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# Mapping paths to equitable dental care: a study on the practice locations of oral health sciences graduates and underserved communities

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BOSTON UNIVERSITY

ARAM V. CHOBANIAN & EDWARD AVEDISIAN SCHOOL OF MEDICINE

Thesis

**MAPPING PATHS TO EQUITABLE DENTAL CARE: A STUDY ON THE  
PRACTICE LOCATIONS OF ORAL HEALTH SCIENCES GRADUATES AND  
UNDERSERVED COMMUNITIES**

by

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B.S., University of Michigan-Dearborn, 2021

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**ABSTRACT**

The Master's in Oral Health Sciences (OHS) program, a collaborative initiative between Boston University's Graduate Medical Sciences and the Henry M. Goldman School of Dental Medicine, has been instrumental since its establishment in 2005 in providing a pathway for students from underrepresented backgrounds to gain admission to dental school. Designed to strengthen academic qualifications for entry into dental school, this program has been crucial in fostering diversity within the dental profession.

Access to dental care is a critical public health concern, particularly in underserved or economically impoverished areas. This research endeavors to explore the career trajectories of pre-dental students who successfully completed the OHS program, pursued dental education, and subsequently became practicing dentists. Our primary objective is to evaluate the geographical distribution of these dental graduates, with a specific focus on whether they returned to similar hometowns or cities to their own upbringing, especially those marked by underservice in dental care.

Data for this study were sourced from deidentified OHS matriculation and graduation records. A comprehensive dataset, including demographic information such as

race, ethnicity, gender, disadvantaged and first-generation status, OHS admission years, and career status, was compiled. Underrepresented minority (URM) status, encompassing Black or African American, Hispanic or Latino, American Indian or Alaska Native, and Native Hawaiian or Other Pacific Islander, was a key focus within the dataset. Furthermore, student career outcomes post-dental school were gathered from online platforms, including social media networks and LinkedIn.

The study evaluated data from 276 students enrolled in the OHS program between 2005 and 2018. This cohort presented a diverse range of demographics, including 47.5% male and 52.2% female, 16.3% disadvantaged, 10.1% first generation students and 28.3% from groups under-represented in dentistry enabling an in-depth examination of career outcomes for students from historically underrepresented racial and ethnic backgrounds.

Through an examination of the practice locations of OHS graduates, we have observed a significant proportion opting to practice in areas marked by dental care shortages and socioeconomic challenges. Specifically, among the 276 OHS graduates, a substantial proportion, accounting for 41.7% of the total, chose to practice in underserved areas. Among the 45 OHS graduates categorized by their disadvantaged status, 42.2% of the graduates opted to practice in underserved areas, aligning their practice locations with the communities they grew up (although not statistically significant ( $\chi^2(1) = 0.007$ ,  $p = 0.9341$ )). Further, among the 78 graduates from underrepresented groups, an even larger percentage, 57.7%, opted to work in underserved areas. The results indicated that there was a statistically significant association between URM status and their likelihood of

working in underserved areas,  $\chi^2 (1) = 0.0007$ ,  $p = 11.489$ . The results not only shed light on the success of the OHS Pathway Program in enhancing diversity within the dental profession but also revealed a distinctive preference among graduates to return to underserved communities to practice.

Additionally, the study underscores the significance of pathway programs and the importance of enrichment programming to support disadvantaged and underrepresented students. These are key to the success of the MS in Oral Health Sciences program. By providing mentorship, academic and professional development resources, and social support, through enrichment and a near-peer mentoring program, not only do graduates' gain professional development but also build the academic and self-confidence they need to be successful in dental school and beyond. Training in such a culture cultivates a sense of social responsibility and commitment to community and addressing disparities.

Further investigation is necessary to understand the factors contributing to dental outcome difference and to explore long-term career outcomes, particularly in terms of location preferences for serving communities in need.

This study underscores the correlation between OHS graduate students and their preferences to serve in areas with underserved populations, encouraged by a strong foundation in the OHS Pathway Program. It emphasizes the growing importance of creating pathway programs similar to OHS to enhance diversity within the dental profession and address healthcare disparities.

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## LIST OF ABBREVIATIONS

ADA	American Dental Association
BU	Boston University
DAT	Dental Admission Test
FPL	Federal Poverty Level
GIS	Geographic Information Systems
HHS	Health and Human Services
HPSA	Health Professional Shortage Areas
HRSA	Health Resources and Services Administration
HURM	Historically Underrepresented Minority
NHSC	National Health Service Corps
NIDCR	National Institute of Dental and Craniofacial Research
OHS	Oral Health Sciences
RHI	Rural Health Information
URM	Underrepresented Minority

## INTRODUCTION

The pursuit of equitable oral healthcare stands as a cornerstone in the quest for comprehensive public health. Within this pursuit, the dental profession serves as a vital conduit, offering pathways for graduates to navigate, each laden with promises of professional growth and societal impact. However, amidst the myriad of opportunities, a poignant reality persists: minority graduates, especially those from underrepresented backgrounds, encounter unique challenges within the dental profession. Despite the positive trajectory of dental education, hurdles loom large, contributing to the persistent underrepresentation of minority groups within dental ranks. Financial constraints, limited access to mentorship, systemic inequalities, and cultural factors serve as formidable barriers, hindering the realization of diversity and inclusivity within the profession (National Institute of Dental and Craniofacial Research (NIDCR), 2021; Mertz et al, 2016; Mertz, Wides, et al., 2017; Mertz, Calvo et al., 2017).

Amidst this backdrop, the Master's in Oral Health Sciences (OHS) program emerges as a collaborative initiative between Boston University's Graduate Medical Sciences and the Henry M. Goldman School of Dental Medicine, designed to pave a pathway for students from underrepresented backgrounds (Boston University Oral Health Sciences Program, (n.d.). Since its establishment in 2005, the OHS program has been instrumental in providing a vital bridge, bolstering the academic qualifications of aspiring dentists and fostering diversity within the dental profession (Davies et al. 2019). At its

core lies a commitment to breaking down barriers and creating opportunities for individuals from diverse backgrounds, including underrepresented minority groups, economically disadvantaged backgrounds, and first-generation college students. In this research, among the 276 OHS graduates included in the analysis, a substantial proportion, accounting for 41.7% of the total, chose to practice in underserved areas. Conversely, the majority of graduates, comprising 58.3% of the total, opted to practice in areas other than underserved ones.

The overarching goal of the OHS program is to empower students to pursue careers in dentistry and become catalysts for change within their communities. Through a rigorous curriculum, mentorship, and hands-on clinical experiences, the program equips students with the skills, knowledge, and confidence needed to succeed in dental school and beyond (Davies et al., 2019; Boston University Oral Health Sciences Curriculum, n.d.). Moreover, the OHS program fosters a culture of inclusivity and equity, recognizing the value of diversity in addressing healthcare disparities and advancing equitable oral healthcare for all.

Against the backdrop of a dental workforce reflective of evolving demographics, the OHS program stands as a testament to the transformative power of education and opportunity. As the dental profession continues its journey towards diversity, equity, and inclusion, the OHS program serves as a path forward towards a more equitable and accessible oral healthcare landscape for all.

## LITERATURE REVIEW

There continues to exist a lack of underrepresentation of clinicians from varied race/ethnic minorities in dentistry. This is well-documented and continues to increase ongoing problems related to access, particularly in underserved communities where disparities in oral health outcomes persist (National Institute of Dental and Craniofacial Research (NIDCR), 2021). One of the contributing factors to these disparities is the lack of diversity within the dental profession. Minority groups, including underrepresented minorities (URMs), face unique challenges in accessing dental care, exacerbating existing inequalities in oral health (NIDCR, 2021). Studies have consistently shown disparities in dental care utilization and oral health outcomes across different demographic groups, with racial and ethnic minorities often experiencing disproportionately higher rates of dental disease and lower access to preventive services. Research has shown that dentists who themselves are disadvantaged or from underrepresented groups will often practice in marginalized areas however the burden to overcome of the diversity-workforce deficit (Mertz et al., 2016; Alexander et al., 2013; Hewett et al., 2022; Prouty et al., 2023).

