UCLA CENTER FOR HEALTH POLICY RESEARCH

Assessing the Contribution of the Dental Care System to Oral Health Care Disparities

Final Report to
The National Institute for Dental and Craniofacial Research

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Executive Summary

Background

A vicious cycle perpetuates disparities in the oral health of underserved populations: oral health status declines with limited access to dental care which in turn leads to further decline of oral health status. Improving access to dental care is the solution most likely to break this cycle and reduce observed disparities in oral health of underserved populations. Much of the effort in addressing disparities in access to dental care is focused on public insurance provision and federal funding for designated dental health professional shortage areas (DHPSA). Yet in spite of these efforts, inequalities persist. One specific shortfall in the DHPSA designation lies with the assumption that increased prevalence of dentists or dental personnel increases access to dental care in general. Such a measure of supply does not account for the dental care delivery system characteristics that ultimately influence the dentists' facility to provide dental care, thereby limiting the effectiveness of policies aimed at reducing these disparities. Furthermore, the scope of prior research on dentist characteristics and their impact on access has been limited to disparities in the type of clinical care delivered to patients and predictors of public program participation. Such a limited scope has been due primarily to a paucity of detailed data on the private practice dentists who supply the majority of dental care in the United States.

This project seeks to provide an original assessment of the impact of dentist and practice characteristics on access to dental care for underserved populations, beyond the existing individual demographic and socioeconomic predictors. The specific aims of the study were:

Aim #1. To assess the impact of the dental care delivery system on access to dental care of underserved populations, measured by characteristics of dentists.

Aim #2. To assess the potential differences in impact of the dental care delivery system on specific categories of the underserved, such as low-income, and racial/ethnic populations.

Methods

Dentist characteristics from a 2003 California survey of private practice dentists (California Dentist Survey; CDS) and population level data from the 2003 California Health Interview Survey (CHIS) were merged at the Medical Study Service Area (MSSA) to conduct this study. We augmented this data with statewide data on the number of dentists practicing in public settings, including safety-net clinics and dental schools, and Census data on aggregate population characteristics. We expanded on the conceptual framework developed by Andersen and developed an analytic framework for examining the relationship of the characteristics of dentists on access to dental care.

To examine the proposed hypotheses we developed random effects logistic models to account for the sampling error associated with use of the CDS data as contextual variables. We examined adults and children separately to account for inherent differences in need and service use of each group, and conducted stratified analyses by poverty and race/ethnicity to assess whether disparities in access were present. We examined two indicators of access to dental care: 1) having a dental visit in the past year and 2) having reported foregoing or delaying needed dental care due to costs in the past year. Independent variables included dentists' personal and practice characteristics as well as overall measures of supply of dentists. We controlled for the impact of individual level determinants of access including predisposing, enabling and need indicators. We also controlled for the impact of overall supply of private and public practice dentists as well as the aggregate racial/ethnic makeup of the population.

Summary of Findings and Conclusions

Hypothesis 1

Impact of supply of dentists who are nearing retirement age on annual visits. The larger supply of dentists nearing retirement age in an MSSA was associated with lower likelihood of an annual visit for adults below 200% FPL, Asian Americans, and Latinos. This hypothesis is confirmed. The findings seem to indicate that the older dentists may have reduced productivity which negatively impacts the underserved in their access to dental services.

Impact of supply of dentists who are nearing retirement age on unmet need. The larger supply of dentists nearing retirement age in an MSSA was associated with lower likelihood of unmet need for children below 200% FPL and Latino children, but a higher likelihood of unmet need for white children. These findings partially confirm the hypothesis of reduced productivity but not for the disadvantaged. In fact, the findings indicate that older dentists may be more likely to see underserved children in their practice by virtue of practicing in underserved areas and being more willing to treat children.

Impact of supply of newly graduated dentists on annual visits. The larger supply of dentists who are recent graduates in an MSSA was associated with lower likelihood of an annual visit for children at or above 200% FPL. This finding does not confirm the hypothesis. Younger dentists do not positively impact access for the underserved.

Impact of supply of newly graduated dentists on unmet need. The larger supply of dentists who are recent graduates in an MSSA was associated with higher likelihood of unmet need for children at or above 200% FPL, African American adults and Latino children. These findings are the reverse of hypothesis that newly graduated dentists reduce disparities. The reason for the findings may be that

younger dentists working on their own have small practices and lower productivity as a result. Others who work as associates in larger practices may be located in areas with high levels of need.

Impact of supply of dentists who are non-white on annual visits. The larger supply of dentists who are non-white in an MSSA was associated with lower likelihood of an annual visit for African American adults. This finding does not support the hypothesis. The reason for this finding may be lack of racial/ethnic concordance between dentists and patients given that a very small percentage of dentists in California are African American, Latino, or American Indian/Alaska Native. The majority of California dentists are white followed by Asian American. However, the great majority of the California population are white and Latino, followed by Asian Americans and others.

Impact of supply of dentists who are non-white on unmet need. The larger supply of dentists who are non-white in an MSSA was associated with lower likelihood of unmet need for children at or above 200% FPL and Asian American adults. These findings confirm the hypothesis.

Impact of supply of dentists who are generalists on annual visits. The larger supply of dentists who are generalists in an MSSA was associated with higher likelihood of an annual visit for children below 200% FPL and Latino children. These findings confirm the hypothesis and indicate that more generalist dentists may alleviate disparities in visits for underserved children because it is easier to find a dentist who sees underserved children.

Impact of supply of dentists who are generalists on unmet need. The larger supply of dentists who are generalists in an MSSA was associated with higher likelihood of unmet need for Asian American adults. This finding does not confirm the hypothesis and indicates a reverse effect than expected for one underserved group. The reason for this finding is not immediately apparent.

Impact of supply of dentists who are female on annual visits. The larger supply of dentists who are female in an MSSA was associated with higher likelihood of an annual visit for both adults and children overall, for children at or above 200% FPL and for white adults. These findings do not confirm the hypothesis that female dentist lead to lower visits for the underserved. However, the findings indicated a strong association with higher likelihood of a visit for better served populations. The findings may indicate differentials in female dentists' provision of preventive care and their willingness to treat children.

Impact of supply of dentists who are female on unmet need. The larger supply of dentists who are female in an MSSA was associated with lower likelihood of unmet need for children overall, adults at or above 200% FPL, white children and adults, and African American, Asian American, and Latino adults. These findings also are the reverse of what was hypothesized. Female dentist may be more willing to provide care to some underserved populations, even if their work weeks may be shorter.

Hypothesis 2

Impact of supply of visits per dentist (average number of visits per week) on annual visits. There were no significant independent associations for this indicator. This hypothesis is not confirmed.

Impact of supply of productive visits per week on unmet need. There were no significant independent associations for this indicator. This hypothesis is not confirmed.

Impact of supply of dentists who own or are partners in their practice on annual visits. There were no significant independent associations for this indicator. This hypothesis is not confirmed.

Impact of supply of dentists who own or are partners in their practice on unmet need. The larger supply of dentists who own or are partners in their practice in an MSSA was associated with higher likelihood of unmet need for children at or above 200% FPL. This hypothesis is not confirmed. The reason for the observed impact among the higher income population is not immediately apparent.

Impact of supply of dentists who employ hygienists on annual visits. There were no significant independent associations for this indicator. This hypothesis is not confirmed.

Impact of supply of dentists who employ hygienists on unmet need. The larger supply of dentists who employ at least one hygienist in an MSSA was associated with lower likelihood of unmet need for adults at or above 200% FPL. This hypothesis is not confirmed. However, this most likely reflects the higher level of demand for preventive care among higher income populations.

Impact of supply of dentists who employ two or more dental assistants on annual visits. The larger supply of dentists who employ two or more dental assistants in an MSSA was associated with lower likelihood of an annual visit for children overall, children at or above 200% FPL, and white adults. This hypothesis is not confirmed. However, these findings indicate that there may be differentials in types of care provided in general and to better served populations by dentists with more dental assistants. The higher number of dental assistants in a practice is found to be associated with provision of less preventive care and more aesthetic care in other research.

Impact of supply of dentists who employ two or more dental assistants on unmet need. There were no significant independent associations for this indicator. This hypothesis is not confirmed.

Impact of supply of dentists who have more than one practice location on annual visits. The larger supply of dentists who have more than one practice location in an MSSA was associated with higher likelihood of an annual visit for adults below 200% FPL. This hypothesis is not confirmed and the finding is the reverse of what was expected. Multiple locations appears to increase availability of dental care in more areas, even if that availability may be restricted to less than full-time presence of a dentist.

This finding indicates that even limited access in some areas improves access to dental care for low income populations.

Impact of supply of dentists who have more than one practice location on unmet need. The larger supply of dentists who have more than one practice location in an MSSA was associated with lower likelihood of unmet need for Latino adults and a higher likelihood for Latino children. This hypothesis is partially confirmed. The limited time spent by dentists in a second or more locations may be spent providing care to adults rather than children. Other research indicates that dentists are less willing to provide care to young children.

Impact of supply of dentists who are busy or overworked on annual visits. The larger supply of dentists who are busy or overworked in an MSSA was associated with lower likelihood of an annual visit for adults overall, adults at or above 200% FPL and white and Asian American adults. However, it was associated with a higher likelihood of visits for children at or above 200% FPL. This hypothesis is not confirmed. Busy or overworked dentists are perhaps busy due to higher demand in their area of practice but may also be more busy because they are providing care to better served populations.

Impact of supply of dentists who are busy or overworked on unmet need. The larger supply of dentists who are busy or overworked in an MSSA was associated with lower likelihood of unmet need for adults overall and a higher likelihood of unmet need for children overall, children below 200% FPL, and Latino children. This hypothesis is not confirmed. These findings indicate that in areas with high level of demand, the needs of children in general and underserved children in particular are less likely to be met.

Impact of supply of dentists who have shorter appointments (lower than the median of 45 minutes) on annual visits. The larger supply of dentists who have shorter appointments in an MSSA was associated with higher likelihood of an annual visit for Latino adults. This hypothesis is confirmed. However, the findings may be an indication of practice differences by dentists or demand for care, since shorter appointments may reflect less advanced or intensive treatment.

Impact of supply of dentists who have shorter appointments (lower than the median of 45 minutes) on unmet need. There were no significant independent associations for this indicator. This hypothesis is not confirmed.

Impact of supply of dentists who have long waits for appointments (more than the median of 5 days) on annual visits. The larger supply of dentists who have long waits for appointments in an MSSA was associated with lower likelihood of an annual visit for children overall. This hypothesis is not confirmed in the sense that no differences for underserved populations were observed. However, to the degree that children may be considered underserved, this finding indicates that dentists with long wait

times (due to higher demand or fewer work hours or other reasons) do not see many children in their practice.

Impact of supply of dentists who have long waits for appointments (more than the median of 5 days) on unmet need. The larger supply of dentists who have long waits for appointments in an MSSA was associated with lower likelihood of unmet need for adults below 200% FPL and adults at or above 200% FPL and white and Latino adults. This hypothesis is not confirmed and is the reverse of what is expected. The findings may be because the dentists with long wait times are more in demand because they are more likely to accept low income patients or provide discounts.

Hypothesis 3

Impact of supply of dentists who offer discounted fees on annual visits. The larger supply of dentists who offer discounted fees in an MSSA was associated with higher likelihood of an annual visit for adults and children below 200% of FPL and Latino adults. This hypothesis is confirmed. Even though the level of discount provided was not available in this data, the findings indicate the importance of availability of lower cost dental care on improved rates of visits among the underserved.

Impact of supply of dentists who offer discounted fees on unmet need. The larger supply of dentists who offer discounted fees in an MSSA was associated with lower likelihood of unmet need for children overall, children below 200% FPL, white children, and Latino children. This hypothesis is confirmed. However, discounted care seems to also improve access for better served populations as well as the underserved.

Impact of supply of dentists who accept publicly insured patients in their practice on annual visits. The larger supply of dentists who accept publicly insured patients in their practice in an MSSA was associated with lower likelihood of an annual visit for children overall, children below 200% FPL, white adults, and Latino children. This hypothesis is not confirmed. About 40% of dentists in the sample reported accepting publicly insured patients. It appears that this limited group of dentist may prefer adult patients over children.

Impact of supply of dentists who accept publicly insured patients in their practice on unmet need. The larger supply of dentists who accept publicly insured patients in their practice in an MSSA was associated with higher likelihood of unmet need for adults at or above 200% FPL and African American adults. This hypothesis is not confirmed. These findings may reflect the level of demand for dentists who accept public insurance and the shortage of such dentists.

Impact of supply of dentists who had no bilingual/multilingual capacity (dentist and staff spoke English only) on annual visits. The larger supply of dentists who had no bilingual capacity in an

MSSA was associated with lower likelihood of an annual visit for adults at or above 200% FPL. This hypothesis is not confirmed.

Impact of supply of dentists who had no bilingual/multilingual capacity (dentist and staff spoke English only) on unmet need. The larger supply of dentists who had no bilingual capacity in an MSSA was associated with higher likelihood of unmet need for adults below 200% of FPL. This hypothesis is confirmed. This finding may indicate the possibility that dentists without bilingual/multilingual capacity do not see as many low-income populations.

Hypothesis 4

Impact of overall supply of public dentists (full-time equivalent dentist per 5,000 population) on annual visits. The larger supply of public dentists per population in an MSSA was associated with lower likelihood of an annual visit overall and for white adults. This hypothesis is not confirmed and the finding represents the reverse of the original hypothesis. This finding most likely reflects the high level of demand for care in areas where safety net clinics and dental schools are located.

Impact of overall supply of public dentists (full-time equivalent dentist per 5,000 population) on unmet need. The larger supply of public dentists per population in an MSSA was associated with higher likelihood of unmet need for Latino adults. This hypothesis is not confirmed. This finding most likely reflects the high level of demand for care in areas where safety net clinics and dental schools are located.

Hypothesis 5

Impact of overall supply of private dentists (full-time equivalent dentist per 5,000 population) on annual visits. The larger overall supply of dentists in an MSSA was associated with higher likelihood of an annual visit for adults overall, adults and children at or above 200% FPL, and white adults and white children. This hypothesis is not confirmed. This finding indicates that the overall supply of dentists improves access to care, but not significantly for underserved populations.

