1.96–4.08</b>	<b>&lt;0.001</b>
		<b>Postgraduate study/professional degree</b>	<b>5.61</b>	<b>3.39–9.70</b>	<b>&lt;0.001</b>
	Last dental visit	Within the last year	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>More than a year ago</b>	<b>0.69</b>	<b>0.56–0.85</b>	<b>&lt;0.001</b>
	Oral health symptom in the last year	No	<i>ref</i>	<i>ref</i>	<i>ref</i>
Yes		0.60	0.49–0.73	<0.001	
Dental home	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	<b>No</b>	<b>2.28</b>	<b>1.77–2.97</b>	<b>&lt;0.001</b>	

OR = odds ratio; 95% CI = 95% confidence interval; ref = variable reference level; **bold = significant at p<0.05**

## Appendix D2

## Teledentistry Regression Analysis Results: Satisfaction with Teledentistry Experience

Question	Variable	Categories	OR	95% CI	P value
How would you rate your general experience with teledentistry? <i>Somewhat/very unsatisfied</i>	Age	18–29 years	<i>ref</i>	<i>ref</i>	<i>ref</i>
		30–44 years	1.82	0.85–3.99	0.13
		45–59 years	1.20	0.56–2.57	0.6
		60+ years	1.30	0.52–3.18	0.6
	Gender	Male	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Female	0.89	0.51–1.53	0.7
	Race/ethnicity	White	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Black	0.59	0.31–1.12	0.11
		Hispanic	0.57	0.28–1.16	0.12
		Asian	<b>0.03</b>	<b>0.00–0.18</b>	<b>0.003</b>
		Other	0.03	—	0.2
	Dental insurance	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>
		No	1.21	0.64–2.29	0.6
	Urbanicity	Nonmetro area	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Metro area	1.34	0.66–2.81	0.4
	Income	Less than \$30,000	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>\$30,000–under \$60,000</b>	<b>2.52</b>	<b>1.29–5.02</b>	<b>0.007</b>
		<b>\$60,000–under \$100,000</b>	<b>4.56</b>	<b>2.06–10.3</b>	<b>&lt;0.001</b>
		\$100,000 or more	1.10	0.30–3.49	0.9
	Education	Less than high school	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>High school graduate or equivalent</b>	<b>0.16</b>	<b>0.07–0.35</b>	<b>&lt;0.001</b>
<b>Some college/associate’s degree</b>		<b>0.27</b>	<b>0.12–0.59</b>	<b>0.001</b>	
<b>Bachelor’s degree</b>		<b>0.18</b>	<b>0.06–0.53</b>	<b>0.002</b>	
Postgraduate study/ professional degree		0.00	—	>0.9	
Last dental visit	Within the last year	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	More than a year ago	1.04	0.57–1.89	0.9	
Oral health symptom in the last year	No	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	Yes	0.69	0.38–1.26	0.2	
Dental home	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	<b>No</b>	<b>2.33</b>	<b>1.20–4.51</b>	<b>0.012</b>	

OR = odds ratio; 95% CI = 95% confidence interval; *ref* = variable reference level; **bold** = significant at  $p < 0.05$