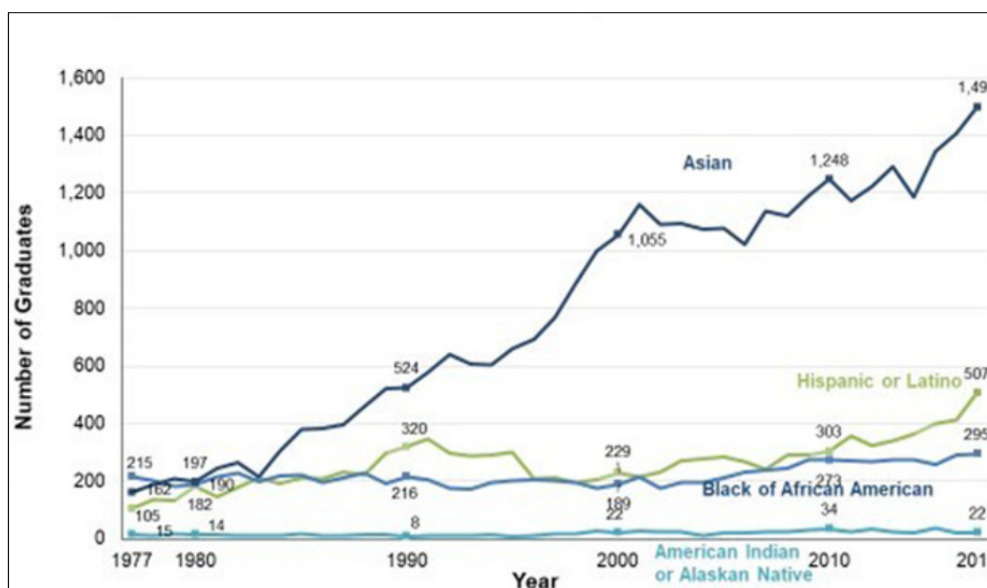
The literature highlights various barriers that contribute to these disparities, including socioeconomic factors, limited access to dental insurance, cultural and language barriers, and geographic maldistribution of dental providers (Patrick et al., 2006; Cadoret & Garcia, 2013). For example, residents of rural and remote areas often face challenges in accessing dental care due to a shortage of dentists and limited availability of dental services. Additionally, individuals from low-income backgrounds and racial or ethnic minority groups are more likely to experience barriers to accessing

dental care, including financial constraints and lack of culturally competent care (Mertz et al., 2016).

### **Pathway Programs as an Answer to Diversity**

Pathway programs have emerged as a promising solution to promote diversity within the dental profession. Over the past 20 years, various programs ranging from 2 to 10-week summer programs (Gravely et al., 2004; Johnson et al., 2013) to non-credentialing post-bac programs and Masters degrees have developed (Giordani, et al., 2001, Wides et al., 2013, Formicola et al., 2010). These programs, including Boston University's Oral Health Sciences (OHS) Master's program, aim to provide students from groups underrepresented in dentistry with opportunities to strengthen their academic qualifications and gain admission to dental school (Davies et al., 2019). The OHS program, established in 2005, has been instrumental in fostering diversity and inclusion within the dental workforce. Studies evaluating the effectiveness of pathway programs have consistently demonstrated positive outcomes in terms of completion of dental school and entry into the workforce promoting diversity enhancement as demonstrated by the more recent study reviewing several of these programs by Johnson et al. (2017). Even a recent reports on best practices by Hewlett et al. (2022) has begun to show some positive trends in increasing number of Hispanic/Latino and Black/African American graduates (Figure 1). These pathway programs provide students from underrepresented backgrounds with mentorship, academic support, and opportunities for professional development, addressing some of the systemic barriers that hinder diversity in the dental profession. Furthermore, pathway programs often prioritize recruiting students from

underserved communities, thereby helping to address geographic disparities in access to dental care (Smith et al., 2009; Brunson et al., 2010; Alexander & Mitchell, 2010; McClain et al., 2013; McCann et al., 2014).



**Figure 1: Dental School Graduate from Minority Groups: 1977-2017**

This line graph illustrates the trends in the representation of minority groups among dental school graduates in the United States from 1977 to 2017. The data includes four distinct minority groups: Asian, Hispanic or Latino, Black or African American, and American Indian or Alaskan Native. Each line on the graph represents a specific minority group, with distinctive colors for clarity. The navy line represents the Asian group, the green line represents the Hispanic or Latino group, the blue line represents the Black or African American group, and the light blue line represents the American Indian or Alaskan Native group. The x-axis of the graph denotes the years from 1977 to 2017, while the y-axis indicates the percentage or proportion of dental school graduates belonging to each minority group. The graph provides a visual depiction of the changes in minority representation within dental school cohorts over the four-decade period. Overall, the graph offers valuable insights into the trends and patterns of minority representation in dental education, highlighting shifts in enrollment demographics and progress in diversity efforts within the dental profession. Taken from Hewlett et al., 2022.

### ***MS in Oral Health Sciences Program***

Pathway programs, such as Boston University's Oral Health Sciences (OHS) program, play a crucial role in promoting diversity within the dental profession and addressing healthcare disparities. In the healthcare sector, where racial and ethnic minorities have long faced underrepresentation, pipeline initiatives play a crucial role in addressing disparities in healthcare access and outcomes. These programs are designed to bridge educational gaps and cultivate interest in healthcare careers among underrepresented groups from an early stage, often starting in pre-college and continuing through post-college endeavors (Gravely et al., 2004; Crall et al., 2009, Smith et al., Part 1, Part 2, 2009; Wides et al, 2013).

Research underscores the importance of racial and ethnic diversity among healthcare providers, as they are more likely to serve underrepresented minority patients, leading to improved patient satisfaction and better communication between practitioners and patients (Smith et al., 2009, Part 1, Part 2). In dentistry, pipeline programs, such as the original Dental Pipeline Program started at BU's Goldman School of Dental Medicine (Crall et al, 2009; Formicola et al., 2010) are specifically tailored to enhance diversity within the profession and address oral health disparities in underserved communities.

By actively recruiting and supporting individuals from underrepresented racial, ethnic, and socioeconomic backgrounds, programs, such as OHS, contribute to creating a more inclusive dental workforce. Moreover, by nurturing talent from these communities, pipeline initiatives aim to cultivate a culturally competent healthcare workforce capable

of effectively serving diverse patient populations (Wides et al, 2013; Greenway et al., 2021; Hewlett et al., 2022).

Given the persistent lack of underrepresented minority representation in dentistry, as highlighted by data from the American Dental Association (ADA), pipeline programs are crucial for addressing potential workforce shortages and ensuring equitable access to dental care services. By identifying and fostering interest in dentistry among promising individuals, these programs help sustain a steady supply of qualified dental professionals, particularly in regions facing shortages or serving underserved communities (Alexander et al., 2013, Greenway et al., 2021).

### **Career Trajectories of Minority Graduates**

Several studies have examined the impact of pipeline programs on the career trajectories of participants and their subsequent practice location choices. Enabulele (2024) conducted a longitudinal study evaluating the outcomes of graduates from the OHS program. Specifically, 75.1% of OHS graduates and 92.2% of URM-OHS graduates pursue careers in general practice, while 24.9% of OHS graduates and 7.8% of URM-OHS graduates opt for specialization in post-graduate programs (Enabulele, 2024). Notably, a lower proportion of URM-OHS graduates choose to specialize compared to national URM graduate trends, warranting further investigation into potential contributing factors and long-term career outcomes.