Impact of overall supply of private dentists (full-time equivalent dentist per 5,000 population) on unmet need. There were no significant independent associations for this indicator. This hypothesis is not confirmed.

Policy Implications

A vicious cycle perpetuates disparities in oral health of underserved populations: oral health status declines with limited access to dental care which in turn leads to further decline of oral health status. Improving access to dental care is the solution most likely to break this cycle and reduce observed

disparities in oral health of underserved populations. The policy implications of the findings include, but are not limited to, the following:

- Understanding the specific aspects of the dental workforce, particularly dentists, is essential in understanding access to care barriers for underserved populations. Such understanding requires collection of data on the dentist workforce beyond the number of actively licensed dentists. Licensing boards can be the vehicle for collecting a number of important characteristics. Such data should be available for continuous monitoring of the impact of public policies or other changes in supply of dental providers on disparities.

- The reasons for more limited access of children in general and underserved children in particular should be closely examined and addressed. Training dentists with very young children can improve their skills and comfort level. Allowing independent practice for alternative providers including dental hygienists may be another way of improving access to care of children.

- Focused intervention in areas with higher concentration of aging or newly graduated dentists is required to improve access to care of underserved populations in those areas. Attracting more experienced dentist of African American or Latino descent or female dentists to underserved areas should also be considered. Efforts to training more African American and Latino dentists should continue.

- A better assessment of dental care needs and demand for dental care among underserved populations is needed. Statewide representative population-based telephone surveys could also be a vehicle to assess demand for dental care at a more local level.

- Part-time presence of dentists in underserved areas is also beneficial, if not optimal. However, better needs assessment at the local level is needed to better understand the solutions for improving access when dentists maybe overwhelmed with demand.

- Data on the level of discounts that improve access to care is needed to better understand the role of discounts on access. Policies that address the ability to pay for care by improving dental insurance coverage and improving benefits should be considered. The 2010 Patient Protection and Affordable Care Act mandates the availability of dental policies for children under the Health Benefit Exchange and in the Essential Health Benefits Package definition. Dental access could be strengthened for adults by offering dental plans in the Exchange or by including dental benefits in the adult benefits package.

- Increases in Medicaid fees are a policy solution that is unlikely to be implemented as budget shortages continue to plague the nation. However, improved fees for children services under Medicaid may address the apparent disparities experienced by children with such coverage. In addition, improved payments to safety net providers may also help particularly for Medicaid insured adults in California, though publicly insured patients still have to compete with privately insured and higher income patients for those services.

Chapter One: Introduction

National data on dental care utilization has shown that disparities in access to care for disadvantaged populations depend on individual characteristics such as dental insurance and socioeconomic status. Thus, much of the effort on promoting access to dental care is focused on providing public insurance and directing federal funds to low-cost providers in designated dental health professional shortage areas (DHPSA). Yet, difficulties in access to care persist despite availability of public insurance and in areas that are designated as DHPSA.[2-4] The designation of shortage area and other measures of supply of dental care are based on the assumption that presence of dentists or dental personnel will increase access to dental care in general. Previous studies of the supply of dentists and dental personnel have primarily measured supply using presence of dentists in an area.[5] Such measures fall short of evaluating dentists' true capacity for providing dental care. Dentist characteristics such as part-time employment, number of staff and chairs (or operatories), accepting public coverage, and reduced fees are essential components of measuring the capacity for provision of care to the underserved, but are generally unavailable in studies of access. The dearth of information on these characteristics of the dental care delivery system hinders the formation of policies aiming to address systemic barriers that perpetuate disparities in access to care for underserved populations.

Background and Significance

Underserved populations such as children, elderly, minorities, the uninsured, and the low-income have been shown to experience disparities in access to dental care as measured by dentist visits.[3, 6-11] Lower utilization has been linked to poorer oral health status and thus these populations are considered underserved with limited access to dental care.[7, 8] The unequal burden of oral disease among these underserved populations and their difficulties in marshaling resources to address their dental health needs are well documented.[8, 12] Policies to address such difficulties include provision of affordable dental care and public coverage of dental care to the most vulnerable. However, increasing evidence shows that many of the underserved still fall through the cracks due to the inadequacies of the dental care delivery system.[2, 13-16]

Emerging empirical evidence demonstrates that the characteristics of the medical care delivery system impact access to medical care on the community's residents.[17-21] Community level characteristics, including per capita income and the presence of medical safety-net providers, present the context in which the individual can obtain services, and these characteristics can promote or inhibit use.[1] The importance of characteristics of practicing dentists on access to dental care in a geographic area is recognized by the Health Services and Resource Administration, Bureau of Health Professions and used as the basis for designation of dental health professional shortage areas (DHPSA). The capacity for delivery of care is measured by age of the dentist, the number of hours the dentist works (full-time

equivalent or FTE), and the number of allied personnel in the practice.[22] While the importance of dental provider characteristics are acknowledged in this context, research that quantifies and measures the impact of these and other characteristics of dentists on access to care has been generally restricted to the examination of supply using limited licensure or professional association membership data.[5] The scarcity of research on more detailed characteristics of the dental care system is primarily due to lack of detailed data on characteristics of the dentists in private practice who provide the majority of dental care in the U.S.

Research on dentist characteristics and their impact on access is, thus far, limited to studies of disparities in the type of clinical care delivered to patients[23, 24] and predictors of participation in public programs. At least two studies have indicated that dentists' and physicians' specialty, gender, race, number of years in practice, and solo practice are linked to provision of care to publicly insured patients.[25, 26] Using 2003 survey of California dentists, the PIs of this project found that bilingual/multilingual capacity in practice, acceptance of discounted fees, multiple practice locations, shorter appointment times, and provision of more operative, periodontic, and surgical care are additional factors that are associated with dentists' provision of care to publicly insured patients.[27]

Detailed data on characteristics of private practice dentists are regularly collected by the American Dental Association at the national level and, occasionally, a limited number of variables are summarized at the state level. However, other than the 2003 California Dental Survey (CDS) conducted by the PIs, few have the sufficient sample size or the level of detail needed to examine the comprehensive characteristics of dentists at the community level. Similarly, other than the California Health Interview Survey (CHIS) used in this study, few state or national population level data have the sufficient sample size and the geographic data needed to estimate access to dental care at the community level. To our knowledge, no previous studies have successfully combined population level data with dentists' characteristics (as a measure of the dental care delivery system) to assess the relationship of the dental care delivery system with access to care of the underserved.

Chapter Two: Specific Aims, Conceptual Framework, and Hypothesis

Specific Aims

This project aims to gauge the impact of the dental care delivery system on access to dental care of underserved populations, beyond existing predictors such as individuals' demographic and socioeconomic factors. The specific aims of the project were:

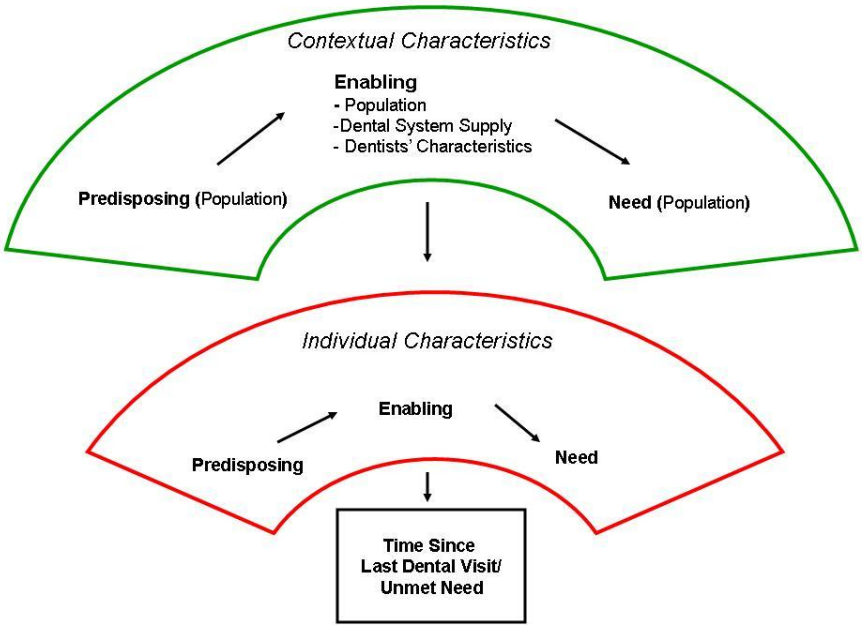
Aim #1. To assess the impact of the dental care delivery system on access to dental care of underserved populations, measured by characteristics of dentists.

Aim #2. To assess the potential differences in impact of the dental care delivery system on specific categories of the underserved, such as low-income, and racial/ethnic populations.

Conceptual Framework

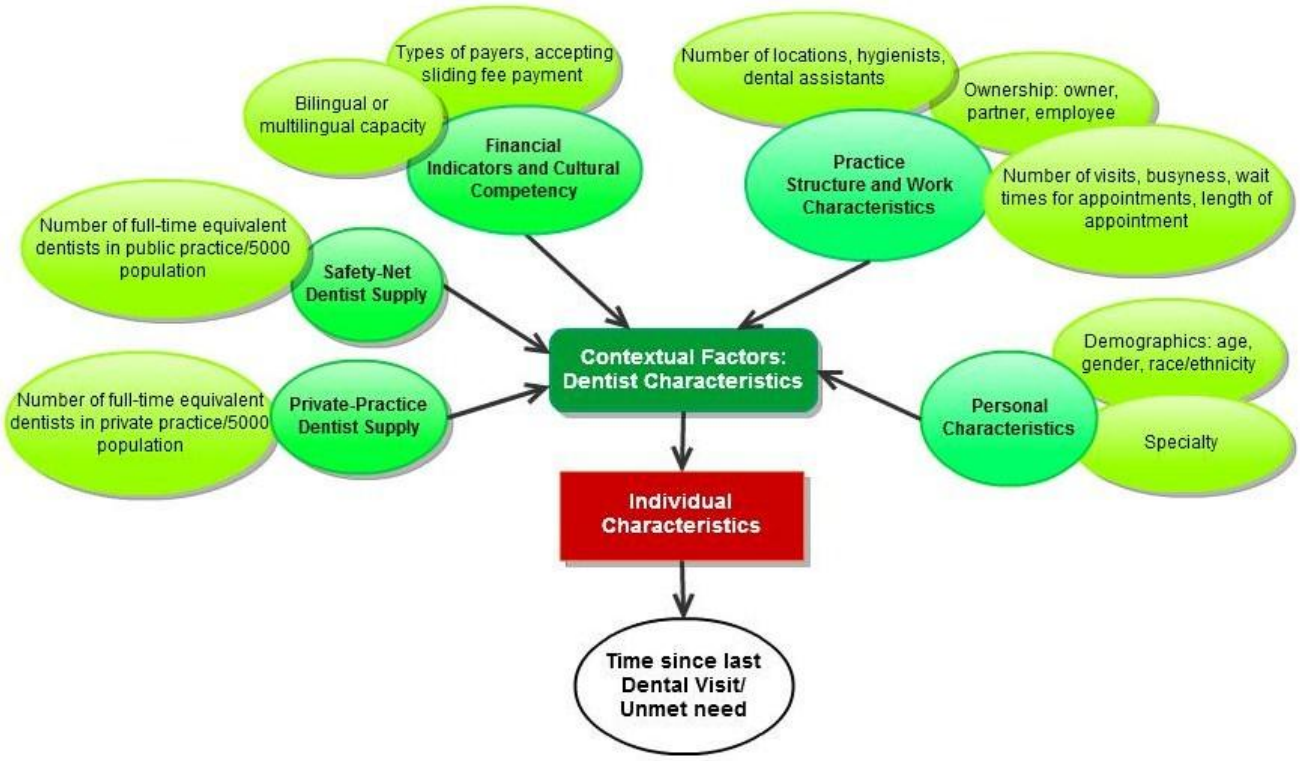
The conceptual framework of the study is based on the model developed by Andersen,[1] which is used in numerous settings, including dental care, and proposes that utilization of services by individuals is a function of individual and contextual characteristics (Exhibit 1a). At the individual level, utilization is determined by predisposing (e.g. age), enabling (e.g. insurance), and need (e.g. illness) factors. The relationship between the individual variables and utilization is modified by the context within which the individual seeks care. Contextual factors can include the characteristics of the larger community (e.g. age, poverty, or illness) as well as the characteristics of the health care delivery system (e.g. supply of health care providers or their characteristics).

Exhibit 1a. Conceptual framework for dental utilization based on Andersen's model.



We developed an analytic framework to further illustrate the relationship of dentist characteristics with access to care (Exhibit 1b). Characteristics of dentists include (demographics, training); practice structure (ownership; size); work characteristics (volume of care, care delivery characteristics); and financial indicators (income, discounted care).

Exhibit 1b. Analytic framework illustrating supply and of characteristics dentists and their role in dental utilization.



Hypotheses

Hypothesis 1: As the percentage of private dentists in the community who are nearing retirement age, are female, are specialists, or are white increases, the odds of having a dental visit by underserved populations will decrease (as compared to whites). These predicted odds are based on empirical evidence that suggests that older and female dentists provide less care than younger and male dentists who are more likely to work full-time and longer hours. On the other hand, newly graduated dentists are more likely to work full-time and longer hours. Some specialists, other than pediatric dentists, provide less general care than non-specialists. In addition, white dentists have a smaller proportion of minority patients in their practices than do minority dentists.

Hypothesis 2: As the percentage of private dentists in the community increases who have smaller practices as indicated by fewer visits, do not own their practice or are not partners, no hygienists, less than two dental assistants, more than one office location, not busy or overworked status, longer

appointment times per visit, or longer waiting times to get an appointment, the odds of having a dental visit by underserved populations will decrease and the odds of having unmet dental care will increase (as compared to whites). Alternatively, as the percentage of dentists with larger and more productive practices, as indicated by the reverse of the measures indicated above increases, the odds of having a dental visit will increase and the odds of having unmet dental care will decrease. These predicted odds are informed by preliminary analyses of CDS data where these characteristics were found to contribute to the probability of dentists' participation in care of publicly insured patients.