## Appendix D3

## Teledentistry Regression Analysis Results: Teledentistry Would Improve My Access to Oral Health Care Services

Question	Variable	Categories	OR	95% CI	P value
<b>Teledentistry would improve my access to oral health care services.</b> <i>Somewhat/strongly disagree</i>	Age	18–29 years	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>30–44 years</b>	<b>1.13</b>	<b>1.01–1.26</b>	<b>0.031</b>
		<b>45–59 years</b>	<b>1.20</b>	<b>1.07–1.35</b>	<b>0.002</b>
		<b>60+ years</b>	<b>1.64</b>	<b>1.46–1.83</b>	<b>&lt;0.001</b>
	Gender	Male	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Female</b>	<b>1.46</b>	<b>1.36–1.57</b>	<b>&lt;0.001</b>
	Race/ethnicity	White	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Black</b>	<b>0.52</b>	<b>0.46–0.58</b>	<b>&lt;0.001</b>
		<b>Hispanic</b>	<b>0.63</b>	<b>0.57–0.70</b>	<b>&lt;0.001</b>
		<b>Asian</b>	<b>0.39</b>	<b>0.34–0.45</b>	<b>&lt;0.001</b>
		<b>Other</b>	<b>0.70</b>	<b>0.57–0.88</b>	<b>0.001</b>
	Dental insurance	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>
		No	1.08	0.99–1.18	0.085
	Urbanicity	Nonmetro area	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Metro area	0.94	0.85–1.05	0.3
	Income	Less than \$30,000	<i>ref</i>	<i>ref</i>	<i>ref</i>
		\$30,000–under \$60,000	1.08	0.98–1.20	0.13
		<b>\$60,000–under \$100,000</b>	<b>1.13</b>	<b>1.01–1.27</b>	<b>0.034</b>
		<b>\$100,000 or more</b>	<b>1.44</b>	<b>1.28–1.63</b>	<b>&lt;0.001</b>
	Education	Less than high school	<i>ref</i>	<i>ref</i>	<i>ref</i>
High school graduate or equivalent		0.91	0.79–1.05	0.2	
<b>Some college/associate’s degree</b>		<b>1.18</b>	<b>1.02–1.36</b>	<b>0.024</b>	
<b>Bachelor’s degree</b>		<b>1.21</b>	<b>1.04–1.41</b>	<b>0.015</b>	
<b>Postgraduate study/professional degree</b>		<b>1.25</b>	<b>1.05–1.48</b>	<b>0.011</b>	
Last dental visit	Within the last year	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	<b>More than a year ago</b>	<b>0.65</b>	<b>0.60–0.71</b>	<b>&lt;0.001</b>	
Oral health symptom in the last year	No	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	Yes	0.76	0.70–0.81	<0.001	
Dental home	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	<b>No</b>	<b>0.80</b>	<b>0.72–0.88</b>	<b>&lt;0.001</b>	

OR = odds ratio; 95% CI = 95% confidence interval; ref = variable reference level; **bold = significant at p<0.05**

## Appendix D4

## Teledentistry Regression Analysis Results: Choosing Teledentistry over In-Office Visit

Question	Variable	Categories	OR	95% CI	P value
If I had the option of choosing between an in-office visit or a teledentistry visit, I would choose teledentistry. Somewhat/strongly disagree	Age	18–29 years	<i>ref</i>	<i>ref</i>	<i>ref</i>
		30–44 years	0.97	0.85–1.10	0.6
		45–59 years	0.93	0.81–1.06	0.3
		<b>60+ years</b>	<b>1.53</b>	<b>1.33–1.75</b>	<b>&lt;0.001</b>
	Gender	Male	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Female	1.28	1.17–1.40	<0.001
	Race/ethnicity	White	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Black</b>	<b>0.43</b>	<b>0.38–0.49</b>	<b>&lt;0.001</b>
		<b>Hispanic</b>	<b>0.62</b>	<b>0.55–0.69</b>	<b>&lt;0.001</b>
		<b>Asian</b>	<b>0.35</b>	<b>0.29–0.41</b>	<b>&lt;0.001</b>
		<b>Other</b>	<b>0.74</b>	<b>0.57–0.96</b>	<b>0.021</b>
	Dental insurance	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>
		No	0.92	0.83–1.02	0.12
	Urbanicity	Nonmetro area	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Metro area	1.04	0.92–1.18	0.5
	Income	Less than \$30,000	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>\$30,000–under \$60,000</b>	<b>1.18</b>	<b>1.05–1.33</b>	<b>0.007</b>
		<b>\$60,000–under \$100,000</b>	<b>1.20</b>	<b>1.05–1.36</b>	<b>0.008</b>
		<b>\$100,000 or more</b>	<b>1.71</b>	<b>1.48–1.99</b>	<b>&lt;0.001</b>
	Education	Less than high school	<i>ref</i>	<i>ref</i>	<i>ref</i>
		High school graduate or equivalent	1.15	0.99–1.34	0.068
		<b>Some college/associate’s degree</b>	<b>1.70</b>	<b>1.45–1.99</b>	<b>&lt;0.001</b>
		<b>Bachelor’s degree</b>	<b>2.37</b>	<b>1.98–2.84</b>	<b>&lt;0.001</b>
		<b>Postgraduate study/professional degree</b>	<b>2.18</b>	<b>1.77–2.68</b>	<b>&lt;0.001</b>
	Last dental visit	Within the last year	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>More than a year ago</b>	<b>0.55</b>	<b>0.50–0.61</b>	<b>&lt;0.001</b>
	Oral health symptom in the last year	No	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Yes</b>	<b>0.74</b>	<b>0.67–0.81</b>	<b>&lt;0.001</b>
Dental home	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	<b>No</b>	<b>0.63</b>	<b>0.56–0.70</b>	<b>&lt;0.001</b>	