The study conducted by the University of California, San Francisco School of Dentistry evaluated the long-term practice patterns of participants in the Dental

Postbaccalaureate Program, which was established to support students from economically and/or educationally disadvantaged backgrounds who were previously denied admission to dental school (Wides et al., 2013). The program aimed to enhance diversity in the dental student population and improve access to dental services for underserved communities. Data from 94 program participants were collected to assess short- and mid-term outcomes, including demographics, pre/post-program Dental Admission Test (DAT) scores, and dental school admission results. Long-term outcomes and practice patterns were examined through a census survey administered between 2009 and 2011 to participants who had completed dental school and practiced for at least two years (n=57), with a response rate of 93 percent (Wides et al., 2013). The study found that program participants' DAT scores improved by an average of two points, and 98 percent were accepted to dental school, indicating the program's success in facilitating admission to dental education. Notably, all survey respondents were practicing dentistry, with 81 percent reporting serving underserved populations (Wides et al., 2013). These participants exhibited a higher propensity to treat Medicaid recipients compared to most dentists, and their patient population was more diverse than the general population. These findings underscore the program's effectiveness in increasing diversity within the dental profession and expanding access to oral healthcare for underserved populations. By nurturing and supporting underrepresented students through dental education, the program contributes to addressing healthcare disparities and promoting equity in dental care delivery (Wides et al., 2013).

Similar to the study performed by Wides, Alexander et al. (2013) reported students serving more patients in underserved areas, especially those receiving Medicare. These studies demonstrate that pathway programs prepare students to serve similar population to those with which they were raised.

### **Dentists to Serve in Rural Areas**

Rural areas often face challenges in recruiting and retaining dentists, leading to disparities in access to oral healthcare services. However, programs such as the National Health Service Corps (NHSC) Scholarship Program have been successful in incentivizing dentists to practice in underserved regions. These programs offer loan forgiveness and other financial incentives to dentists who commit to serving in rural or underserved areas, addressing workforce shortages and improving access to care for rural residents.

Despite the success of programs like the NHSC Scholarship Program, recruiting dentists to rural and underserved areas remains a persistent challenge (Prouty et al., 2023). Factors such as limited career opportunities, isolation, and cultural differences between rural and urban settings can deter dentists from practicing in rural areas. Additionally, rural communities often lack the infrastructure and resources necessary to support dental practices, further complicating recruitment efforts (Hewlett et al., 2022).

The geographic distribution of the dental workforce has been a topic of significant interest within the healthcare research community. Several studies have examined the distribution of dentists across different regions, highlighting disparities in access to oral healthcare services. For example, Cha and Cohen (2021) conducted an analysis of dentist-to-population ratios, revealing significant variations in the availability of dental

services between urban and rural areas. The study investigated disparities in dental care utilization between urban and rural areas among adults aged 18-64. Findings revealed significant differences in the receipt of dental services based on geographic location.

Residents in rural areas were found to be less likely to receive preventive dental services and more likely to undergo restorative and oral surgery procedures compared to their urban counterparts (Cha and Cohen, 2021). In 2019, data showed that 66.7% of adults in urban areas and 57.6% of adults in rural areas had visited a dentist within the past 12 months (Cha and Cohen, 2021). Notably, a higher percentage of women than men had utilized dental services in both urban and rural areas. Moreover, disparities were observed across racial and ethnic groups; in urban areas, a higher percentage of non-Hispanic white adults had visited a dentist compared to Hispanic or non-Hispanic black adults, while in rural areas, non-Hispanic white adults were more likely than Hispanic adults to have had a dental visit (Cha and Cohen, 2021). Additionally, the study found that dental care utilization increased with family income as a percentage of the Federal Poverty Level (FPL) in both urban and rural settings. However, the percentage of adults with a dental visit was generally higher in urban areas than in rural areas, except for those with family incomes falling between 139% and 250% of the FPL (Cha and Cohen, 2021).

Understanding the factors influencing practice location decisions among dental graduates is crucial for addressing healthcare disparities and promoting equitable access to oral healthcare services. Studies have investigated the determinants of practice location choices, ranging from personal preferences to socioeconomic considerations. For instance, (Prouty et al. (2023) conducted a qualitative study exploring the motivations

and barriers faced by dentists when choosing practice locations in rural areas. Their findings highlighted the importance of financial incentives, professional support networks, and community engagement in attracting dentists to underserved communities. Participants in the study were predominantly male (75%), under the age of 35 (44%), and white (88%)(Prouty et al. (2023) . A significant proportion of dentists practiced in partnership arrangements (44%). Analysis of the interview data revealed several key themes regarding dentists' motivations and experiences in practicing in rural areas. These themes included familiarity with rural areas, community connections, financial considerations, and aspects of clinical care delivery. Notably, many dentists cited having been raised in a rural area as a major influence in their decision to locate their practice in a rural setting. The findings of this study underscore the importance of considering rural upbringing in dental student admissions processes (Prouty et al. (2023) . Dentists who were raised in rural areas exhibited a strong affinity for practicing in similar environments, highlighting the potential value of recruiting students with rural backgrounds to address dental workforce shortages in underserved regions. Additionally, the study identified other factors such as financial benefits and aspects of clinical care delivery that may further inform recruitment efforts aimed at attracting dentists to rural practice settings (Prouty et al. (2023) . Having exposure to rural living is one of the key factors impacting personal choice to practice in rural environments (Godwin et al., 2014, Prouty et al, 2023). By leveraging these findings, policymakers and dental education programs can develop targeted strategies to enhance recruitment and retention efforts in rural areas, ultimately improving access to dental care for rural residents.

### **Encouraging Students to Work in Underserved Areas**

Evidence suggests that students from pathway programs and underrepresented groups in medicine and dentistry are more likely to return to underserved communities to practice (Alexander et al., 2013; Wides et al., 2013; Prouty et al., 2023). Studies have shown that factors such as cultural familiarity, community connections, and financial incentives influence students' decisions to work in underserved areas (Greenway et al., 2021). By leveraging these findings, educational institutions and policymakers can develop targeted strategies to encourage students to pursue careers in underserved areas, ultimately addressing disparities in access to dental care.

Moreover, initiatives aimed at increasing the diversity of the dental workforce should prioritize recruiting students from rural and underserved backgrounds. Research has shown that individuals who have been raised in rural areas or have personal connections to underserved communities are more likely to practice in these areas (Godwin et al., 2014, Prouty et al, 2023). Therefore, targeting recruitment efforts towards students with rural backgrounds may be an effective strategy for addressing workforce shortages in rural and underserved areas.

Overall, pathway programs and targeted recruitment efforts play a critical role in promoting diversity within the dental profession and addressing disparities in access to oral healthcare services. By addressing the root causes of workforce shortages and enhancing diversity, these initiatives contribute to the goal of achieving equitable access to dental care for all individuals, regardless of their background or geographic location.

Continued research and investment in these programs are essential for addressing the ongoing challenges in dental care delivery and promoting oral health equity.

## OBJECTIVES

The objective of this thesis is to investigate the practice locations of Oral Health Sciences (OHS) graduates, aiming to ascertain whether they are actively serving underserved communities and thereby contributing to the provision of equitable dental care. This research is motivated by the need to address disparities in access to dental services and oral health outcomes, particularly among marginalized populations and underserved communities. Through an exploration of the career trajectories of OHS graduates, this thesis seeks to uncover discernible patterns and trends, shaping their choice of practice locations, with a specific emphasis on areas characterized by dental care shortages and socioeconomic challenges.

The primary goal of this research is to analyze the geographic distribution of OHS graduates and discern significant patterns associated with their selection of practice locations, particularly investigating whether they opt to serve in underserved communities. By examining the demographic characteristics, academic backgrounds, and career outcomes of OHS graduates, this thesis aims to elucidate any potential correlations between students' choice of practice location and their personal childhood demographics or background, or if their selection is primarily driven by personal preference. Identifying such correlations and potential inequities is crucial for developing future initiatives aimed at fostering diversity within the dental profession and addressing healthcare disparities.