Hypothesis 3: As the percentage of private dentists in the MSSA who can accommodate the specific needs or characteristics of the underserved populations, as indicated by accepting discounted fees, accepting publicly insured patients, or having bilingual/multilingual capacity in practice increases, the odds of having a dental visit by underserved populations will increase and the odds of having unmet dental need will decrease (as compared to whites). These odds are predicted based on the preliminary analyses of the CDS data that showed dentists participating in public programs were more likely to have such characteristics. Given the higher prevalence of low income, LEP, and publicly insured among the underserved populations, it is expected that dentists with such practice characteristics are more likely to provide care to all underserved populations and will increase access of the underserved to dental care.

Hypothesis 4: The increase in the total number of full-time equivalent dentists in dental safety-net community clinics and dental schools within the MSSA where the individual resides per 5000 MSSA population will increase the odds of having a dental visit and decrease the odds of having unmet dental need for the underserved (as compared to whites). These odds are based on the premise that public safety-net providers are an important source of dental care to underserved populations and improve access to care accordingly.

Hypothesis 5: As the private practice dentist to population ratio increases, the odds of having a dental visit by underserved populations will increase and the odds of having unmet dental need will decrease (as compared to whites). These odds are predicted based on the premise that increases in the number of providers and their staff will lead to more competition for available patients and will lead to greater access by underserved populations.

Chapter Three: Methods

Data and Sample

We used multiple data sources to achieve the aforementioned specific aims. These data sources are described below.

The California Health Interview Survey (CHIS 2003)

Data on characteristics and utilization of the civilian non-institutionalized population in California was obtained from the 2003 California Health Interview Survey (CHIS). CHIS is the largest state level health data source and covers a broad range of public health topics. A total of 42,000 individuals were surveyed on their demographics, health status, and health care utilization. The interviews were conducted in the second half of 2003 in English, Spanish, Mandarin, Cantonese, Korean, and Vietnamese in order to capture the diverse populations of California and include monolingual populations of the state. CHIS 2003 data is geocoded based on the respondents' residence information, making CHIS the dataset of choice for merging of contextual variables at the geographic level. CHIS data have been compared with the California samples of NHIS and MEPS data extensively and a number of basic estimates have been found to be comparable across the surveys, indicating reliability of the data despite the comparatively lower CHIS response rate. The literature on surveys of physicians indicates that response rates are routinely in the 40-50% range.[29] The extended response rate of CHIS 2003 is 60%. Of all sampled respondents, 55.9% were screened for eligibility.[30] Additionally, the response rate in CHIS 2003 is similar to that of other large telephone surveys such as the 2003 California Behavioral Risk Factor Surveillance System.

California Dentist Survey (CDS 2003)

Data on private practice dentists was obtained from the 2003 California Dentist Survey, which sampled California dentists in private practice for estimating practice characteristics. The sample included about 14,000 licensed dentists in California stratified by county of practice or, if practice address was unavailable, by residence. The primary practice location of each dentist is geocoded, providing the ability to link this data at the geographic level with CHIS 2003. Dentists eligible for the survey actively practiced in dentist owned private practices and were not specialists such as oral and maxillofacial surgeons, oral and maxillofacial pathologists, oral and maxillofacial radiologists, and public health dentists. Dentist were mailed a survey and offered a free 5-unit continuing education course as an incentive. Extensive mail and telephone survey follow up efforts yielded over 4,400 completed surveys with an overall unadjusted response rate of 31%. Adjusted response rates of 40%-51% (most to least conservative) were calculated discounting ineligible, unlocatable and unknown eligibility groups using the follow-up and screener data.[31, 32] Analysis of survey non-respondents using existing California

Dental Association data on active licensure status, age, gender, location, years since graduation, and specialty did not reveal any differences with survey respondents. CDS data was weighted to account for sampling design and non-response based on Yang's propensity model approach.[33] The only comparable data to CDS is the American Dental Association survey, with similar questions to CDS. We found remarkable similarities between CDS and the 2003 American Dental Association data which indicates the CDS data are likely to be relatively reliable given the response rate.

Other Data Sources

Data on the characteristics of the population by geographic areas were obtained from Census 2000 Summary File 3 (SF3), a 5% sample weighted to represent the entire population of the U.S.[34] Data on the DHPSA designation were obtained from the California Office of Statewide Health Planning and Development (OSHPD). To analyze and control for the capacity of safety net dental care providers, which consists primarily of dentists working in clinics and other non-private settings, we included data from the 2003 OSHPD Primary Care Clinics Annual Utilization Data. OSHPD data included information on dentists working in federally-funded or free-standing community clinics as well as those affiliated with hospitals, dental and hygiene schools, or local governments. Though the data does not represent the universe of the safety-net providers, it is the best approximation publicly available. We also obtained data on the number of full-time equivalent dental students and dental school faculty providing patient care in 2003 in all California dental schools and satellite clinics by geographic location.

CDS, OSHPD, Census and dental school clinic data were merged with 2003 CHIS data at the Medical Service Study Area (MSSA) level. The MSSA is a set of one or more complete census tracts, not crossing county lines, and is recognized by the US Public Health Service as a rational service area for providing primary health care services. Where possible, the census tracts within an MSSA are within 30 minutes travel time to the largest populated location, and urban and rural MSSAs are separately designated. Urban MSSAs' have a population range of 75,000 to 125,000, but could be as large as 200,000 individuals. The minimum size of an urban MSSA is five square miles unless the population density exceeds 200,000, in which case the MSSA can be smaller. Rural MSSAs have a population density of less than 250 individuals per square mile and the population of a rural MSSA would not exceed 50,000. MSSA boundaries reflect community and neighborhood boundaries as well as demographics such as income level and ethnicity.

The California Office of Statewide Health Planning and Development (OSHPD) designates MSSA after each decadal census and uses MSSAs to further designate Dental Health Professional Shortage Areas (DHPSA),[35] if an application for such designation is filed by an entity such as a community health center. Some areas with low supply of dentists may not receive a DHPSA designation due to the considerable burden of collecting specific data by organizations seeking the DHPSA designation.

DHPSA designations will also be merged with the CHIS data at the MSSA level. DHPSAs have a 5,000:1 or 4,000:1 population to general practice dentist ratio, and include populations that are considered unusually high need and experience dental care access barriers due to distance to and overutilization of existing resources. A DHPSA designation can bring funding and scholarships for training of general dentists in return for services in the DHPSA, as well as loan repayment program through the National Health Service Corps.[36]

We assessed the number, type, and capacity for care of dental safety-net providers in each MSSA and merged the data at the MSSA level. The location of safety-net providers was geocoded and merged with the CHIS data. Census 2000 data was available at the census tract level and was aggregated at the MSSA level and merged with CHIS. Of 542 California MSSAs, 14 had no dentists in 2003 and a further 14% were not represented in the CDS data and were excluded from the final dataset. All MSSAs had CHIS respondents. The complete merged dataset provided individual-level data from CHIS along with contextual data from the CDS, OSHPD, Census and dental schools at the MSSA level.

The final sample size included 39,960 adults and 11,103 children (51,063 total individuals) who resided in MSSAs with practicing dentists and with available data on the characteristics of those dentists.

Dependent Variables

Access to dental care was measured by two variables. The first was time since last dental visit wherein we examined whether a respondent had a dental visit within the past year, the recommended timeframe for dental care. The second variable measured whether a respondent reported having foregone or delayed needed dental care due to costs (unmet need). This variable was also considered a proxy for affordability of dental care.

Independent Variables

Independent variables were at the individual level and contextual level. The independent variables of interest were the characteristics of dentists in private practice at the MSSA level. These characteristics include: percentage of dentists over age 60, percentage of nonwhite dentists, percentage of generalist dentists, percentage of female dentists, percentage of dentists who employ 2 or more dental assistants, percentage of dentists reporting being busy or overworked, percent of dentists who own or are partner in dental practice, percentage of dentists who have multiple practice locations, percentage of dentists who report lower than median wait time for an appointment (5 days), percentage of dentists who report lower than median appointment length (45 min), percentage of dentists who employ a dental hygienist, percentage of dentists who accept discounted fees, percentage of dentists who accept public insurance, percentage of dentists and office staff who speak English only, average number of dental visits in a week, and ratio of full-time equivalent dentist to 5,000 population. All but the last two of these

variables were dichotomous variables in the CDS data, the proportion with each characteristic per MSSA was calculated and this data was merged with CHIS data at the MSSA level. The latter two variables were continuous variables and were averaged per MSSA and merged with CHIS data.

The control variables include individual level predisposing determinants including age, gender, race/ethnicity, limited English proficiency, citizenship, college education, and urban/rural residence. Individual enabling determinants included federal poverty level (FPL) of less than 200% vs. higher and dental insurance coverage. Individual need determinants included general self-assessed health status (in the absence of dental health status in CHIS data), chronic conditions such as asthma and diabetes, and smoking status. Population level contextual and predisposing determinants include percentages of non-whites in the MSSA. Additional contextual indicators of supply included the number of full-time dentists in public clinics and the number of full-time dental school student and faculty providing patient care at the dental school and affiliated clinics.

Analysis methods

Consistent with the hypotheses and goal of this study, we focused on the impact of dental care system characteristics on access to care and controlled for alternative explanations for access differentials to the degree possible. To examine the hypotheses of the independent and joint effect of dental system and control variables, we developed two general models of access to dental care as follows.

$\text{Logit}[p(Y)] = \beta X + \gamma Z_i$; Where $Z_i \sim (Z, \Sigma)$

Where **Y** is a binomial variable (**Model 1**) with those who reported a dental visit in the past year versus those who did not (reference group); **X** is a vector of controls including individual and other contextual factors. $\mathbf{Z_i}$ is a vector of dentists' characteristics including demographics, availability of discounted fees, and size of private practices (staffing and multiple offices). $\mathbf{Z_i}$ is considered to be random, as these elements are estimates from the CDS survey. The included measurement error is externally approximated though variance estimates of the CDS variables in $\mathbf{Z_i}$ and is represented in the models by **Σ**. Furthermore, the variables in $\mathbf{Z_i}$ are assumed to be independent and normally distributed. **Model 2** is a logistic model where **Y** is a binomial variable with those who reported foregoing or delaying needed dental care due to costs in the past year (unmet need) versus those who did not (reference group). All other elements are similar to Model 1.

The impact of the dental care delivery system on access to dental care of underserved populations (Aim 1) was assessed by first creating a model of access (separately for children and adults) with only the independent variable of interest (the unadjusted model), followed by similar models including the independent variable of interest as well as all control variables (the adjusted model). The examination

of the coefficient for each independent variable of interest in unadjusted and adjusted model allowed for a better understanding of the role of these contextual variables on access to dental care.

The relationship of dental care system predictors on access to dental care of the underserved population is examined separately for children and adults to accommodate for the systematic differences in a number and type of predictors of access in each population. Within each group, the relationship of dental care system predictors and access were examined for the following categories of underserved populations when sample sizes allowed: Latinos, Asian Americans, African Americans, American Indians, and those living at or near poverty (less than 200% of the federal poverty level or FPL). Access to care of these populations was compared to whites and those living at higher levels of FPL, respectively.

A number of variables were proposed for inclusion in the analysis but were excluded later on because of lack or scarcity of data, colinearity with other indicators, and model non-convergence. These included years of residence in the U.S., missed school or work due to dental problems, population limited English proficiency, population proportion of those aged 65 and older, percentage of the population below 100% of the federal poverty level, designation of dental health professional shortage area, percent of the population reporting good dental health and fluoridation of drinking water.

The GLIMMIX procedure in SAS v. 9.1.3 statistical software was used to produce the random effects estimates for these models. We examined the relationship of each independent variable of interest in separate models. We included the ratio of private dentists to 5,000 as well as the ratio of public dentists to 5,000 population in the MSSA in each model to control for the role of overall supply of dental providers in a given MSSA. We carefully examined the limitations of the Bonferroni adjustment, particularly the high probability of type II error. We discussed the findings in terms of broad patterns of findings to reduce the emphasis on individually significant results rather than applying the Bonferroni adjustment.

We created a series of four models with the same dependent variable for each independent variable of interest. All adjusted models were controlled for individual's age, gender, race/ethnicity, limited English proficiency, citizenship, college education, urban/rural residence, federal poverty level, dental insurance coverage, asthma, diabetes, and smoking status. Each adjusted model also controlled for percentage of non-white populations in the MSSA. Other controls included the ratio of full-time equivalent dentists in public clinics and dental school student and faculty providing patient care and the ratio of full-time equivalent dentists in private practice per 5,000 population.

Chapter Four: Results

The characteristics of the individuals in the sample are displayed in Exhibit 2. The majority of the adult (71%) and child (81%) population in the sample reported having had a visit in the past year. Also, 18% of adult and 8% of the child population reported having delayed or foregone dental care due to costs in the past year.

Exhibit 2. Individual Sample Characteristics.

Adult Sample	
Sample Size	39,960
Last Visited Dentist Less Than a Year Ago	67%
Delayed or Forgone Needed Dental Care Due to Costs in Past Year	20%
Demographic Characteristics	
Age	
18-64	85%
65+	15%
Female	51%
Race/Ethnicity	
White	52%
African American	6%
Latino	26%
Asian-American	12%
American Indian	1%
Other	3%
College Education or higher	56%
Citizenship	
US Born or Naturalized Citizen	82%
Non-Citizen	18%
English Language Proficiency	
Native English Speaker	73%
Speaks English Well	11%
Speaks English Not Well/Not At All	16%
Rural	10%
200%FPL or greater	67%
Health Insurance and Status	
Dental Insurance	
No Dental Insurance	35%
Public Insurance	12%
Private Insurance	53%
Fair/Poor Health	20%
Has Asthma	12%
Has Diabetes	7%
Smoking Status	
Currently smokes	16%
Quit smoking	24%
Never smoked	60%

Child/Teen Sample	
Sample Size	11,103
Last Visited Dentist Less Than a Year Ago	80%
Delayed or Forgone Needed Dental Care Due to Costs in Past Year	9%
Demographic Characteristics	
Age	
2-5	24%
6-11	38%
12-14	20%
15-17	18%
Female	49%
Race/Ethnicity	
White	41%
African American	8%
Latino	36%
Asian-American	10%
American Indian	2%
Other	3%
Adult Respondent has College Education or higher	60%
Citizenship	
US Born or Naturalized Citizen	92%
Non-Citizen	8%
Rural	10%
200% FPL or greater	56%
Health Insurance and Status	
Dental Insurance	
No Dental Insurance	18%
Public Insurance	32%
Private Insurance	50%
Fair/Poor Health	9%
Missed School Due to Dental Problem	7%
Has Asthma	16%

The contextual characteristics are displayed in Exhibit 3.