OR = odds ratio; 95% CI = 95% confidence interval; ref = variable reference level; **bold = significant at p<0.05**

## Appendix D5

## Teledentistry Regression Analysis Results: Teledentistry Would Provide for My Oral Health Needs

Question	Variable	Categories	OR	95% CI	P value
<b>Teledentistry would provide for my oral health needs.</b> <i>Somewhat/strongly disagree</i>	Age	18–29 years	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>30–44 years</b>	<b>1.15</b>	<b>1.01–1.30</b>	<b>0.030</b>
		<b>45–59 years</b>	<b>1.19</b>	<b>1.05–1.35</b>	<b>0.007</b>
		<b>60+ years</b>	<b>1.62</b>	<b>1.43–1.84</b>	<b>&lt;0.001</b>
	Gender	Male	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Female	1.46	1.35–1.59	<0.001
	Race/ethnicity	White	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Black</b>	<b>0.31</b>	<b>0.27–0.35</b>	<b>&lt;0.001</b>
		<b>Hispanic</b>	<b>0.47</b>	<b>0.42–0.52</b>	<b>&lt;0.001</b>
		<b>Asian</b>	<b>0.25</b>	<b>0.21–0.29</b>	<b>&lt;0.001</b>
		<b>Other</b>	<b>0.71</b>	<b>0.55–0.92</b>	<b>0.007</b>
	Dental insurance	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>
		No	1.08	0.98–1.19	0.13
	Urbanicity	Nonmetro area	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Metro area	1.00	0.89–1.13	>0.9
	Income	Less than \$30,000	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>\$30,000–under \$60,000</b>	<b>1.19</b>	<b>1.06–1.34</b>	<b>0.003</b>
		<b>\$60,000–under \$100,000</b>	<b>1.15</b>	<b>1.02–1.31</b>	<b>0.028</b>
		<b>\$100,000 or more</b>	<b>1.44</b>	<b>1.26–1.66</b>	<b>&lt;0.001</b>
	Education	Less than high school	<i>ref</i>	<i>ref</i>	<i>ref</i>
		High school graduate or equivalent	0.87	0.75–1.01	0.067
		<b>Some college/associate’s degree</b>	<b>1.32</b>	<b>1.13–1.54</b>	<b>&lt;0.001</b>
		<b>Bachelor’s degree</b>	<b>1.62</b>	<b>1.36–1.92</b>	<b>&lt;0.001</b>
		<b>Postgraduate study/professional degree</b>	<b>1.83</b>	<b>1.51–2.23</b>	<b>&lt;0.001</b>
	Last dental visit	Within the last year	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>More than a year ago</b>	<b>0.76</b>	<b>0.68–0.84</b>	<b>&lt;0.001</b>
	Oral health symptom in the last year	No	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Yes</b>	<b>0.84</b>	<b>0.78–0.92</b>	<b>&lt;0.001</b>
Dental home	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	<b>No</b>	<b>0.74</b>	<b>0.66–0.83</b>	<b>&lt;0.001</b>	