Ultimately, by shedding light on the pathways to equitable dental care provision and the pivotal role played by OHS graduates in serving underserved communities, this thesis endeavors to contribute to ongoing efforts geared towards promoting diversity,

inclusivity, and accessibility within the dental profession. Through an exploration of practice locations and their impact on underserved communities, this research seeks to better understand the contribution of pathway programs, such as the MS in Oral Health Sciences, at advancing equitable oral healthcare in area of low socioeconomic status or rural geographic locations.

## **METHODS**

This study, sanctioned by the IRB board at Boston University Medical Campus, received an EXEMPT status (H-33295). To safeguard confidentiality, strict data collection procedures were upheld. These included utilizing a secure database for information storage and immediate de-identification of data upon export.

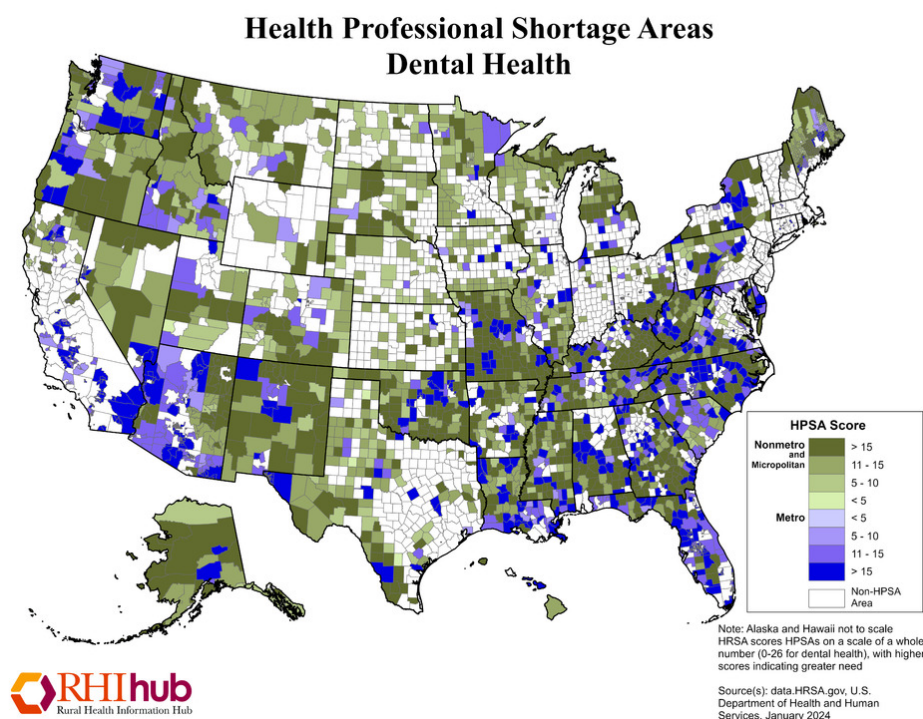
### **Subjects**

Data was evaluated on 276 students enrolled in the MS in Oral Health Sciences program between the years 2005-2018 and dental school between 2009 and 2022. Data for this study were sourced from deidentified OHS admissions and graduation records. A comprehensive dataset, including demographic information such as race, ethnicity, gender, disadvantaged and first-generation status, OHS admission years, and post-graduation career status, was compiled. Underrepresented minority (URM) status, including Black or African American, Hispanic or Latino, American Indian or Alaska Native, and Native Hawaiian or other Pacific Islander, was collected. Student career outcomes post-dental school were gathered from online platforms, including social media networks and LinkedIn.

### **Determination of Underserved Areas**

Underserved areas were identified using the Health Professional Shortage Areas (HPSAs) for Dental Care, by County, 2024 Map, obtained from The Rural Health Information (RHI) Hub (RHI Hub Maps (n.d.)). The Rural Health Information Hub is supported by the Health Resources and Services Administration (HRSA) of the U.S. Department of Health and Human Services (HHS) under Grant Number U56RH05539

(Rural Assistance Center for Federal Office of Rural Health Policy Cooperative Agreement). The Health Professional Shortage Areas (HPSAs) for Dental Care, by County, 2024 Map provides a comprehensive overview of areas across the United States that are designated as having shortages of dental care professionals (RHI Hub - HPSA - Dental Care. (n.d.). These designations are based on various factors, including population-to-provider ratios, geographic accessibility, and the availability of dental services within specific counties. The HPSA map utilized in this study presents a visual representation of dental care shortage areas at the county level, allowing for the identification of regions with limited access to dental services (RHI Hub - HPSA - Dental Care., n.d.). Each county is color-coded based on its designation as either a dental HPSA or a non-HPSA area, providing a clear delineation of underserved and adequately served regions. The HPSA map was analyzed to determine the distribution and prevalence of underserved areas across the United States. Counties designated as dental HPSAs were considered underserved in terms of access to dental care (RHI Hub - HPSA - Dental Care., n.d.) (Figure 2). The prevalence of OHS graduates practicing in these underserved areas was then compared to graduates practicing in non-HPSA counties to assess the extent to which OHS graduates contribute to addressing dental care shortages in underserved communities.



**Figure 2: Health Profession Shortage Areas Nationally for lack of Dental Care**

Shown are the areas nationally based on color for HPSA (Health Profession Shortage Areas) for oral health care across the United State. Taken from (RHI Hub Rural Dental Maps, n.d.)

### **Determination of Practice Locations**

The practice locations of Oral Health Sciences (OHS) graduates were determined based on comprehensive analysis of available data sources. The criteria for determining whether a practice location was considered underserved or not were established using a combination of factors, including geographic designation and demographic characteristics of the served population. Underserved areas were identified based on established criteria, including designation as Health Professional Shortage Areas (HPSAs) for Dental Care, low dentist-to-population ratios, and socioeconomic indicators

indicative of limited access to dental services (RHI Hub - HPSA - Dental Care., n.d.). Additionally, areas with high concentrations of Medicaid recipients, uninsured individuals, and low-income populations were considered underserved. Data sources utilized for determining practice locations included professional licensing databases, healthcare provider directories, and geographic information systems (GIS) mapping tools. These sources provided comprehensive information on the geographic distribution of OHS graduates' practices and allowed for the identification of underserved areas based on predefined criteria. Each practice location was systematically assessed against the predetermined criteria for underserved areas. Practice locations located within designated HPSAs for Dental Care, areas with low dentist-to-population ratios, and regions characterized by socioeconomic disparities were classified as underserved (RHI Hub - HPSA - Dental Care., n.d.). Conversely, practice locations situated in regions with adequate access to dental services and higher socioeconomic indicators were categorized as non-underserved. The proportion of OHS graduates practicing in underserved areas was calculated based on the total number of graduates included in the analysis. The percentage of graduates practicing in underserved areas was determined by dividing the number of graduates in underserved areas by the total number of graduates and multiplying by 100.

### **Statistical Analysis**

All statistical analyses were performed using the latest version of Prism GraphPad, with an alpha significance level set at 0.05 to determine statistical significance. Chi-square

tests of association were performed to evaluate the relationship between disadvantaged status and URM status with the current underserved status of work area.

## RESULTS

The career outcomes of 276 students who successfully completed the Oral Health Sciences (OHS) program within the timeframe spanning from 2005 to 2018 were evaluated in the current study. Students subsequently graduated from dental school between 2009 and 2022, forming the cohort for analysis. A total of 282 students matriculated to OHS during this time frame. Students who did not fulfill the requirements of the study, either by withdrawal from OHS or dental school or by non-matriculation to dental school, were excluded. Additionally, individuals who could not be tracked post-dental school graduation due to logistical constraints or unavailability of contact information were also excluded. The primary criterion for exclusion was the inability to locate students, which could be attributed to factors such as outdated contact information. Ultimately, a total of 276 students were included in the statistical analysis.