Exhibit 3. Contextual Sample Characteristics.

Sample Size	51,063
	Average per MSSA
Percent of dentists over age 60	14%
Percent of dentists who graduated within past 5 years	10%
Percent of nonwhite dentists	10%
Percent of generalist dentists	87%
Percent of female dentists	25%
Average number of dental visits in a week	39
Percent of dentists who own or are partner in dental practice	80%
Percent of dentists who employ a dental hygienist	45%
Percent of dentists who employ 2 or more dental assistants	62%
Percent of dentists who have multiple practice locations	15%
Percent of dentists reporting being busy or overworked	24%
Percent of dentists who report lower than median appointment length (45 min)	38%
Percent of dentists who report lower than median wait time for an appointment (5 days)	50%
Percent of dentists who accept discounted fees	52%
Percent of dentists who accept public insurance	47%
Percent of dentists and office staff who speak English only	2%
Public safety-net dentist to population ratio (per 5,000)	0.34
Dentist to population ratio (per 5,000)	2.86

The role of Dentist characteristics on the likelihood of a dental visit within the past year

Exhibit 4 displays the association of independent variables of interest from the unadjusted and adjusted models and for each hypothesis.

Hypothesis 1*: As the percentage of private dentists in the community who are nearing retirement age, are female, are specialists, or are white increases, the odds of having a dental visit by underserved populations decreases.*

Percent of Dentists nearing retirement age in an MSSA. We examined the proportion of dentists in a given MSSA that were over 60 and found that:

- No significant associations were found for adults or children in adjusted or unadjusted models (Exhibit 4).

- A decline in likelihood of a visit in the past year for adults under 200% FPL, only in the adjusted model (Exhibit 5).
- No significant differences were found for those at or above 200% FPL (Exhibit 6).
- No significant associations were found for whites (Exhibit 7).
- No significant associations were found for African Americans (Exhibit 8).
- A decline in the likelihood of a visit was found for Asian American adults in the adjusted model and Asian American Children in the unadjusted model (Exhibit 9). The adjusted model for children did not converge.
- A decline in the likelihood of having a dental visit was found for Latino adults in the adjusted model only (Exhibit 10).
- The American Indian/Alaska Native adult and child models did not converge (Exhibit 11).

Percent of newly graduated dentists in an MSSA. We examined the proportion of dentists in a given MSSA who had graduated within the past 5 years and found that:

- A higher likelihood of a visit was found for adults in the unadjusted model only (Exhibit 4).
- A higher likelihood of a visit was found for adults in the unadjusted model only for adults under 200% FPL (Exhibit 5).
- A lower likelihood of a visit was found for children in both models for those at or above 200% FPL (Exhibit 6).
- No significant associations were found for whites (Exhibit 7).
- No significant associations were found for African Americans (Exhibit 8).
- No significant associations were found for Asian Americans (Exhibit 9). The adjusted model for children did not converge.
- A higher likelihood of a visit was found for adults in the unadjusted model only for Latinos (Exhibit 10).
- No significant associations were found for American Indian/Alaska Native adult and child unadjusted models. The adjusted models did not converge (Exhibit 11).

Percentage of dentists in an MSSA who are white. We examined the percentage of dentists in an MSSA who are non-white and found that:

- No significant associations were found for adults or children in adjusted or unadjusted models (Exhibit 4)
- No significant associations were for adults or children in adjusted or unadjusted models for those below 200% FPL (Exhibit 5).
- No significant associations were for adults or children in adjusted or unadjusted models for those at or above 200% FPL (Exhibit 6).
- A decline in the likelihood of having a visit was found for white adults in the unadjusted model only (Exhibit 7).
- A decline in the likelihood of a visit was found for African American adults in adjusted model only (Exhibit 8).
- No significant associations were found for Asian American adults or children in adjusted or unadjusted models (Exhibit 9).
- No significant associations were found for Latino adults or children in adjusted or unadjusted models (Exhibit 10).
- No significant associations were found for American Indian/Alaska Native in unadjusted models (Exhibit 11). Adjusted models did not converge.

Percentage of dentists in an MSSA who are generalist. We found that:

- A lower likelihood of having had a visit in the past year was found in the unadjusted model for adults only (Exhibit 4).
- A higher likelihood of having had a visit in the past year was found for children below 200% FPL in both adjusted and unadjusted models, but no association for adults (Exhibit 5).
- A lower likelihood of having a visit was found for both adults and children at or above 200% of FPL in unadjusted models but no association in adjusted models (Exhibit 6).
- A lower likelihood of visits for white adults and children was found in unadjusted model only (Exhibit 7).

- No significant associations were found for African American adults or children in adjusted or unadjusted models (Exhibit 8).
- No significant associations were found for Asian American adults or children in adjusted or unadjusted models (Exhibit 9).
- A higher likelihood of a visit was found for Latino children in the adjusted model (Exhibit 10).
- No significant associations were found for American Indian/Alaska Native adults or children in unadjusted models (Exhibit 11). Adjusted models did not converge.

Percentage of dentists in an MSSA who are female. We found that:

- A higher likelihood of having had a visit in the past year was found in all the models for adults and children (Exhibit 4).
- A higher likelihood of a visit was found for adults and children below 200% of FPL in unadjusted models only (Exhibit 5).
- A higher likelihood of a visit was found for adults in the unadjusted model for adults and a higher likelihood of visits in the adjusted model for children for those at or above 200% FPL (Exhibit 6).
- A higher likelihood of a visit was found for white adults in unadjusted and adjusted models but not for white children (Exhibit 7).
- A higher likelihood of a visit was found for African American children in the unadjusted model, and the adjusted model did not converge and there are no results to present (Exhibit 8).
- A higher likelihood of a visit was found for Asian American adults in the unadjusted model only (Exhibit 9).
- No significant associations were found for Latino adults or children in adjusted or unadjusted models (Exhibit 10).
- No significant associations were found for American Indian/Alaska Native adults in unadjusted model (Exhibit 11). Other models did not converge.

Hypothesis 2*: Increases in the percentage of private dentists who have smaller practices as indicated by fewer visits, no associates or contractor dentists, no hygienists, less than two dental assistants, more than one office location, not busy or overworked status, longer appointment times per visit, or longer waiting times to get an appointment, will lead to decreases in the odds of having a dental visit by underserved.*

Average number of dental visits by private dentists per MSSA. We found that:

- No significant associations were found for adults and children in adjusted or unadjusted models (Exhibit 4).
- No significant associations were found for adults and children below 200% of FPL in adjusted or unadjusted models (Exhibit 5).
- No significant associations were found for adults and children in adjusted or unadjusted models for those at or above 200% FPL (Exhibit 6).
- No significant associations were found for adults and children in adjusted or unadjusted models for whites (Exhibit 7).
- No significant associations were found for adults and children in adjusted or unadjusted models for African Americans (Exhibit 8).
- A higher likelihood of a visit was found for Asian American adults in the unadjusted model only (Exhibit 9).
- No significant associations were found for Latino adults or children in adjusted or unadjusted models (Exhibit 10).
- No significant associations were found for American Indian/Alaska Native adults or children in unadjusted models (Exhibit 11). Adjusted models did not converge.

Percent of dentists with no associates or contracted dentists in an MSSA. We examined the percent of dentist who owned or were partners in the dental practice. This variable was highly correlated with the number of FTE dentists per practice, which was not tested in the hypotheses as a result. We found that:

- A lower likelihood of a visit was found for adults and children in the unadjusted models only (Exhibit 4).
- A lower likelihood of a visit was found for children in unadjusted model only for those below 200% of FPL (Exhibit 5).
- No significant associations were found for adults and children in adjusted or unadjusted models for those at or above 200% FPL (Exhibit 6).
- No significant associations were found for adults and children in adjusted or unadjusted models for whites (Exhibit 7).

- A lower likelihood of a visit was found for children in the unadjusted model for African Americans and no results are available for the adjusted child model due to non-convergence (Exhibit 8).
- No significant associations were found for adults and children in adjusted or unadjusted models for Asian Americans (Exhibit 9).
- A higher likelihood of a visit was found for children in the unadjusted model only for Latinos (Exhibit 10).
- No significant associations were found for American Indian/Alaska Native in unadjusted models (Exhibit 11). Adjusted models did not converge.

Percent of dentists with no hygienist in an MSSA. We examined the percent of dentists who employ a dental hygienist and found that:

- A higher likelihood of a visit was found for adults in both adjusted and unadjusted models and for children in the unadjusted model only (Exhibit 4).
- No significant associations were found for adults and children in adjusted or unadjusted models for those below 200% of FPL (Exhibit 5).
- A higher likelihood of a visit was found for adults and children in unadjusted models only for those at or above 200% FPL (Exhibit 6).
- A higher likelihood of a visit was found for adults in unadjusted model only for whites (Exhibit 7).
- No significant associations were found for adults and children in adjusted or unadjusted models for African Americans (Exhibit 8).
- A higher likelihood of a visit was found for adults in unadjusted model only for Asian Americans (Exhibit 9).
- No significant associations were found for adults and children in adjusted or unadjusted models for Latinos (Exhibit 10).
- A lower likelihood of a visit was found for children in the unadjusted model for American Indian/Alaska Native (Exhibit 11). Adjusted models did not converge.

Percent of dentists employing 2 or more dental assistants in an MSSA. We found that

- A lower likelihood of a visit was found for children in the adjusted model only (Exhibit 4).

- No significant associations were found for adults and children in adjusted or unadjusted models for those below 200% of FPL (Exhibit 5).
- A lower likelihood of a visit was found for children in adjusted or unadjusted models for those at or above 200% FPL (Exhibit 6).
- A lower likelihood of a visit was found for adults in the adjusted model and for children in the unadjusted model for whites (Exhibit 7).
- No significant associations were found for adults and children in adjusted or unadjusted models for African Americans (Exhibit 8).
- No significant associations were found for Asian American adults or children in adjusted or unadjusted models (Exhibit 9).
- No significant associations were found for Latino adults or children in adjusted or unadjusted models (Exhibit 10).
- No significant associations were found for American Indian/Alaska Native in unadjusted models (Exhibit 11). Adjusted models did not converge.

Percent of dentists who have multiple practice locations in an MSSA. We found that

- A higher likelihood of a visit was found for adults in the unadjusted model only (Exhibit 4).
- A higher likelihood of a visit was found for adults in the unadjusted and adjusted models for those below 200% of FPL (Exhibit 5).
- No significant associations were found for adults and children in adjusted or unadjusted models for those at or above 200% FPL (Exhibit 6).
- No significant associations were found for adults and children in adjusted or unadjusted models for whites (Exhibit 7).
- A higher likelihood of a visit was found for adults and children in unadjusted models for African Americans (Exhibit 8).
- No significant associations were found adults or children in adjusted or unadjusted models for Asian Americans (Exhibit 9).
- A higher likelihood of a visit was found for adults in the unadjusted model only for Latinos (Exhibit 10).

- No significant associations were found for American Indian/Alaska Native in unadjusted models (Exhibit 11). Adjusted models did not converge.

Percent of dentists reporting being busy or overworked.

- A higher likelihood of a visit was found for adults in the unadjusted model, but a lower likelihood was found in the adjusted model. Also a higher likelihood was found for children in the unadjusted model only (Exhibit 4).
- No significant associations were found for adults and children in adjusted or unadjusted models for those below 200% of FPL (Exhibit 5).
- A lower likelihood of a visit was found for adults in both models. And a higher likelihood was found for children in the adjusted model only for those at or above 200% FPL (Exhibit 6).
- A lower likelihood of a visit was found for adults in the adjusted model only for whites (Exhibit 7).
- No significant associations were found adults or children in adjusted or unadjusted models for African Americans (Exhibit 8).
- A lower likelihood was found for adults in the adjusted model only for Asian Americans (Exhibit 9).
- A higher likelihood was found for adults in the unadjusted model only for Latinos (Exhibit 10).
- No significant associations were found for American Indian/Alaska Native in unadjusted models (Exhibit 11). Adjusted models did not converge.

Percent of dentists who report longer appointment length per visit in an MSSA. We examined the percent of dentists in an MSSA who reported longer lower than median appointment length of 45 minutes and found that:

- A higher likelihood of a visit was found for adults in the unadjusted model, but a lower likelihood was found for children in the adjusted model only (Exhibit 4).
- No significant associations were found for adults and children in adjusted or unadjusted models for those below 200% of FPL (Exhibit 5).
- No significant associations were found for adults and children in adjusted or unadjusted models for those at or above 200% FPL (Exhibit 6).
- A lower likelihood of a visit was found for adults in the adjusted model only for whites (Exhibit 7).

- A lower likelihood of a visit was found for children in the unadjusted model only for African Americans (Exhibit 8).

- No significant associations were found for adults and children in adjusted or unadjusted models for Asian Americans (Exhibit 9).

- No significant associations were found for adults and children in adjusted or unadjusted models for Latinos (Exhibit 10).

- No significant associations were found for American Indian/Alaska Native in unadjusted models (Exhibit 11). Adjusted models did not converge.

Percent of dentists who report lower wait time for an appointment in an MSSA. We examined the percent of dentists in an MSSA who reported longer than median wait time of 5 days for an appointment and found that:

- A higher likelihood of a visit was found for adults in the unadjusted model only (Exhibit 4).