OR = odds ratio; 95% CI = 95% confidence interval; ref = variable reference level; **bold = significant at p<0.05**

## Appendix E1

## Discrimination and Dignity Regression Analysis Results: My Oral Health Provider Respected Me

Question	Variable	Categories	OR	95% CI	P value
At my last oral health visit, my oral health provider respected me. <i>Somewhat or strongly disagree, neither agree nor disagree</i>	Age	18–29 years	<i>ref</i>	<i>ref</i>	<i>ref</i>
		30–44 years	1.15	0.88–1.51	0.3
		45–59 years	0.96	0.72–1.27	0.8
		<b>60+ years</b>	<b>0.69</b>	<b>0.52–0.92</b>	<b>0.012</b>
	Gender	Male	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Female	1.03	0.85–1.24	0.8
	Race/ethnicity	White	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Black	1.30	0.98–1.72	0.066
		<b>Hispanic</b>	<b>1.31</b>	<b>1.02–1.67</b>	<b>0.032</b>
		Asian	0.94	0.60–1.43	0.8
		Other	0.95	0.53–1.63	0.9
	Dental insurance	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>
		No	1.15	0.94–1.42	0.2
	Urbanicity	Rural	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Suburban</b>	<b>1.31</b>	<b>1.01–1.72</b>	<b>0.044</b>
		Urban	1.08	0.81–1.45	0.6
	Income	Less than \$30,000	<i>ref</i>	<i>ref</i>	<i>ref</i>
		\$30,000–under \$60,000	0.93	0.73–1.19	0.6
		\$60,000–under \$100,000	0.80	0.61–1.05	0.11
		<b>\$100,000 or more</b>	<b>0.51</b>	<b>0.37–0.70</b>	<b>&lt;0.001</b>
	Education	Less than high school	<i>ref</i>	<i>ref</i>	<i>ref</i>
		High school graduate or equivalent	1.29	0.92–1.82	0.15
		Some college/associate's degree	1.13	0.80–1.61	0.5
		Bachelor's degree	0.91	0.61–1.36	0.6
		Postgraduate study/professional degree	1.16	0.74–1.82	0.5
	Last dental visit	Within the last year	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>More than a year ago</b>	<b>2.10</b>	<b>1.68–2.61</b>	<b>&lt;0.001</b>
Oral health symptom in the last year	No	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	<b>Yes</b>	<b>1.43</b>	<b>1.18–1.73</b>	<b>&lt;0.001</b>	
Dental home	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	<b>No</b>	<b>3.31</b>	<b>2.65–4.15</b>	<b>&lt;0.001</b>	

OR = odds ratio; 95% CI = 95% confidence interval; ref = variable reference level; **bold = significant at p<0.05**