### Demographics

The OHS-DMD cohort of 276 students analyzed consisted of 47.5% male and 52.2% female, 16.3% disadvantaged, and 10.1% first generation students. A total of 28 students are first generation and thus are the first from their family to attend college. In terms of race and ethnicity, there was a total of 121 White students accounting for 43.8% of the group of 276, 23 Black (8.3%), 46 Hispanic (16.7%), 71 Asian (25.7%), 2 American Indian, Native Alaskan/Hawaiian or other Pacific Islander (NA/HI & PI) (0.72%), and 13 of mixed races (4.7%).

**Table 1: Demographics of OHS Students Included in Study Cohort**

Shown are number of students, gender, disadvantaged, first generation status of OHS student cohort of 276 total students for years 2005-2018 included in the study. A total of 47.5% male (131 students) and 52.2% female (145 students), 16.3% disadvantaged (45 students), and 10.1% first generation students (28 students).

<b>Year Admitted</b>	<b>Number of Students</b>	<b>Male</b>	<b>Female</b>	<b>Dis-advantaged</b>	<b>First Generation</b>
2005	6	4	2	1	1
2006	13	4	9	0	1
2007	9	4	5	1	0
2008	23	11	12	4	0
2009	15	10	5	2	1
2010	6	4	2	0	0
2011	8	5	3	1	2
2012	17	8	9	4	1
2013	20	9	11	3	3
2014	22	9	13	4	6
2015	24	9	15	2	3
2016	39	20	19	5	4
2017	38	15	23	6	5
2018	36	19	17	12	7
<b>Total</b>	<b>276</b>	<b>131 (47.5%)</b>	<b>145 (52.5%)</b>	<b>45 (16.3%)</b>	<b>28 (10.1%)</b>

Table 2 provides a comprehensive overview of the demographic composition of graduates from the Oral Health Sciences (OHS) program over a span of fourteen years, from 2005 to 2018. The table categorizes 276 graduates based on their racial and ethnic backgrounds, including White, Black, Hispanic, Native American/Hawaiian or Pacific Islander (NA/HI & PI), and Other. In this group, there was a total of 78 students who were considered underrepresented minority, accounting for 28.3% of the entire group (Table 2).

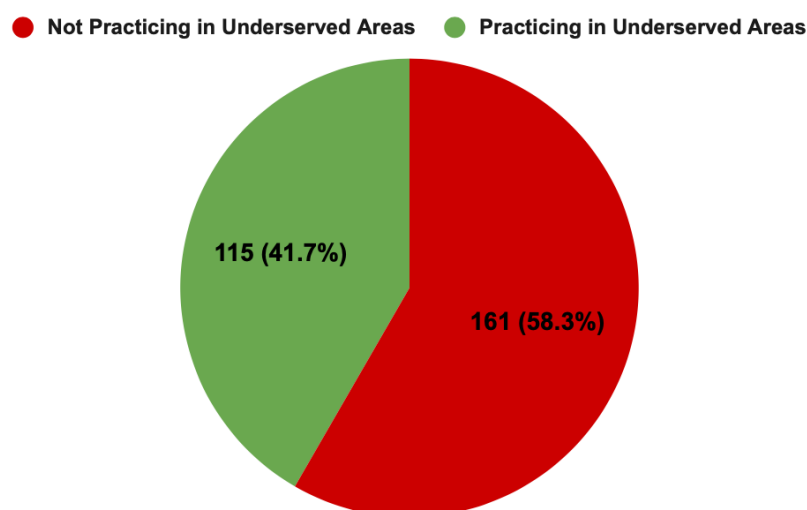
**Table 2: Race and Ethnicity of Graduates from OHS Students Enrolled from 2006-2018.**

Shown are the number of students that identified as different racial/ethnic categories and total URM students enrolled in OHS. Other represents students that identified with two or more races/ethnicities (n=276). Abbreviations: Indian, Native Alaskan/Hawaiian or other Pacific Islander (NA/HI & PI).

<b>Year Admitted</b>	<b>Number of Graduates</b>	<b>White</b>	<b>Asian</b>	<b>Black</b>	<b>Hispanic</b>	<b>(NA/HI &amp; PI)</b>	<b>Other</b>	<b>URM Total</b>
2005	6	4	1	0	1	0	0	1
2006	13	6	2	1	3	0	1	4
2007	9	4	1	3	1	0	0	4
2008	23	13	5	0	1	1	3	2
2009	15	7	3	1	3	0	1	4
2010	6	1	2	0	3	0	0	3
2011	8	3	2	0	2	1	0	3
2012	17	7	7	2	1	0	0	3
2013	20	8	8	0	1	0	3	1
2014	22	10	3	3	6	0	0	9
2015	24	11	3	2	8	0	0	10
2016	39	15	13	2	10	0	0	12
2017	38	16	12	7	3	1	0	11
2018	36	16	9	3	7	1	2	11
Total	276	121 (43.8%)	71 (25.7%)	24 (8.70%)	50 (18.1%)	4 (1.45%)	10 (3.62%)	78 (28.3%)

### Geographic Location and Disadvantage Status

Analysis of the practice location decisions of Oral Health Sciences (OHS) graduates is shown in Figure 3. Among the 276 OHS graduates included in the analysis, a substantial proportion, accounting for 41.7% of the total, chose to practice in underserved areas. Conversely, the majority of graduates, comprising 58.3% of the total, opted to practice in areas other than underserved ones.

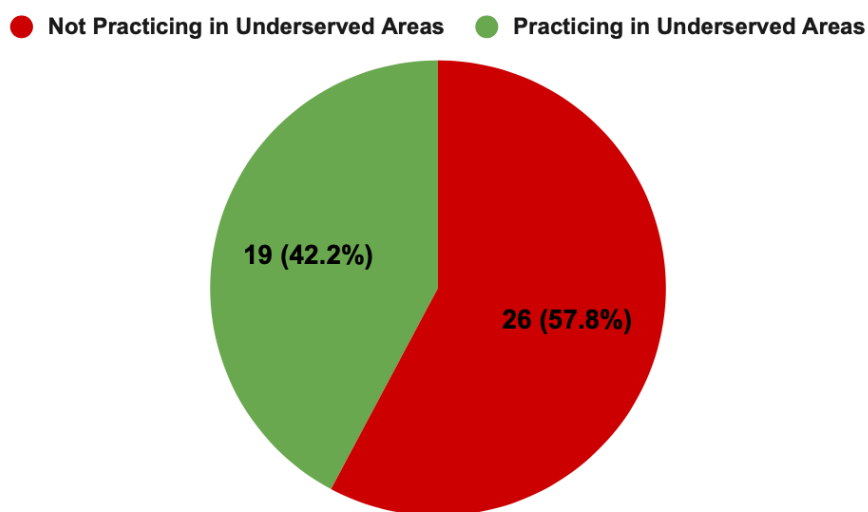


**Figure 3: Distribution of OHS Graduates' Practice Locations**

Geographic placement of Oral Health Sciences (OHS) graduates' practices serving in underserved areas compared to those who did not. The chart represents a total of 276 graduates.

Further analysis, as depicted in Figure 4, explores the practice location choices of graduates based on their disadvantaged status. Among the 45 OHS graduates categorized by their disadvantaged status, 42.2% of the graduates opted to practice in underserved

areas, aligning their practice locations with the communities they grew up in prior to matriculation into the OHS program. In contrast, 57.8% of the total, chose to practice in areas other than underserved ones.