- No significant associations were found for adults and children in adjusted or unadjusted models for those below 200% of FPL (Exhibit 5).

- No significant associations were found for adults and children in adjusted or unadjusted models for those at or above 200% FPL (Exhibit 6).

- No significant associations were found for adults and children in adjusted or unadjusted models for whites (Exhibit 7).

- No significant associations were found for adults and children in adjusted or unadjusted models for African Americans (Exhibit 8).

- A higher likelihood was found for children in the unadjusted model for Asian Americans (Exhibit 9).

- A higher likelihood of a visit was found for adults in the adjusted model only for Latinos (Exhibit 10).

- No significant associations were found for American Indian/Alaska Native in unadjusted models (Exhibit 11). Adjusted models did not converge.

Hypothesis 3*: As the percentage of private dentists in the MSSA who can accommodate the specific needs or characteristics of the underserved populations, as indicated by accepting discounted fees,*

accepting publicly insured patients, or having bilingual/multilingual capacity in practice increases, the odds of having a dental visit by underserved populations will increase.

Percent of dentists in an MSSA who accept discounted fees. We found that:

- A higher likelihood of a visit was found for adults in the unadjusted model only (Exhibit 4).
- A higher likelihood of a visit was found for adults and children in adjusted or unadjusted models for those below 200% of FPL (Exhibit 5).
- No significant associations were found for adults and children in adjusted or unadjusted models for those at or above 200% FPL (Exhibit 6).
- No significant associations were found for adults and children in adjusted or unadjusted models for whites (Exhibit 7).
- A higher likelihood of a visit was found for children in the unadjusted model for African Americans (Exhibit 8).
- No significant associations were found for adults and children in adjusted or unadjusted models for Asian Americans (Exhibit 9).
- A higher likelihood was found for adults in both models for Latinos (Exhibit 10).
- A higher likelihood of a visit was found for American Indian/Alaska Native adults in the unadjusted model only (Exhibit 11). Adjusted models did not converge.

Percent of dentists in an MSSA who accept public insurance. We found that:

- A lower likelihood of a visit was found for adults in the unadjusted model and for children in both models (Exhibit 4).
- A lower likelihood of a visit was found for children in the adjusted model only for those below 200% of FPL (Exhibit 5).
- A lower likelihood of a visit was found for adults and children in the unadjusted models for those at or above 200% FPL (Exhibit 6).
- A lower likelihood of a visit was found for adults in both models and for children in the unadjusted model only for whites (Exhibit 7).
- No significant associations were found for adults and children in adjusted or unadjusted models for African Americans (Exhibit 8).

- No significant associations were found for adults and children in adjusted or unadjusted models for Asian Americans (Exhibit 9).
- A lower likelihood of a visit was found for children in both models for Latinos (Exhibit 10).
- No significant associations were found for American Indian/Alaska Native in unadjusted models (Exhibit 11). Adjusted models did not converge.

Percent of dentists in an MSSA who have bilingual/multilingual capacity. We examined the percent of dentists in an MSSA who spoke English only (did not have bilingual/multilingual capacity) and found that:

- A higher likelihood of a visit was found for children in the unadjusted model only (Exhibit 4).
- No significant associations were found for adults and children in adjusted or unadjusted models for those below 200% of FPL (Exhibit 5).
- A lower likelihood of a visit was found for adults in the adjusted model only and a higher likelihood was found for children in the unadjusted model only for those at or above 200% FPL (Exhibit 6).
- A lower likelihood of a visit was found for adults in the unadjusted model only for whites (Exhibit 7).
- No significant associations were found for adults in adjusted or unadjusted models for African Americans (Exhibit 8). Children's models did not converge.
- No significant associations were found for adults in adjusted or unadjusted models for Asian Americans (Exhibit 9). Children's models did not converge.
- No significant associations were found for adults and children in adjusted or unadjusted models for Latinos (Exhibit 10).
- No significant associations were found for American Indian/Alaska Native in unadjusted models (Exhibit 11). Adjusted models did not converge.

Hypothesis 4*: The increase in the total number of visits per 1000 MSSA population provided by public dental safety-net providers such as community health centers within the MSSA where the individual resides will increase the odds of having a dental visit for the underserved.*

The total number of visits per 1000 MSSA population provided by public dental safety-net providers. We examined the ratio of full-time equivalent dentists working in community clinics and dental schools per 5,000 population in an MSSA and found that:

- A lower likelihood of a visit was found for adults in the adjusted model only (Exhibit 4).
- A lower likelihood of a visit was found for adults in the unadjusted model only for those below 200% of FPL (Exhibit 5).
- No significant associations were found for adults and children in adjusted or unadjusted models for those at or above 200% FPL (Exhibit 6).
- A lower likelihood of a visit was found for adults in the adjusted model only for whites (Exhibit 7).
- No significant associations were found for adults in adjusted or unadjusted models or children's unadjusted model for African Americans (Exhibit 8). Children's adjusted model did not converge.
- No significant associations were found for adults in adjusted or unadjusted models for Asian Americans (Exhibit 9). Children's models did not converge.
- A lower likelihood of a visit was found for adults and children in unadjusted model for Latinos (Exhibit 10).
- No significant associations were found for American Indian/Alaska Native in unadjusted models (Exhibit 11). Adjusted models did not converge.

Hypothesis 5*: As the private practice dentist to population ratio increases, the odds of having a dental visit by underserved populations will increase.*

Private practice dentist to population ratio. We examined the ration of full-time equivalent private practice dentist to 5,000 population in an MSSA and found that:

- A higher likelihood of a visit was found for adults in both models and for children in the unadjusted model (Exhibit 4).
- A higher likelihood of a visit was found for adults and children in the unadjusted model only for those below 200% of FPL (Exhibit 5).
- A higher likelihood of a visit was found for adults and children in the unadjusted models for those at or above 200% FPL (Exhibit 6).

- A higher likelihood of a visit was found for adults and children in the unadjusted models for whites (Exhibit 7).
- A higher likelihood of a visit was found for children in the unadjusted model for African Americans (Exhibit 8).
- No significant associations were found for adults and children in adjusted or unadjusted models for Asian Americans (Exhibit 9).
- No significant associations were found for adults and children in adjusted or unadjusted models for Latinos (Exhibit 10).
- No significant associations were found for American Indian/Alaska Native in unadjusted models (Exhibit 11). Adjusted models did not converge.

Exhibit 4. Odds of Dental Visit within the Past Year.

Model corresponding with:		ADULT Unadjusted		ADULT Adjusted		TEEN/CHILD Unadjusted		TEEN/CHILD Adjusted	
		OR	p value	OR	p value	OR	p value	OR	p value
Hypothesis 1	Percent of dentists over age 60	**1.16**	0.16	**0.83**	0.09	**1.43**	0.06	**1.26**	0.25
	Percent of dentists who graduated within past 5 years	**1.63***	0.0004	**1.18**	0.25	**0.93**	0.73	**0.75**	0.13
	Percent of nonwhite dentists	**0.90**	0.43	**0.90**	0.42	**1.10**	0.65	**1.30**	0.22
	Percent of dentists who are generalist	**0.69***	0.02	**0.92**	0.52	**0.74**	0.23	**1.16**	0.54
	Percent of female dentists	**1.65***	<.0001	**1.2***	0.048	**1.75***	0.0003	**1.33***	0.04
Hypothesis 2	Average number of dental visits in a week	**1.01**	0.93	**1.01**	0.92	**1.00**	0.98	**1.00**	1.00
	Percent of dentists who own or are partner in dental practice	**1.33***	<.0001	**0.93**	0.28	**1.45***	0.003	**1.23**	0.10
	Percent of dentists who employ a dental hygienist	**1.91***	<.0001	**1.00**	0.95	**1.65***	<.0001	**1.10**	0.43
	Percent of dentists who employ 2 or more dental assistants	**1.18**	0.05	**0.98**	0.80	**0.82**	0.14	**0.71***	0.01
	Percent of dentists who have multiple practice locations	**1.59***	<.0001	**1.24**	0.06	**1.14**	0.45	**0.91**	0.54
	Percent of dentists reporting being busy or overworked	**1.28***	0.014	**0.81***	0.02	**1.54***	0.01	**1.15**	0.36
	Percent of dentists who report lower than median appointment length (45 min)	**1.23***	0.02	**1.02**	0.72	**0.89**	0.38	**0.87**	0.25
	Percent of dentists who report lower than median wait time for an appointment (5 days)	**1.3***	0.002	**0.95**	0.40	**1.06**	0.63	**0.79***	0.045
Hypothesis 3	Percent of dentists who accept discounted fees	**1.4***	<.0001	**1.11**	0.08	**1.2**	0.11	**1.14**	0.24
	Percent of dentists who accept public insurance	**0.59***	<.0001	**0.92**	0.17	**0.53***	<.0001	**0.63***	0.0002
	Percent of dentists and office staff who speak English only	**1.46**	0.12	**0.71**	0.15	**5.86***	0.004	**1.68**	0.40
Hypothesis 4	Public safety-net dentist to population ratio (per 5,000)	**1.00**	0.56	**0.99***	0.04	**0.99**	0.38	**1.00**	0.88
Hypothesis 5	Dentist to population ratio (per 5,000)	**1.12***	<.0001	**1.02***	<.0001	**1.06***	<.0001	**1.02**	0.09

Notes. Each row represents a series of four models with the same dependent variable. The control variables in the adjusted models are described under methods.

Exhibit 5. Odds of Dental Visit within the Past Year for Respondents with Family Income below 200% Federal Poverty Level.

Model corresponding with:		ADULT Unadjusted		ADULT Adjusted		TEEN/CHILD Unadjusted		TEEN/CHILD Adjusted	
		OR	p value	OR	p value	OR	p value	OR	p value
Hypothesis 1	Percent of dentists over age 60	**0.95**	0.70	**0.65***	0.004	**1.22**	0.40	**1.13**	0.61
	Percent of dentists who graduated within past 5 years	**1.54***	0.02	**1.06**	0.74	**1.13**	0.65	**0.77**	0.27
	Percent of nonwhite dentists	**0.95**	0.76	**0.83**	0.27	**1.6**	0.06	**1.67**	0.05
	Percent of generalist dentists	**0.81**	0.34	**0.77**	0.23	**2.22***	0.03	**2.23***	0.03
	Percent of female dentists	**1.33***	0.02	**1.13**	0.36	**1.73***	0.005	**1.3**	0.21
Hypothesis 2	Average number of dental visits in a week	**1.01**	0.86	**1.02**	0.82	**1.01**	0.83	**1.02**	0.83
	Percent of dentists who own or are partner in dental practice	**1.11**	0.27	**0.96**	0.72	**1.38***	0.04	**1.35**	0.08
	Percent of dentists who employ a dental hygienist	**1.2**	0.06	**0.9**	0.37	**1.13**	0.41	**1.01**	0.96
	Percent of dentists who employ 2 or more dental assistants	**1.13**	0.27	**1.03**	0.77	**0.87**	0.46	**0.73**	0.09
	Percent of dentists who have multiple practice locations	**1.74***	0.002	**1.47***	0.01	**0.96**	0.85	**0.87**	0.53
	Percent of dentists reporting being busy or overworked	**1.25**	0.08	**0.95**	0.71	**1.21**	0.35	**1.07**	0.74
	Percent of dentists who report lower than median appointment length (45 min)	**1.25**	0.06	**1.67**	0.19	**0.86**	0.37	**0.84**	0.34
	Percent of dentists who report lower than median wait time for an appointment (5 days)	**1.07**	0.53	**0.96**	0.76	**0.96**	0.83	**0.88**	0.48
Hypothesis 3	Percent of dentists who accept discounted fees	**1.35***	0.004	**1.27***	0.02	**1.55***	0.01	**1.4***	0.04
	Percent of dentists who accept public insurance	**0.88**	0.23	**0.98**	0.86	**0.73**	0.06	**0.54***	0.001
	Percent of dentists and office staff who speak English only	**1.35**	0.42	**1.08**	0.87	**1.51**	0.06	**0.58**	0.60
Hypothesis 4	Public safety-net dentist to population ratio (per 5,000)	**0.98***	0.004	**1.00**	0.87	**0.97**	0.08	**0.98**	0.15
Hypothesis 5	Dentist to population ratio (per 5,000)	**1.07***	0.01	**1.04**	0.21	**1.08***	0.03	**1.04**	0.33

Notes. Each row represents a series of four models with the same dependent variable. The control variables in the adjusted models are described under methods.

Exhibit 6. Odds of Dental Visit within the Past Year for Respondents with Family Income at or above 200% of Federal Poverty Level.