## Appendix E2

## Discrimination and Dignity Regression Analysis Results: I Trusted the Oral Health Provider I Saw

Question	Variable	Categories	OR	95% CI	P value
At my last oral health visit, I trusted the oral health provider I saw. Somewhat or strongly disagree, neither agree nor disagree	Age	18–29 years	ref	ref	ref
		30–44 years	1.13	0.87–1.48	0.4
		45–59 years	1.00	0.76–1.32	>0.9
		<b>60+ years</b>	<b>0.68</b>	<b>0.51–0.91</b>	<b>0.009</b>
	Gender	Male	ref	ref	ref
		Female	1.08	0.90–1.31	0.4
	Race/ethnicity	White	ref	ref	ref
		Black	1.30	0.98–1.72	0.068
		<b>Hispanic</b>	<b>1.59</b>	<b>1.25–2.02</b>	<b>&lt;0.001</b>
		Asian	1.16	0.76–1.72	0.5
		Other	1.05	0.59–1.77	0.9
	Dental insurance	Yes	ref	ref	ref
		No	1.10	0.89–1.35	0.4
	Urbanicity	Rural	ref	ref	ref
		Suburban	1.27	0.97–1.66	0.084
		Urban	1.22	0.92–1.64	0.2
	Income	Less than \$30,000	ref	ref	ref
		\$30,000–under \$60,000	0.89	0.70–1.14	0.3
		<b>\$60,000–under \$100,000</b>	<b>0.63</b>	<b>0.48–0.83</b>	<b>0.001</b>
		<b>\$100,000 or more</b>	<b>0.47</b>	<b>0.34–0.65</b>	<b>&lt;0.001</b>
	Education	Less than high school	ref	ref	ref
		High school graduate or equivalent	1.14	0.82–1.59	0.5
		Some college/associate's degree	1.06	0.76–1.50	0.7
		Bachelor's degree	1.06	0.72–1.55	0.8
		Postgraduate study/professional degree	1.14	0.73–1.77	0.6
	Last dental visit	Within the last year	ref	ref	ref
		<b>More than a year ago</b>	<b>1.85</b>	<b>1.48–2.29</b>	<b>&lt;0.001</b>
Oral health symptom in the last year	No	ref	ref	ref	
	<b>Yes</b>	<b>1.27</b>	<b>1.05–1.53</b>	<b>0.013</b>	
Dental home	Yes	ref	ref	ref	
	<b>No</b>	<b>4.22</b>	<b>3.39–5.28</b>	<b>&lt;0.001</b>	

OR = odds ratio; 95% CI = 95% confidence interval; ref = variable reference level; **bold = significant at p<0.05**

## Appendix E3

## Discrimination and Dignity Regression Analysis Results: My Oral Health Provider Tried to Make Me Feel Comfortable and At Ease

Question	Variable	Categories	OR	95% CI	P value
<b>At my last oral health visit, my oral health provider tried to make me feel comfortable and at ease.</b> <i>Somewhat or strongly disagree, neither agree nor disagree</i>	Age	18–29 years	<i>ref</i>	<i>ref</i>	<i>ref</i>
		30–44 years	1.08	0.83–1.41	0.6
		45–59 years	0.97	0.74–1.28	0.8
		<b>60+ years</b>	<b>0.62</b>	<b>0.47–0.82</b>	<b>&lt;0.001</b>
	Gender	Male	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Female	1.16	0.96–1.40	0.12
	Race/ethnicity	White	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>Black</b>	<b>1.47</b>	<b>1.11–1.93</b>	<b>0.006</b>
		<b>Hispanic</b>	<b>1.50</b>	<b>1.18–1.90</b>	<b>&lt;0.001</b>
		Asian	1.36	0.89–2.01	0.14
		Other	1.02	0.57–1.74	>0.9
	Dental insurance	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>
		No	1.15	0.94–1.41	0.2
	Urbanicity	Rural	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Suburban	1.27	0.98–1.65	0.071
		Urban	1.08	0.82–1.44	0.6
	Income	Less than \$30,000	<i>ref</i>	<i>ref</i>	<i>ref</i>
		\$30,000–under \$60,000	1.06	0.84–1.35	0.6
		\$60,000–under \$100,000	0.81	0.62–1.07	0.14
		<b>\$100,000 or more</b>	<b>0.50</b>	<b>0.36–0.68</b>	<b>&lt;0.001</b>
	Education	Less than high school	<i>ref</i>	<i>ref</i>	<i>ref</i>
		High school graduate or equivalent	1.20	0.87–1.67	0.3
		Some college/associate's degree	0.88	0.63–1.23	0.4
		Bachelor's degree	0.74	0.51–1.09	0.12
		Postgraduate study/professional degree	0.85	0.54–1.31	0.5
	Last dental visit	Within the last year	<i>ref</i>	<i>ref</i>	<i>ref</i>
		<b>More than a year ago</b>	<b>1.71</b>	<b>1.38–2.12</b>	<b>&lt;0.001</b>
	Oral health symptom in the last year	No	<i>ref</i>	<i>ref</i>	<i>ref</i>
<b>Yes</b>		<b>1.31</b>	<b>1.08–1.58</b>	<b>0.005</b>	
Dental home	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	<b>No</b>	<b>3.67</b>	<b>2.94–4.58</b>	<b>&lt;0.001</b>	