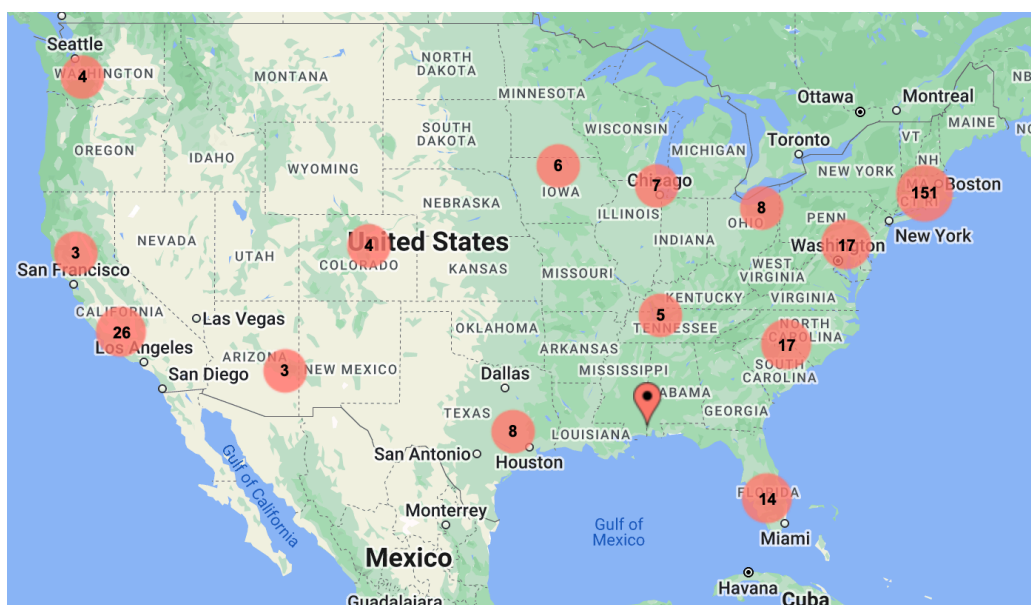


**Figure 4: Distribution of OHS Graduates' Practice Locations Based on Disadvantaged Status**

Geographical placement of Oral Health Sciences (OHS) graduates' practices, categorized by their disadvantaged status for a total of 45 OHS graduates.

In Figure 5, the distribution of Oral Health Sciences (OHS) Graduates' Practice Locations Map provides a visual representation of the geographical placement of OHS graduates' practices across the United States upon completion of their dental degrees. Each practice location is denoted by a numerical marker, showcasing the distribution of OHS graduates' practices throughout the country.

The map highlights a notable concentration of practices, primarily centered around the Midwest region, with a significant concentration observed in Boston, MA with 151 locations there in total. However, beyond this cluster, the map reveals a diverse range of practice locations based on zip codes, indicating that OHS graduates are serving communities across various regions of the United States.



**Figure 5: Distribution of OHS Graduates' Practice Locations Map**

Geographical placement of Oral Health Sciences (OHS) graduates' practices shown on the United States map based on practice location zip codes. The number of practices per area is shown by number. This map was made using the (EasyMapMaker program, n.d.).

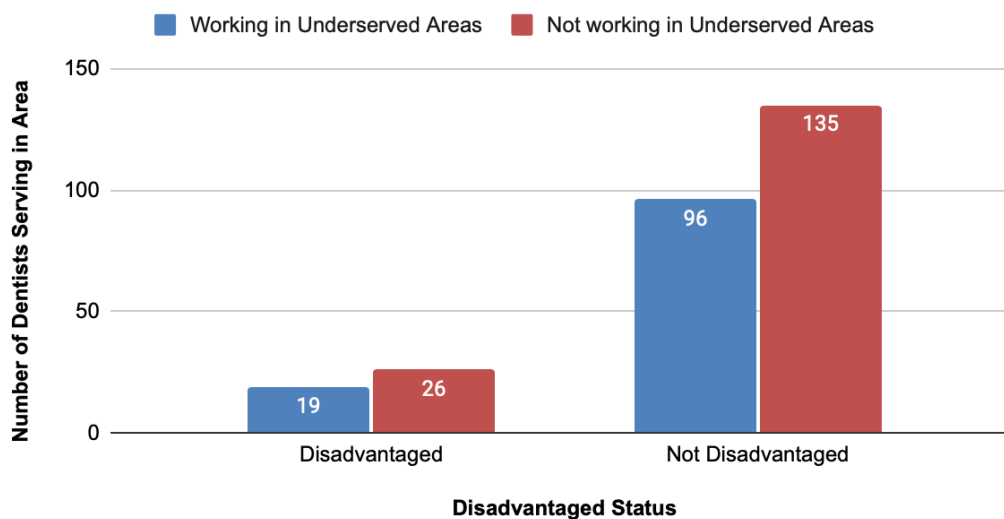
A chi-square test for association was used to evaluate the relationship between underserved status of work area and disadvantaged status. Figure 6 shows the number of participants in each category used for analysis. All expected cell frequencies were greater than five. The results showed no statistically significant association between

disadvantaged status and working in underserved areas,  $\chi^2 (1) = 0.007$ ,  $p = 0.9341$  (Table 3).

**Table 3: Number of Disadvantaged and non-Disadvantaged Graduates Working in Underserved Areas .**

Shown are the data used in a chi-square test for association between underserved status of work area and disadvantaged status. All expected cell frequencies were greater than five. No statistically significant association between factors were found-  $\chi^2 (1) = 0.007$ ,  $p = 0.9341$ .

	<b>Working in Underserved Areas</b>	<b>Not working in Underserved Areas</b>	<b>Total</b>
Disadvantaged	19	26	45
Not Disadvantaged	96	135	231
Total	115	161	276
$\chi^2 (1) = 0.007$ , $p = 0.9341$			



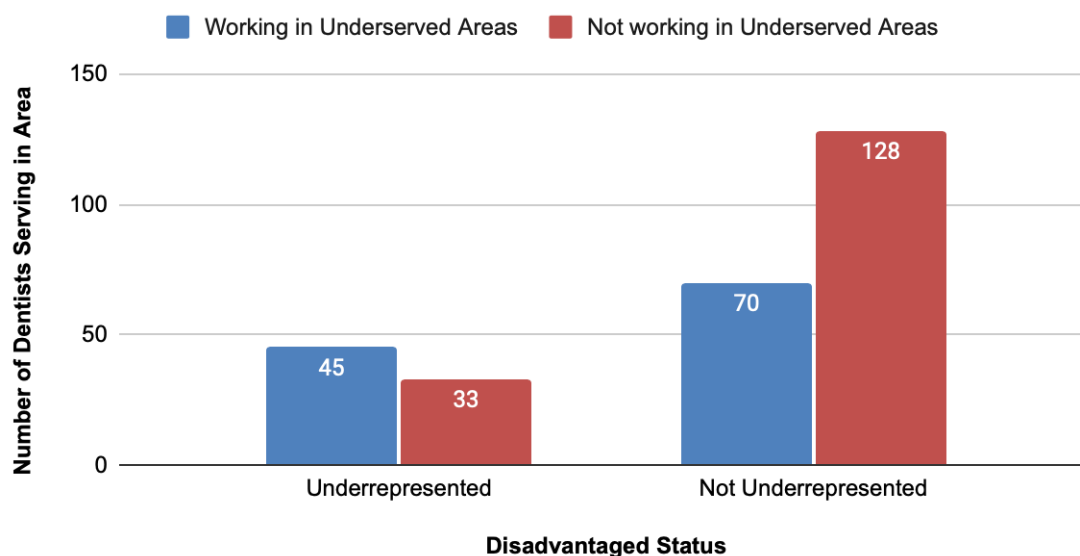
**Figure 6: Working in Underserved Areas and Not working in Underserved Areas**

The bar graph illustrates the distribution of participants across two categories: "Working in Underserved Areas" shown in blue and "Not working in Underserved Areas" shown in red. Each bar represents the number of participants within each category, with the height of the bar indicating the frequency or count. In the disadvantaged group of 45, 19 disadvantaged students ended up working in areas that were disadvantaged, 26 of them ended up not working in underserved areas. For the group of 231 non-disadvantaged students, 96 ended up working in underserved areas and 135 in non-disadvantaged areas. Results of a chi-square test found no statistically significant relationship ( $\chi^2 (1) = 0.007$ ,  $p = 0.9341$ ).