Model corresponding with:		ADULT Unadjusted		ADULT Adjusted		TEEN/CHILD Unadjusted		TEEN/CHILD Adjusted	
		OR	p value	OR	p value	OR	p value	OR	p value
Hypothesis 1	Percent of dentists over age 60	**0.92**	0.52	**0.8**	0.08	**1.28**	0.34	**1.48**	0.15
	Percent of dentists who graduated within past 5 years	**1.00**	0.99	**0.98**	0.92	**0.51***	0.004	**0.53***	0.01
	Percent of nonwhite dentists	**0.85**	0.29	**0.92**	0.59	**0.86**	0.58	**1.13**	0.68
	Percent of generalist dentists	**0.73***	0.045	**1.03**	0.86	**0.52***	0.03	**0.61**	0.14
	Percent of female dentists	**1.28***	0.03	**1.21**	0.07	**1.13**	0.52	**1.52***	0.03
Hypothesis 2	Average number of dental visits in a week	**1.00**	0.95	**1.00**	0.997	**1.01**	0.92	**1.01**	0.88
	Percent of dentists who own or are partner in dental practice	**1.06**	0.51	**0.91**	0.27	**1.18**	0.39	**1.29**	0.21
	Percent of dentists who employ a dental hygienist	**1.54***	<.0001	**1.12**	0.15	**1.61***	0.0002	**1.4**	0.07
	Percent of dentists who employ 2 or more dental assistants	**0.94**	0.46	**0.95**	0.55	**0.70***	0.04	**0.69***	0.04
	Percent of dentists who have multiple practice locations	**0.92**	0.50	**1.00**	0.99	**1.06**	0.77	**1.15**	0.53
	Percent of dentists reporting being busy or overworked	**0.78***	0.03	**0.74***	0.004	**1.43**	0.08	**1.67***	0.02
	Percent of dentists who report lower than median appointment length (45 min)	**0.87**	0.14	**0.95**	0.52	**0.83**	0.25	**0.95**	0.75
	Percent of dentists who report lower than median wait time for an appointment (5 days)	**1.02**	0.80	**0.96**	0.59	**0.94**	0.73	**0.73**	0.07
Hypothesis 3	Percent of dentists who accept discounted fees	**0.93**	0.36	**0.98**	0.81	**0.97**	0.84	**0.96**	0.83
	Percent of dentists who accept public insurance	**0.64***	<.0001	**0.88**	0.12	**0.61***	0.001	**0.73**	0.07
	Percent of dentists and office staff who speak English only	**0.79**	0.43	**0.53***	0.03	**7.92***	0.02	**2.57**	0.30
Hypothesis 4	Public safety-net dentist to population ratio (per 5,000)	**1.00**	0.46	**1.00**	0.61	**1.04**	0.21	**1.03**	0.42
Hypothesis 5	Dentist to population ratio (per 5,000)	**1.05***	<.0001	**1.02***	0.001	**1.05***	0.01	**1.05***	0.02

Notes. Each row represents a series of four models with the same dependent variable. The control variables in the adjusted models are described under methods.

Exhibit 7. Odds of Dental Visit within the Past Year for White Respondents.

Model corresponding with:		ADULT Unadjusted		ADULT Adjusted		TEEN/CHILD Unadjusted		TEEN/CHILD Adjusted	
		OR	p value	OR	p value	OR	p value	OR	p value
Hypothesis 1	Percent of dentists over age 60	**0.95**	0.71	**0.96**	0.74	**0.93**	0.82	**0.74**	0.36
	Percent of dentists who graduated within past 5 years	**1.32**	0.11	**1.19**	0.35	**0.93**	0.82	**1.04**	0.91
	Percent of nonwhite dentists	**0.70***	0.03	**0.80**	0.14	**0.59**	0.11	**0.90**	0.76
	Percent of generalist dentists	**0.66***	0.02	**0.87**	0.37	**0.50***	0.04	**0.68**	0.30
	Percent of female dentists	**1.54***	0.0005	**1.27***	0.04	**1.49**	0.1	**1.34**	0.24
Hypothesis 2	Average number of dental visits in a week	**1.01**	0.91	**1.01**	0.94	**1.03**	0.68	**1.03**	0.72
	Percent of dentists who own or are partner in dental practice	**0.98**	0.83	**0.86**	0.14	**0.94**	0.8	**0.97**	0.90
	Percent of dentists who employ a dental hygienist	**1.63***	<.0001	**1.08**	0.41	**0.91**	0.61	**0.68**	0.07
	Percent of dentists who employ 2 or more dental assistants	**0.82**	0.06	**0.82***	0.03	**0.64***	0.03	**0.68**	0.08
	Percent of dentists who have multiple practice locations	**1.09**	0.54	**1.04**	0.81	**0.82**	0.43	**0.72**	0.21
	Percent of dentists reporting being busy or overworked	**0.79**	0.06	**0.79***	0.03	**1.20**	0.43	**1.58**	0.06
	Percent of dentists who report lower than median appointment length (45 min)	**0.87**	0.22	**0.90**	0.24	**0.75**	0.12	**1.05**	0.81
	Percent of dentists who report lower than median wait time for an appointment (5 days)	**1.26***	0.03	**1.00**	0.97	**0.83**	0.33	**0.81**	0.29
Hypothesis 3	Percent of dentists who accept discounted fees	**1.03**	0.79	**1.00**	0.97	**1.22**	0.26	**1.47**	0.06
	Percent of dentists who accept public insurance	**0.48***	<.0001	**0.74***	0.001	**0.60***	0.002	**0.82**	0.31
	Percent of dentists and office staff who speak English only	**0.51***	0.02	**0.60**	0.06	**1.78**	0.43	**0.77**	0.73
Hypothesis 4	Public safety-net dentist to population ratio (per 5,000)	**1.00**	0.75	**0.98***	0.003	**0.99**	0.81	**1.00**	0.92
Hypothesis 5	Dentist to population ratio (per 5,000)	**1.08***	<.0001	**1.05***	<.0001	**1.05***	0.01	**1.05***	0.04

Notes. Each row represents a series of four models with the same dependent variable. The control variables in the adjusted models are described under methods.

Exhibit 8. Odds of Dental Visit within the Past Year for African American Respondents.

Model corresponding with:		ADULT Unadjusted		ADULT Adjusted		TEEN/CHILD Unadjusted		TEEN/CHILD Adjusted[1]	
		OR	p value	OR	p value	OR	p value	OR	p value
Hypothesis 1	Percent of dentists over age 60	**0.93**	0.81	**0.73**	0.29	**3.05**	0.06		
	Percent of dentists who graduated within past 5 years	**1.42**	0.34	**0.90**	0.74	**1.80**	0.32		
	Percent of nonwhite dentists	**0.58**	0.07	**0.56***	0.03	**2.34**	0.09		
	Percent of generalist dentists	**1.03**	0.96	**1.33**	0.58	**0.34**	0.25		
	Percent of female dentists	**0.89**	0.63	**0.81**	0.36	**2.41***	0.03		
Hypothesis 2	Average number of dental visits in a week	**1.03**	0.72	**1.03**	0.74	**1.07**	0.48		
	Percent of dentists who own or are partner in dental practice	**0.80**	0.33	**0.64**	0.09	**0.25***	0.01		
	Percent of dentists who employ a dental hygienist	**1.06**	0.79	**0.91**	0.74	**1.65**	0.17		
	Percent of dentists who employ 2 or more dental assistants	**1.43**	0.1	**1.28**	0.31	**0.73**	0.42		
	Percent of dentists who have multiple practice locations	**1.89***	0.02	**1.52**	0.12	**3.94***	0.003		
	Percent of dentists reporting being busy or overworked	**0.71**	0.21	**0.74**	0.27	**1.53**	0.33		
	Percent of dentists who report lower than median appointment length (45 min)	**1.24**	0.32	**1.35**	0.18	**0.89**	0.75		
	Percent of dentists who report lower than median wait time for an appointment (5 days)	**1.22**	0.36	**1.13**	0.61	**2.13***	0.03		
Hypothesis 3	Percent of dentists who accept discounted fees	**1.07**	0.73	**0.77**	0.21	**5.50***	<.0001		
	Percent of dentists who accept public insurance	**0.88**	0.54	**1.08**	0.75	**0.68**	0.28		
	Percent of dentists and office staff who speak English only	**0.74**	0.82	**0.28**	0.50	**-**[1]	0.10		
Hypothesis 4	Public safety-net dentist to population ratio (per 5,000)	**1.00**	0.87	**0.99**	0.50	**1.06**	0.39		
Hypothesis 5	Dentist to population ratio (per 5,000)	**1.04**	0.44	**0.94**	0.25	**1.18***	0.039		

[1] No data available due to model non-convergence or sparse data.

Notes. Each row represents a series of four models with the same dependent variable. The control variables in the adjusted models are described under methods.

Exhibit 9. Odds of Dental Visit within the Past Year for Asian American Respondents.

Model corresponding with:		ADULT Unadjusted		ADULT Adjusted		TEEN/CHILD Unadjusted		TEEN/CHILD Adjusted[1]	
		OR	p value	OR	p value	OR	p value	OR	p value
Hypothesis 1	Percent of dentists over age 60	**0.61**	0.08	**0.39***	0.002	**0.25***	0.03		
	Percent of dentists who graduated within past 5 years	**0.74**	0.34	**1.31**	0.42	**0.4**	0.19		
	Percent of nonwhite dentists	**1.33**	0.30	**1.03**	0.92	**1.52**	0.51		
	Percent of generalist dentists	**0.68**	0.34	**0.82**	0.62	**1.57**	0.58		
	Percent of female dentists	**1.58***	0.045	**1.46**	0.12	**1.64**	0.30		
Hypothesis 2	Average number of dental visits in a week	**1.01**	0.86	**1.01**	0.92	**0.95**	0.71		
	Percent of dentists who own or are partner in dental practice	**1.37**	0.14	**1.17**	0.49	**2.2**	0.07		
	Percent of dentists who employ a dental hygienist	**1.91***	0.0003	**1.25**	0.34	**1.75**	0.15		
	Percent of dentists who employ 2 or more dental assistants	**1.64***	0.02	**1.27**	0.26	**0.72**	0.47		
	Percent of dentists who have multiple practice locations	**1.32**	0.28	**1.45**	0.18	**1.21**	0.73		
	Percent of dentists reporting being busy or overworked	**0.68**	0.11	**0.58***	0.03	**2.11**	0.14		
	Percent of dentists who report lower than median appointment length (45 min)	**0.90**	0.64	**0.89**	0.61	**2.32***	0.049		
	Percent of dentists who report lower than median wait time for an appointment (5 days)	**1.16**	0.50	**1.12**	0.62	**1.13**	0.76		
Hypothesis 3	Percent of dentists who accept discounted fees	**1.05**	0.81	**1.10**	0.61	**1.24**	0.59		
	Percent of dentists who accept public insurance	**0.93**	0.7	**1.34**	0.11	**1.09**	0.81		
	Percent of dentists and office staff who speak English only	**1.72**	0.57	**0.62**	0.64	**-**[1]	0.15		
Hypothesis 4	Public safety-net dentist to population ratio (per 5,000)	**1.00**	0.74	**1.00**	0.99	**1.06**	0.33		
Hypothesis 5	Dentist to population ratio (per 5,000)	**1.01**	0.41	**1.00**	0.79	**1.05**	0.23		

[1] No data available due to model non-convergence or sparse data.
Notes. Each row represents a series of four models with the same dependent variable. The control variables in the adjusted models are described under methods.

Exhibit 10. Odds of Dental Visit within the Past Year for Latino Respondents.

Model corresponding with:		ADULT Unadjusted		ADULT Adjusted		TEEN/CHILD Unadjusted		TEEN/CHILD Adjusted	
		OR	p value	OR	p value	OR	p value	OR	p value
Hypothesis 1	Percent of dentists over age 60	**0.79**	0.16	**0.63***	0.01	**1.47**	0.13	**1.47**	0.16
	Percent of dentists who graduated within past 5 years	**1.59***	0.02	**1.15**	0.46	**0.72**	0.28	**0.76**	0.37
	Percent of nonwhite dentists	**1.37**	0.08	**1.00**	0.995	**1.38**	0.23	**1.70**	0.07
	Percent of generalist dentists	**0.92**	0.76	**0.87**	0.60	**1.98**	0.09	**2.73***	0.01
	Percent of female dentists	**1.32**	0.05	**1.17**	0.26	**1.31**	0.19	**1.22**	0.36
Hypothesis 2	Average number of dental visits in a week	**1.00**	0.99	**1.00**	0.98	**1.03**	0.67	**1.02**	0.78
	Percent of dentists who own or are partner in dental practice	**1.09**	0.40	**1.01**	0.97	**1.43***	0.03	**1.37**	0.08
	Percent of dentists who employ a dental hygienist	**1.12**	0.29	**0.94**	0.66	**1.38**	0.06	**1.23**	0.29
	Percent of dentists who employ 2 or more dental assistants	**1.26**	0.09	**1.17**	0.26	**0.92**	0.74	**0.73**	0.10
	Percent of dentists who have multiple practice locations	**1.54***	0.007	**0.96**	0.77	**0.85**	0.49	**0.74**	0.17
	Percent of dentists reporting being busy or overworked	**1.67***	0.0004	**1.25**	0.16	**1.21**	0.39	**1.03**	0.90
	Percent of dentists who report lower than median appointment length (45 min)	**1.23**	0.12	**1.31***	0.04	**0.85**	0.39	**0.73**	0.09
	Percent of dentists who report lower than median wait time for an appointment (5 days)	**0.88**	0.32	**0.79**	0.08	**0.97**	0.88	**0.78**	0.19
Hypothesis 3	Percent of dentists who accept discounted fees	**1.55***	0.0003	**1.44***	0.003	**1.07**	0.71	**0.92**	0.63
	Percent of dentists who accept public insurance	**1.13**	0.35	**1.09**	0.54	**0.64***	0.01	**0.47***	0.0001
	Percent of dentists and office staff who speak English only	**1.95**	0.25	**2.22**	0.38	**2.64**	0.41	**3.85**	0.29
Hypothesis 4	Public safety-net dentist to population ratio (per 5,000)	**0.98***	0.04	**1.00**	0.87	**0.96***	0.04	**0.98**	0.38
Hypothesis 5	Dentist to population ratio (per 5,000)	**1.05**	0.11	**1.01**	0.77	**1.06**	0.12	**0.98**	0.32

Notes. Each row represents a series of four models with the same dependent variable. The control variables in the adjusted models are described under methods.

Exhibit 11. Odds of Dental Visit within the Past Year for American Indian/Alaska Native Respondents.