OR = odds ratio; 95% CI = 95% confidence interval; ref = variable reference level; **bold = significant at p<0.05**

## Appendix E4

## Discrimination and Dignity Regression Analysis Results: My Oral Health Provider Believed Me

Question	Variable	Categories	OR	95% CI	P value
At my last oral health visit, my oral health provider believed me when I reported my oral health needs, knowledge, and behaviors. <i>Somewhat or strongly disagree, neither agree nor disagree</i>	Age	18–29 years	<i>ref</i>	<i>ref</i>	<i>ref</i>
		30–44 years	1.03	0.81–1.31	0.8
		45–59 years	1.10	0.86–1.41	0.5
		60+ years	0.79	0.62–1.01	0.064
	Gender	Male	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Female	1.03	0.88–1.22	0.7
	Race/ethnicity	White	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Black	1.08	0.84–1.39	0.5
		<b>Hispanic</b>	<b>1.29</b>	<b>1.04–1.59</b>	<b>0.021</b>
		Asian	1.02	0.70–1.46	>0.9
		Other	0.92	0.55–1.50	0.7
	Dental insurance	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>
		No	1.09	0.91–1.31	0.4
	Urbanicity	Rural	<i>ref</i>	<i>ref</i>	<i>ref</i>
		Suburban	1.15	0.92–1.44	0.2
		Urban	1.12	0.87–1.43	0.4
	Income	Less than \$30,000	<i>ref</i>	<i>ref</i>	<i>ref</i>
		\$30,000–under \$60,000	0.89	0.72–1.10	0.3
		<b>\$60,000–under \$100,000</b>	<b>0.68</b>	<b>0.53–0.86</b>	<b>0.002</b>
		<b>\$100,000 or more</b>	<b>0.52</b>	<b>0.39–0.68</b>	<b>&lt;0.001</b>
	Education	Less than high school	<i>ref</i>	<i>ref</i>	<i>ref</i>
		High school graduate or equivalent	1.16	0.87–1.57	0.3
		Some college/associate's degree	0.99	0.73–1.34	>0.9
Bachelor's degree		0.97	0.69–1.36	0.8	
Postgraduate study/professional degree		0.77	0.52–1.15	0.2	
Last dental visit	Within the last year	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	<b>More than a year ago</b>	<b>2.38</b>	<b>1.97–2.87</b>	<b>&lt;0.001</b>	
Oral health symptom in the last year	No	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	Yes	1.07	0.97–1.26	0.4	
Dental home	Yes	<i>ref</i>	<i>ref</i>	<i>ref</i>	
	<b>No</b>	<b>2.34</b>	<b>1.91–2.86</b>	<b>&lt;0.001</b>	

OR = odds ratio; 95% CI = 95% confidence interval; *ref* = variable reference level; **bold** = significant at  $p < 0.05$

---

## CareQuest Institute for Oral Health

CareQuest Institute for Oral Health® is a national nonprofit championing a more equitable future where every person can reach their full potential through excellent health. We do this through our work in grantmaking, research, health improvement programs, policy and advocacy, and education as well as our leadership in dental benefits and innovation advancements. We collaborate with thought leaders, health care providers, patients, and local, state, and federal stakeholders to accelerate oral health care transformation and create a system designed for everyone. To learn more, visit [carequest.org](https://carequest.org).

---

This report and others are available at [carequest.org](https://carequest.org).