### **Geographic Location and Underrepresented Minority Status**

Among the 78 graduates from underrepresented groups, an even larger percent, 45 of 78 or 57.7%, opted to work in underserved areas (Figure 7). A chi-square test for association was used to evaluate the relationship between underserved status of work area and URM status (Table 4). Figure 7 shows the number of participants in each category used for analysis. All expected cell frequencies were greater than five. The results indicated that there was a statistically significant association between these two factors

and their likelihood of working in underserved areas,  $\chi^2 (1) = 0.0007$ ,  $p = 11.489$  (Table 4). This suggests that the distribution of participants across the categories of working in underserved areas and not working in underserved areas significantly differs between the underrepresented minority groups and the non-underrepresented groups (Table 4).



**Figure 7: Graduates from Underrepresented and non-Underrepresented Minority Groups Working in Underserved Areas and Not working in Underserved Areas**

The bar graph illustrates the distribution of participants across two categories: "Working in Underserved Areas" shown in blue and "Not working in Underserved Areas" shown in red. Each bar represents the number of participants within each category, with the height of the bar indicating the frequency or count. In the URM group of 78, 45 URM students ended up working in areas that were underserved compared to 33 not working in underserved areas. For the group of 198 non-underrepresented students, 70 ended up working in underserved areas and 128 in non-underserved areas. Results of a chi-square test found a statistically significant relationship between group status and working in underserved areas ( $\chi^2 (1) = 0.0007$ ,  $p = 11.489$ ).

**Table 4: Number of Graduates from Underrepresented and Non-Underrepresented Minority Groups Working in Underserved Areas.**

Shown are the data used in a chi-square test for between underserved status of work area and URM status. All expected cell frequencies were greater than five. A statistically significant association between factors were found-  $\chi^2 (1) = 0.0007$ ,  $p = 11.489$ .

	<b>Working in Underserved Areas</b>	<b>Not working in Underserved Areas</b>	<b>Total</b>
Underrepresented	45	33	78
Not Underrepresented	70	128	198
Total	115	161	276
$\chi^2 (1) = 0.0007$ , $p = 11.489$			

## DISCUSSION

The findings presented in this paper offer valuable insights into the practice locations of Oral Health Sciences (OHS) graduates and their impact on underserved communities. By evaluating current locations of graduates and comparing those results with published data from designated HPSAs for dental care, this study contributes to the growing body of knowledge on dental workforce dentist distribution and the potential role that pathway programs, such as the MS in Oral Health Sciences, may play in improving access to dental care in rural and/or underserved areas (RHI Hub - HPSA - Dental Care, n.d.).

Strengths of these studies include the use of large-scale national datasets as a basis to evaluate small pathway programmatic results. For example, Prouty et al. (2023) employed qualitative methods to explore the motivations and barriers faced by dentists when considering practice locations in rural areas, offering valuable insights into the complex decision-making process. They found that the main codes regarding dentists' experiences and motivations to practice in a rural area included familiarity with a rural area, community, financial factors, and clinical care delivery. Having been raised in a rural area was a major influence in most dentists' decisions about where to locate. However, these studies also have certain limitations. One limitation is the lack of granularity in data regarding the specific characteristics of underserved communities and the socioeconomic factors influencing practice location decisions (Prouty et al., 2023). While some studies provide broad classifications of underserved areas, such as rural or urban designations, there is a need for more nuanced analyses that consider factors such

as income level, access to transportation, and availability of healthcare resources (Greenway et al., 2021). Additionally, the studies reviewed primarily focus on descriptive analyses of practice locations, with limited exploration of the underlying motivations and barriers influencing graduates' choices. The visualization in Figure 5 underscores the widespread reach of OHS graduates' practices, demonstrating their commitment to providing dental services in diverse geographical areas. It emphasizes the significance of their contributions to oral healthcare access and underscores the importance of their presence in addressing disparities in underserved communities nationwide.

The interpretation of results reviewed generally aligns with the findings presented. For example, Northridge et al. (2020) acknowledge the disparities in dentist-to-population ratios between urban and rural areas, emphasizing the importance of targeted interventions to address shortages in underserved communities.

Despite the valuable insights provided by previous studies, several questions remain unanswered in the field. One important question is the long-term impact of pathway programs, such as the OHS program, have on the career trajectories of participants and their continued commitment to serving underserved communities. While existing studies have examined short-term outcomes, such as acceptance rates into dental schools and initial practice location choices, there is a need for longitudinal research to assess the sustainability of these outcomes over time. The research conducted at the University of California, San Francisco School of Dentistry on the Dental Postbaccalaureate Program confirms the strength of these programs (Wides et al., 2013). By assessing the short-, mid-, and long-term outcomes of participants in the

postbaccalaureate program, this research provides valuable insights into the effectiveness of pathway programs in achieving these objectives.

The findings of this study align with our research focus on tracking the career trajectories of graduates from pathway programs, such as the OHS program, and determining their contributions to equitable dental care provision (Wides et al., 2013). Specifically, the high acceptance rate of program participants to dental school and their subsequent practice patterns highlight the success of the postbaccalaureate program in preparing individuals from economically and/or educationally disadvantaged backgrounds for careers in dentistry.

Moreover, the significant proportion of program graduates who reported serving underserved populations underscores the program's impact in addressing healthcare disparities and promoting access to oral healthcare services for marginalized communities. The emphasis on treating Medicaid recipients and serving diverse patient populations further demonstrates the program's commitment to fostering a more inclusive and equitable dental workforce (Wides et al., 2013).

Overall, the outcomes of the Dental Postbaccalaureate Program study provide valuable context for understanding the broader implications of pathway programs in enhancing diversity and promoting access to oral healthcare. By corroborating the findings of our research and highlighting the effectiveness of pathway programs in achieving their goals, this study reinforces the importance of ongoing efforts to support and expand such initiatives in dental education (Wides et al., 2013). By adopting a multidimensional approach to understanding practice location decisions, researchers can

develop targeted interventions to support graduates in serving underserved communities effectively.

This study contributes to the greater body of knowledge in the field by providing a comprehensive analysis of the practice locations of OHS graduates and their impact on underserved communities. This study offers valuable insights into factors influencing practice location decisions and highlights the importance of initiatives aimed at fostering diversity within the dental profession. Further survey collection could greatly enhance this study, as well.

Considerably research has explored the role of factors, such as academic support and mentorship programs, community building, networking, and community-based education initiatives, in promoting diversity in dental school applicants and ultimately the dental profession. Many pathway programs and dental schools have reported evidence that education and retention of underrepresented and disadvantaged students are promoted through community building, networking, academic support programming (Alexander et al., 2010; Brunson et al., 2010; McCann, et al., 2013; 2014, Johnson et al., 2019). It is very clear that mentorship and enrichment programs have been found to be very valuable (Smith et al., 2009, Part 1 and 2) and are proven to be very successful.

### **Next Steps**

Moving forward, it is imperative that future research delves deeper into understanding the complex dynamics influencing practice location decisions among dental graduates. While existing studies have provided valuable insights into the factors at play, further exploration is needed to uncover the motivations, barriers, and

considerations that shape graduates' choices regarding their practice locations. This may involve qualitative research methods, such as surveys, to capture the perspectives and experiences of graduates from diverse backgrounds.

It is important to acknowledge potential limitations associated with the use of HPSA maps for identifying underserved areas. While these maps provide valuable insights into geographic disparities in access to dental care, they may not capture all relevant factors influencing dental care provision, such as socioeconomic determinants and cultural barriers (RHI Hub - HPSA - Dental Care, n.d.). Additionally, HPSA designations are subject to periodic updates and revisions, which may impact the accuracy of the data over time. Despite these limitations, HPSA maps remain a valuable resource for researchers and policymakers seeking to understand and address disparities in access to dental services, particularly in underserved and vulnerable communities.