Model corresponding with:		ADULT Unadjusted[1]		ADULT Adjusted[1]		TEEN/CHILD Unadjusted[1]		TEEN/CHILD Adjusted[1]	
		OR	p value	OR	p value	OR	p value	OR	p value
Hypothesis 1	Percent of dentists over age 60	**-[1]**				**-[1]**	0.08		
	Percent of dentists who graduated within past 5 years	**1.85**	0.42			**1.36**	0.82		
	Percent of nonwhite dentists	**0.61**	0.46			**-[1]**	0.21		
	Percent of generalist dentists	**0.49**	0.40			**-[1]**	0.15		
	Percent of female dentists	**4.10***	0.01			**0.60**	0.58		
Hypothesis 2	Average number of dental visits in a week	**1.02**	0.87			**0.99**	0.98		
	Percent of dentists who own or are partner in dental practice	**0.80**	0.67			**0.16**	0.19		
	Percent of dentists who employ a dental hygienist	**0.61**	0.21			**0.19***	0.048		
	Percent of dentists who employ 2 or more dental assistants	**1.04**	0.92			**2.07**	0.33		
	Percent of dentists who have multiple practice locations	**1.12**	0.84			**1.48**	0.71		
	Percent of dentists reporting being busy or overworked	**1.27**	**0.60**			**0.43**	**0.4**		
	Percent of dentists who report lower than median appointment length (45 min)	**1.52**	0.31			**0.51**	0.46		
	Percent of dentists who report lower than median wait time for an appointment (5 days)	**1.20**	0.67			**0.86**	0.86		
Hypothesis 3	Percent of dentists who accept discounted fees	**2.48***	0.03			**1.10**	0.90		
	Percent of dentists who accept public insurance	**1.15**	0.71			**1.96**	0.39		
	Percent of dentists and office staff who speak English only	**0.24**	0.29			**0.01**	0.07		
Hypothesis 4	Public safety-net dentist to population ratio (per 5,000)	**2.54**	0.12			**0.83**	0.4		
Hypothesis 5	Dentist to population ratio (per 5,000)	**1.06**	0.50			**1.17**	0.32		

[1] No data available due to model non-convergence or sparse data.

Notes. Each row represents a series of four models with the same dependent variable. The control variables in the adjusted models are described under methods.

The role of Dentist characteristics on the likelihood of unmet need (foregone or delayed needed dental care due to costs) within the past year

Hypothesis 1*: As the percentage of private dentists in the community who are nearing retirement age, are female, are specialists, or are white increases, the odds of having unmet need by underserved populations will increase.*

Percent of Dentists nearing retirement age in an MSSA. We examined the proportion of dentists in a given MSSA that were over 60 and found that:

- A lower likelihood unmet need was found for adults in the unadjusted model only (Exhibit 12).
- No significant associations were found for adults and children in adjusted or unadjusted models for those below 200% of FPL (Exhibit 13).
- No significant associations were found for adults and children in adjusted or unadjusted models for those at or above 200% FPL (Exhibit 14).
- A higher likelihood of unmet need was found for children in both models for whites (Exhibit 15).
- No significant associations were found for adults and children in adjusted or unadjusted models for African Americans (Exhibit 16).
- No significant associations were found for adults and children in adjusted or unadjusted models for Asian Americans (Exhibit 17).
- A lower likelihood of unmet need was found for children in both models for Latinos (Exhibit 18).
- No significant associations were found for adults and children in adjusted or unadjusted models for American Indian/Alaska Natives (Exhibit 19).

Percent of newly graduated dentists in an MSSA. We examined the proportion of dentists in a given MSSA who had graduated within the past 5 years and found that:

- A lower likelihood unmet need was found for adults in the unadjusted model only, but a higher likelihood was found for children in the unadjusted model only (Exhibit 12).
- No significant associations were found for adults and children in adjusted or unadjusted models for those below 200% of FPL (Exhibit 13).

- A higher likelihood of unmet need was found for children in adjusted model only for those at or above 200% FPL (Exhibit 14).
- No significant associations were found for adults and children in adjusted or unadjusted models for whites (Exhibit 15).
- A higher likelihood of unmet need was found for adults in both models for African Americans (Exhibit 16).
- A higher likelihood of unmet need was found for adults in the unadjusted model only for Asian Americans (Exhibit 17).
- A lower likelihood of unmet need was found for adults in unadjusted model only, but a higher likelihood was found children in both models for Latinos (Exhibit 18).
- No significant associations were found for adults and children in adjusted or unadjusted models for American Indian/Alaska Natives (Exhibit 19).

Percentage of dentists in an MSSA who are white. We examined the percentage of dentists in an MSSA who are non-white and found that:

- No significant associations were found for adults and children in adjusted or unadjusted models (Exhibit 12).
- No significant associations were found for adults and children in adjusted or unadjusted models for those below 200% of FPL (Exhibit 13).
- A lower likelihood of unmet need was found for children in the adjusted model only for those at or above 200% FPL (Exhibit 14).
- No significant associations were found for adults and children in adjusted or unadjusted models for whites (Exhibit 15).
- No significant associations were found for adults and children in adjusted or unadjusted models for African Americans (Exhibit 16).
- A lower likelihood of unmet need was found for adults in both models for Asian Americans (Exhibit 17).
- No significant associations were found for adults and children in adjusted or unadjusted models for Latinos (Exhibit 18).

- No significant associations were found for adults and children in adjusted or unadjusted models for American Indian/Alaska Natives (Exhibit 19).

Percentage of dentists in an MSSA who are generalist. We found that:

- A lower likelihood of unmet need was found for adults and children in unadjusted models only (Exhibit 12).
- No significant associations were found for adults and children in adjusted or unadjusted models for those below 200% of FPL (Exhibit 13).
- A lower likelihood of unmet need was found for adults in the unadjusted model only for those at or above 200% FPL (Exhibit 14).
- No significant associations were found for adults and children in adjusted or unadjusted models for whites (Exhibit 15).
- No significant associations were found for adults in adjusted or unadjusted models for African Americans (Exhibit 16). The models for children did not converge or were unreliable.
- A lower likelihood of unmet need was found for adults and children in both models for Asian Americans (Exhibit 17).
- No significant associations were found for adults and children in adjusted or unadjusted models for Latinos (Exhibit 18).
- A lower likelihood of unmet need was found for adults in adjusted or unadjusted models for American Indian/Alaska Natives (Exhibit 19).

Percentage of dentists in an MSSA who are female. We found that:

- A lower likelihood of unmet need was found for adults both models only (Exhibit 12).
- A lower likelihood of unmet need was found for adults in the unadjusted model only for those below 200% of FPL (Exhibit 13).
- A lower likelihood of unmet need was found for adults in both model for those at or above 200% FPL (Exhibit 14).
- A lower likelihood of unmet need was found for adults and children in both models for whites (Exhibit 15).

- A lower likelihood of unmet need was found for adults in both models for African Americans (Exhibit 16).
- A lower likelihood of unmet need was found for adults and children in both models for Asian Americans (Exhibit 17).
- A lower likelihood of unmet need was found for adults in both models and for children in the adjusted model for Latinos (Exhibit 18).
- No significant associations were found for adults and children in adjusted or unadjusted models for American Indian/Alaska Natives (Exhibit 19).

Hypothesis 2: *Increases in the percentage of private dentists who have smaller practices as indicated by fewer visits, no associates or contractor dentists, fewer no hygienists, less than two dental assistants, more than one office location, not busy or overworked status, longer appointment times per visit, or longer waiting times to get an appointment, will lead to increases in the odds of having unmet need by underserved populations.*

Average number of dental visits by private dentists per MSSA. We found that:

- No significant associations were found for adults and children in adjusted or unadjusted models (Exhibit 12).
- No significant associations were found for adults and children in adjusted or unadjusted models for those below 200% of FPL (Exhibit 13).
- No significant associations were found for adults and children in adjusted or unadjusted models for those at or above 200% FPL (Exhibit 14).
- No significant associations were found for adults and children in adjusted or unadjusted models for whites (Exhibit 15).
- No significant associations were found for adults and children in adjusted or unadjusted models for African Americans (Exhibit 16).
- No significant associations were found for adults and children in adjusted or unadjusted models for Asian Americans (Exhibit 17).
- No significant associations were found for adults and children in adjusted or unadjusted models for Latinos (Exhibit 18).

- No significant associations were found for adults and children in adjusted or unadjusted models for American Indian/Alaska Natives (Exhibit 19).

Percent of dentists with no associates or contracted dentists in an MSSA. We examined the percent of dentist who owned or were partners in the dental practice. This variable was highly correlated with the number of FTE dentists per practice, which was not tested in the hypotheses as a result. We found that:

- A lower likelihood of unmet need was found for adults in the unadjusted model only (Exhibit 12).
- No significant associations were found for adults and children in adjusted or unadjusted models for those below 200% of FPL (Exhibit 13).
- A higher likelihood of unmet need was found for children in both models for those at or above 200% FPL (Exhibit 14).
- A higher likelihood of unmet need was found for adults in the unadjusted model only for whites (Exhibit 15).
- A higher likelihood of unmet need was found for adults in the unadjusted model only for African Americans (Exhibit 16).
- No significant associations were found for adults and children in adjusted or unadjusted models for Asian Americans (Exhibit 17).
- A higher likelihood of unmet need was found for adults in the unadjusted model only for Latinos (Exhibit 18).
- No significant associations were found for adults and children in adjusted or unadjusted models for American Indian/Alaska Natives (Exhibit 19).

Percent of dentists with no hygienist in an MSSA. We examined the percent of dentists who employ a dental hygienist and found that:

- A lower likelihood of unmet need was found for adults in the unadjusted model only (Exhibit 12).
- A lower likelihood of unmet need was found for adults in the unadjusted model only for those below 200% of FPL (Exhibit 13).
- A lower likelihood of unmet need was found for adults in both models for those at or above 200% FPL (Exhibit 14).

- A lower likelihood of unmet need was found for adults in the unadjusted model and a higher likelihood was found for children in the unadjusted model for whites (Exhibit 15).
- No significant associations were found for adults and children in adjusted or unadjusted models for African Americans (Exhibit 16).
- A lower likelihood of unmet need was found for adults in the unadjusted model for Asian Americans (Exhibit 17).
- A lower likelihood of unmet need was found for adults in the unadjusted model for Latinos (Exhibit 18).
- No significant associations were found for adults and children in adjusted or unadjusted models for American Indian/Alaska Natives (Exhibit 19).

Percent of dentists employing 2 or more dental assistants in an MSSA. We found that:

- No significant associations were found for adults and children in adjusted or unadjusted models (Exhibit 12).
- No significant associations were found for adults and children in adjusted or unadjusted models for those below 200% of FPL (Exhibit 13).
- A higher likelihood of unmet need was found for adults in the unadjusted model only for those at or above 200% FPL (Exhibit 14).
- No significant associations were found for adults and children in adjusted or unadjusted models for whites (Exhibit 15).
- A lower likelihood of unmet need was found for children in the unadjusted model for African Americans (Exhibit 16).
- No significant associations were found for adults and children in adjusted or unadjusted models for Asian Americans (Exhibit 17).
- No significant associations were found for adults and children in adjusted or unadjusted models for Latinos (Exhibit 18).
- No significant associations were found for adults and children in adjusted or unadjusted models for American Indian/Alaska Natives (Exhibit 19).

Percent of dentists who have multiple practice locations in an MSSA. We found that:

- A lower likelihood of unmet need was found for adults in the unadjusted model only (Exhibit 12).
- A lower likelihood of unmet need was found for adults in the unadjusted model only for those below 200% of FPL (Exhibit 13).
- No significant associations were found for adults and children in adjusted or unadjusted models for those at or above 200% FPL (Exhibit 14).
- No significant associations were found for adults and children in adjusted or unadjusted models for whites (Exhibit 15).
- No significant associations were found for adults and children in adjusted or unadjusted models for African Americans (Exhibit 16).
- No significant associations were found for adults and children in adjusted or unadjusted models for Asian Americans (Exhibit 17).
- A lower likelihood of unmet need was found for adults in both models, and a higher likelihood was found for children in the adjusted model for Latinos (Exhibit 18).
- A lower likelihood of unmet need was found for children in the unadjusted model only for American Indian/Alaska Natives (Exhibit 19).

Percent of dentists reporting being busy or overworked. We found that:

- A lower likelihood of unmet need was found for adults in both models and a higher likelihood was found for children in both models (Exhibit 12).
- A higher likelihood of unmet need was found for children in the adjusted model only for those below 200% of FPL (Exhibit 13).
- No significant associations were found for adults and children in adjusted or unadjusted models for those at or above 200% FPL (Exhibit 14).
- A lower likelihood of unmet need was found for adults in the unadjusted model only for whites (Exhibit 15).
- A lower likelihood of unmet need was found for children in the unadjusted model only for African Americans (Exhibit 16).
- A higher likelihood of unmet need was found for children in the unadjusted model only for Asian Americans (Exhibit 17).

- A lower likelihood of unmet need was found for adults in the unadjusted model, and a higher likelihood was found for children in both models for Latinos (Exhibit 18).

- A lower likelihood of unmet need was found for adults children in both models and for children in unadjusted model for American Indian/Alaska Natives (Exhibit 19). The adjusted child model did not converge.

Percent of dentists who report longer appointment length per visit in an MSSA. We examined the percent of dentists in an MSSA who reported longer lower than median appointment length of 45 minutes and found that:

- No significant associations were found for adults and children in adjusted or unadjusted models (Exhibit 12).

- No significant associations were found for adults and children in adjusted or unadjusted models for those below 200% of FPL (Exhibit 13).

- A higher likelihood of unmet need was found for children in the unadjusted model only for those at or above 200% FPL (Exhibit 14).

- A lower likelihood of unmet need was found for adults in the unadjusted model only for whites (Exhibit 15).

- No significant associations were found for adults and children in adjusted or unadjusted models for African Americans (Exhibit 16).

- No significant associations were found for adults and children in adjusted or unadjusted models for Asian Americans (Exhibit 17).

- No significant associations were found for adults and children in adjusted or unadjusted models for Latinos (Exhibit 18).

- No significant associations were found for adults and children in adjusted or unadjusted models for American Indian/Alaska Natives (Exhibit 19).

Percent of dentists who report lower wait time for an appointment in an MSSA. We examined the percent of dentists in an MSSA who reported longer than median wait time of 5 days for an appointment and found that:

- A lower likelihood of unmet need was found for adults in the unadjusted model only (Exhibit 12).

- No significant associations were found for adults and children in adjusted or unadjusted models for those below 200% of FPL (Exhibit 13).
- A lower likelihood of unmet need was found for adults in both models for those at or above 200% FPL (Exhibit 14).
- A lower likelihood of unmet need was found for adults in both models for whites (Exhibit 15).
- A lower likelihood of unmet need was found for adults in the unadjusted model for African Americans (Exhibit 16).
- A lower likelihood of unmet need was found for children in the unadjusted model only for Asian Americans (Exhibit 17).
- A lower likelihood of unmet need was found for adults in both models for Latinos (Exhibit 18).
- A lower likelihood of unmet need was found for adults in the adjusted model and children in the unadjusted model for American Indian/Alaska Natives (Exhibit 19).