Moreover, longitudinal studies are essential to assess the long-term impact of pathway programs, like the OHS program, on graduates' career trajectories and their sustained commitment to serving underserved communities. By tracking graduates over an extended period, researchers can evaluate the effectiveness of pipeline programs in promoting diversity within the profession and addressing healthcare disparities. This could be done via the use of the LinkedIn Network platform. Longitudinal studies can also provide insights into the factors influencing graduates' retention in underserved areas and their professional development over time. This finding suggests a nuanced relationship between graduates' disadvantaged status and their choice of practice locations, highlighting the influence of personal background and upbringing on career

decisions. As mentioned previously, Enabulele (2024) also reported, 58.3% of the total, chose to practice in areas other than underserved ones and this too should be evaluated.

Overall, the results underscore the multifaceted nature of practice location decisions among OHS graduates. Among the 276 OHS graduates included in the analysis, a substantial proportion, accounting for 41.7% of the total, chose to practice in underserved areas. This finding underscores the significant contribution of OHS graduates to addressing healthcare disparities and providing essential dental care services in communities with limited access to oral healthcare resources.

In addition to examining the impact of pathway programs, researchers should prioritize the development of targeted interventions aimed at supporting student retention and growth of pathway programs to continue to build on such programs. These programs have been shown to rely heavily on support during the pathway program as well as during dental school.

### **MS in Oral Health Sciences Contribution**

The MS in Oral Health Sciences has integrated a rigorous Mentoring Program (Davies et al., 2019) and more recently an Enrichment Program (Davies & Bowley, 2023, Al-Samer, 2023) to further support the rigorous academic programming. This is a critical piece of the success of the program and likely significantly contributes to the 90% success rate of matriculation to dental school (Davies et al, 2019) and the success post-graduation OHS students have with 25% specializing (Enabulele, 2024).

The Mentoring Program serves as a prime example of how such initiatives can effectively shape students' career trajectories and instill in them a sense of responsibility

to give back to their communities. Davies & Bowley (2023) emphasizes the significance of enrichment programs in fostering a holistic development approach for OHS students, preparing them not only academically but also personally and professionally. By providing exposure to dentistry, facilitating networking opportunities with faculty and practicing dentists, and fostering a sense of community, these programs empower students to thrive in dental school and beyond.

The multidimensional nature of enrichment programs ensures that students from underrepresented and disadvantaged backgrounds receive the support they need to succeed in their academic and professional pursuits (Davies & Bowley, 2023, Al-Samer, 2023). By building their academic skills and confidence through rigorous coursework, these programs lay a solid foundation for students to excel in dental school. Moreover, by emphasizing the development of personal and professional skills, such as effective communication and cultural competence, enrichment programs equip students with the tools they need to navigate diverse practice environments and address the unique needs of underserved populations (Al-Samer, 2023).

Furthermore, the mentorship component of these programs plays a crucial role in fostering a sense of accountability and social responsibility among students. As mentors, OHS graduates are uniquely positioned to inspire and guide the next generation of dental professionals, leveraging their own experiences and insights to support others on their academic and professional journeys. By serving as role models and advocates for equitable oral healthcare access, these mentors reinforce the importance of giving back to

underserved communities and perpetuate a cycle of support and empowerment (Davies et al, 2019).

In essence, the integration of mentoring and enrichment programs within the OHS curriculum not only enhances students' academic and professional development but also fosters a culture of service and social responsibility. By nurturing students' passion for dentistry and instilling in them a commitment to serving the underserved, these programs contribute to the broader goal of addressing healthcare disparities and promoting equitable oral healthcare access for all.

In addition to addressing healthcare disparities and promoting equitable access to oral healthcare, it is crucial to recognize the role of mentoring and resource provision during dental school and pathway programs. These initiatives not only equip graduates with essential skills but also instill a sense of responsibility and commitment to their communities. By nurturing a supportive environment and fostering strong mentorship relationships, dental schools and pathway programs can cultivate a culture of giving back to rural and disadvantaged communities (Lacy et al., 2011; 2012).

Furthermore, graduates who have benefited from mentorship and support programs are more likely to become mentors themselves, perpetuating a cycle of community engagement and service (Erlich & Shaughness, 2014; Benè & Bergus, 2014; Davies et al., 2019). This mentorship model not only enhances graduates' professional development but also strengthens the dental workforce in underserved areas. By empowering graduates to become effective mentors and advocates for their communities,

dental schools and pathway programs can amplify their impact on oral health outcomes and healthcare access.

Taking a holistic approach to understanding practice location decisions involves acknowledging the transformative role of mentorship and resource provision in shaping graduates' career trajectories (McClain et al., 2013). By investing in mentorship programs and providing resources to support graduates' professional development, stakeholders can create an environment conducive to community-focused practice (Brunson et al, 2010; Lacy et al., 2011). Ultimately, this approach contributes to building a more inclusive and accessible dental workforce, thereby improving oral health outcomes for individuals in underserved communities.

### **Summary**

In conclusion, this thesis has shed light on the pivotal role of pathway programs, particularly the Oral Health Sciences (OHS) program, in shaping the career trajectories of dental graduates and fostering a commitment to serving underserved communities.

Through a comprehensive examination of the practice locations of OHS graduates, we have observed a significant proportion opting to practice in areas marked by dental care shortages and socioeconomic challenges. Specifically, among the 276 OHS graduates included in the analysis, a substantial proportion, accounting for 41.7% of the total, chose to practice in underserved areas. Among the 45 OHS graduates categorized as disadvantaged status, almost half (42.2%) opted to practice in underserved areas, aligning their practice locations with the communities they grew up in. Further, among the 78 graduates from underrepresented groups, an even larger percent, 45 of 78 or 57.7%,

opted to work in underserved areas. The results indicated that there was a statistically significant association between URM status and their likelihood of working in underserved areas,  $\chi^2 (1) = 0.0007, p = 11.489$ . This finding underscores the effectiveness of pathway programs in addressing healthcare disparities and promoting equitable access to oral healthcare.

A notable aspect highlighted in this study is the influence of mentorship and support provided by pathway programs in nurturing graduates' desire to give back to their communities. By fostering a supportive environment and providing resources for professional development, pathway programs empower graduates to become effective mentors and advocates for underserved populations. This mentorship model not only enhances graduates' career satisfaction and fulfillment but also strengthens the dental workforce in areas with limited access to care.

Furthermore, the findings of this research underscore the importance of considering personal backgrounds and experiences in understanding practice location decisions among dental graduates. Graduates who have benefited from pathway programs, especially those from underrepresented or disadvantaged backgrounds, are more likely to return to their communities to address oral health disparities (Wides et al., 2013; Alexander et al., 2013; Hewlett et al., 2022). This highlights the transformative impact of pathway programs in promoting diversity, inclusivity, and community engagement within the dental profession.

In essence, this study underscores the significance of pathway programs in nurturing a new generation of dental professionals committed to serving underserved

communities while also diversifying the dental workforce. By providing mentorship, resources, and support, pathway programs not only enhance graduates' professional development but also cultivate a sense of social responsibility and commitment to addressing healthcare disparities. Moving forward, continued investment in pathway programs and mentorship initiatives is essential to building a more inclusive and accessible dental workforce and improving oral health outcomes for all individuals, regardless of their socioeconomic status or geographic location.

## LIST OF JOURNAL ABBREVIATIONS

Acad Med .....	Academic Medicine
Annu Rev Public Health .....	Annual Review Public Health
BMC Oral Health.....	BMC Oral Health
Fam Med.....	Family Medicine
Health Aff (Millwood) .....	Health Affairs (Millwood)
J Am Coll Dent .....	Journal of the American College of Dentists
J Dent Educ.....	Journal of Dental Education
J Evid Based Dent Pract.....	Journal of Evidence-Based Dental Practice
J Natl Med Assoc .....	Journal of the National Medical Association
J Public Health Dent .....	Journal of Public Health Dentistry
Med Teach .....	Medical Teacher
NCHS Data Brief.....	National Center for Health Statistics Data Brief

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**VITA**