Hypothesis 3*: As the percentage of private dentists in the MSSA who can accommodate the specific needs or characteristics of the underserved populations, as indicated by accepting discounted fees, accepting publicly insured patients, or having bilingual/multilingual capacity in practice increases, the odds of having unmet need by underserved populations will decrease.*

Percent of dentists in an MSSA who accept discounted fees. We found that:

- A lower likelihood of unmet need was found for children in the adjusted model only (Exhibit 12).
- A lower likelihood of unmet need was found for children in the adjusted model only for those below 200% of FPL (Exhibit 13).
- A lower likelihood of unmet need was found for adults in both models for those at or above 200% FPL (Exhibit 14).
- A lower likelihood of unmet need was found for children in both models for whites (Exhibit 15).
- A lower likelihood of unmet need was found for children in the unadjusted model only for African Americans (Exhibit 16).
- No significant associations were found for adults and children in adjusted or unadjusted models for Asian Americans (Exhibit 17).

- A lower likelihood of unmet need was found for adults in unadjusted model and for children in both models for Latinos (Exhibit 18).

- No significant associations were found for adults and children in adjusted or unadjusted models for American Indian/Alaska Natives (Exhibit 19).

- ***Percent of dentists in an MSSA who accept public insurance***. We found that:

- A higher likelihood of unmet need was found for adults and children in the unadjusted models (Exhibit 12).

- No significant associations were found for adults and children in adjusted or unadjusted models for those below 200% of FPL (Exhibit 13).

- A higher likelihood of unmet need was found for adults in both models and for children in the unadjusted model for those at or above 200% FPL (Exhibit 14).

- A higher likelihood of unmet need was found for adults in the unadjusted model only for whites (Exhibit 15).

- A higher likelihood of unmet need was found for adults in both models for African Americans (Exhibit 16).

- A higher likelihood of unmet need was found for adults and children in the unadjusted models for Asian Americans (Exhibit 17).

- A lower likelihood of unmet need was found for children in the unadjusted model only for Latinos (Exhibit 18).

- No significant associations were found for adults and children in adjusted or unadjusted models for American Indian/Alaska Natives (Exhibit 19).

Percent of dentists in an MSSA who have bilingual/multilingual capacity. We examined the percent of dentists in an MSSA who spoke English only (did not have bilingual/multilingual capacity) and found that:

- No significant associations were found for adults and children in adjusted or unadjusted models (Exhibit 12).

- A higher likelihood of unmet need was found for adults in the adjusted model only for those below 200% of FPL (Exhibit 13).

- No significant associations were found for adults and children in adjusted or unadjusted models for those at or above 200% FPL (Exhibit 14).
- A higher likelihood of unmet need was found for adults in the unadjusted model only for whites (Exhibit 15).
- No significant associations were found for adults and children in adjusted or unadjusted models for African Americans (Exhibit 16).
- No significant associations were found for adults and children in adjusted or unadjusted models for Asian Americans (Exhibit 17).
- No significant associations were found for adults and children in adjusted or unadjusted models for Latinos (Exhibit 18).
- No significant associations were found for adults and children in adjusted or unadjusted models for American Indian/Alaska Natives (Exhibit 19).

Hypothesis 4*: The increase in the total number of visits per 1000 MSSA population provided by public dental safety-net providers such as community health centers within the MSSA where the individual resides will decrease the odds of having unmet need for the underserved.*

The total number of visits per 1000 MSSA population provided by public dental safety-net providers. We examined the ratio of full-time equivalent dentists working in community clinics and dental schools per 5,000 population in an MSSA and found that:

- No significant associations were found for adults and children in adjusted or unadjusted models (Exhibit 12).
- No significant associations were found for adults and children in adjusted or unadjusted models for those below 200% of FPL (Exhibit 13).
- No significant associations were found for adults and children in adjusted or unadjusted models for those at or above 200% FPL (Exhibit 14).
- No significant associations were found for adults and children in adjusted or unadjusted models for whites (Exhibit 15).
- A higher likelihood of unmet need was found for children in the unadjusted model for African Americans (Exhibit 16).

- No significant associations were found for adults and children in adjusted or unadjusted models for Asian Americans (Exhibit 17).
- A higher likelihood of unmet need was found for adults in both models for Latinos (Exhibit 18).
- No significant associations were found for adults and children in adjusted or unadjusted models for American Indian/Alaska Natives (Exhibit 19).

Hypothesis 5*: As the private practice dentist to population ratio increases, the odds of having unmet by underserved populations will decrease.*

Private practice dentist to population ratio. We examined the ration of full-time equivalent private practice dentist to 5,000 population in an MSSA and found that:

- A lower likelihood of unmet need was found for adults and children in the unadjusted models only (Exhibit 12).
- No significant associations were found for adults and children in adjusted or unadjusted models for those below 200% of FPL (Exhibit 13).
- A lower likelihood of unmet need was found for adults in the unadjusted model only for those at or above 200% FPL (Exhibit 14).
- A lower likelihood of unmet need was found for adults in the unadjusted model only for whites (Exhibit 15).
- No significant associations were found for adults and children in adjusted or unadjusted models for African Americans (Exhibit 16).
- A lower likelihood of unmet need was found for children in the unadjusted model only for Asian Americans (Exhibit 17).
- A lower likelihood of unmet need was found for adults in the unadjusted model only for Latinos (Exhibit 18).
- A higher likelihood of unmet need was found for adults in the adjusted model only for American Indian/Alaska Natives (Exhibit 19).

Exhibit 12. Odds of Unmet Need within the Past Year.

Model corresponding with:		ADULT Unadjusted		ADULT Adjusted		TEEN/CHILD Unadjusted		TEEN/CHILD Adjusted	
		OR	p value	OR	p value	OR	p value	OR	p value
Hypothesis 1	Percent of dentists over age 60	**0.70***	0.002	**0.83**	0.09	**0.92**	0.70	**0.9**	0.64
	Percent of dentists who graduated within past 5 years	**0.67***	0.006	**1.07**	0.55	**1.54***	0.03	**1.48**	0.05
	Percent of nonwhite dentists	**1.05**	0.71	**0.90**	0.42	**1.11**	0.58	**0.86**	0.46
	Percent of generalist dentists	**1.67***	0.001	**0.92**	0.52	**1.80***	0.04	**0.72**	0.28
	Percent of female dentists	**0.49***	<.0001	**0.72***	<.0001	**0.88**	0.41	**0.88**	0.44
Hypothesis 2	Average number of dental visits in a week	**1.00**	0.98	**1.01**	0.92	**0.96**	0.57	**0.96**	0.61
	Percent of dentists who own or are partner in dental practice	**0.76***	0.0002	**0.93**	0.78	**1.34**	0.08	**1.36**	0.07
	Percent of dentists who employ a dental hygienist	**0.45***	<.0001	**1.00**	0.95	**0.87**	0.3	**1.24**	0.15
	Percent of dentists who employ 2 or more dental assistants	**0.90**	0.20	**0.98**	0.80	**0.94**	0.7	**0.9**	0.49
	Percent of dentists who have multiple practice locations	**0.65***	0.0004	**1.24**	0.06	**1.21**	0.24	**1.23**	0.21
	Percent of dentists reporting being busy or overworked	**0.75***	0.01	**0.81***	0.02	**1.44***	0.02	**1.55***	0.01
	Percent of dentists who report lower than median appointment length (45 min)	**0.87**	0.15	**1.02**	0.72	**1.27**	0.07	**1.15**	0.33
	Percent of dentists who report lower than median wait time for an appointment (5 days)	**0.54***	<.0001	**0.95**	0.40	**0.88**	0.37	**0.8**	0.12
Hypothesis 3	Percent of dentists who accept discounted fees	**0.87**	0.09	**1.11**	0.08	**1.06**	0.65	**0.7***	0.01
	Percent of dentists who accept public insurance	**1.91***	<.0001	**0.92**	0.17	**1.52***	0.0004	**0.84**	0.23
	Percent of dentists and office staff who speak English only	**0.59**	0.06	**0.71**	0.15	**0.19**	0.06	**0.75**	0.72
Hypothesis 4	Public safety-net dentist to population ratio (per 5,000)	**1.00**	0.91	**1.01**	0.20	**1.00**	0.88	**0.99**	0.55
Hypothesis 5	Dentist to population ratio (per 5,000)	**0.86***	<.0001	**0.99**	0.34	**0.96***	0.03	**1.02**	0.32

Notes. Each row represents a series of four models with the same dependent variable. The control variables in the adjusted models are described under methods.

Exhibit 13. Odds of Unmet Need within the Past Year for Respondents with Family Income below 200% Federal Poverty Level.

Model corresponding with:		ADULT Unadjusted		ADULT Adjusted		TEEN/CHILD Unadjusted		TEEN/CHILD Adjusted	
		OR	p value	OR	p value	OR	p value	OR	p value
Hypothesis 1	Percent of dentists over age 60	**0.84**	0.23	**1.00**	0.98	**0.95**	0.86	**0.84**	0.52
	Percent of dentists who graduated within past 5 years	**0.77**	0.15	**0.98**	0.92	**1.24**	0.48	**1.30**	0.29
	Percent of nonwhite dentists	**0.88**	0.46	**0.86**	0.39	**0.93**	0.77	**1.08**	0.76
	Percent of generalist dentists	**0.88**	0.57	**0.32**	0.81	**0.53**	0.08	**0.53**	0.10
	Percent of female dentists	**0.69***	0.004	**0.85**	0.25	**0.82**	0.30	**0.99**	0.96
Hypothesis 2	Average number of dental visits in a week	**1.00**	0.95	**0.99**	0.9	**0.95**	0.52	**0.95**	0.45
	Percent of dentists who own or are partner in dental practice	**0.86**	0.11	**1.03**	0.78	**1.09**	0.63	**1.05**	0.82
	Percent of dentists who employ a dental hygienist	**0.71***	0.0004	**0.98**	0.83	**1.32**	0.09	**1.33**	0.14
	Percent of dentists who employ 2 or more dental assistants	**0.90**	0.36	**0.94**	0.59	**0.84**	0.33	**1.02**	0.94
	Percent of dentists who have multiple practice locations	**0.73***	0.37	**0.84**	0.27	**1.09**	0.69	**1.33**	0.18
	Percent of dentists reporting being busy or overworked	**0.92**	0.50	**1.2**	0.20	**1.41**	0.10	**1.74***	1.01
	Percent of dentists who report lower than median appointment length (45 min)	**0.97**	0.82	**1.05**	0.64	**0.91**	0.58	**1.12**	0.51
	Percent of dentists who report lower than median wait time for an appointment (5 days)	**0.65***	0.0001	**0.74***	0.01	**0.89**	0.51	**0.73**	0.08
Hypothesis 3	Percent of dentists who accept discounted fees	**0.94**	0.55	**0.98**	0.86	**0.81**	0.16	**0.74***	0.03
	Percent of dentists who accept public insurance	**0.99**	0.94	**0.90**	0.31	**0.78**	0.10	**0.83**	0.32
	Percent of dentists and office staff who speak English only	**1.43**	0.34	**2.40***	0.02	**0.25**	0.22	**0.34**	0.36
Hypothesis 4	Public safety-net dentist to population ratio (per 5,000)	**1.00**	0.87	**1.00**	0.62	**1.02**	0.45	**1.01**	0.75
Hypothesis 5	Dentist to population ratio (per 5,000)	**0.96**	0.18	**0.98**	0.12	**1.04**	0.09	**1.04**	0.07

Notes. Each row represents a series of four models with the same dependent variable. The control variables in the adjusted models are described under methods.

Exhibit 14. Odds of Unmet Need within the Past Year for Respondents with Family Income at or above 200% Federal Poverty Level.

Model corresponding with:		ADULT Unadjusted		ADULT Adjusted		TEEN/CHILD Unadjusted		TEEN/CHILD Adjusted	
		OR	p value	OR	p value	OR	p value	OR	p value
Hypothesis 1	Percent of dentists over age 60	**0.99**	0.95	**0.89**	0.37	**1.28**	0.54	**0.96**	0.92
	Percent of dentists who graduated within past 5 years	**1.15**	0.43	**1.22**	0.16	**1.99**	0.06	**2.23***	0.03
	Percent of nonwhite dentists	**1.15**	0.31	**0.98**	0.85	**0.68**	0.34	**0.39***	0.02
	Percent of generalist dentists	**1.53***	0.01	**1.11**	0.50	**2.19**	0.12	**1.16**	0.78
	Percent of female dentists	**0.69***	0.001	**0.7***	0.0004	**0.83**	0.54	**0.63**	0.13
Hypothesis 2	Average number of dental visits in a week	**1.00**	0.95	**1.01**	0.83	**0.93**	0.36	**0.94**	0.42
	Percent of dentists who own or are partner in dental practice	**0.98**	0.85	**1.09**	0.40	**2.59***	0.01	**2.49***	0.01
	Percent of dentists who employ a dental hygienist	**0.62***	<.0001	**0.76***	0.002	**0.76**	0.28	**1.03**	0.91
	Percent of dentists who employ 2 or more dental assistants	**1.21***	0.04	**1.15**	0.11	**0.79**	0.39	**0.79**	0.36
	Percent of dentists who have multiple practice locations	**1.12**	0.37	**1.06**	0.60	**1.08**	0.82	**1.00**	0.998
	Percent of dentists reporting being busy or overworked	**1.17**	0.18	**1.18**	0.13	**1.22**	0.53	**1.00**	0.999
	Percent of dentists who report lower than median appointment length (45 min)	**1.01**	0.40	**0.93**	0.41	**1.64***	0.045	**1.25**	0.37
	Percent of dentists who report lower than median wait time for an appointment (5 days)	**0.79***	0.01	**0.82***	0.02	**0.76**	0.30	**0.93**	0.79
Hypothesis 3	Percent of dentists who accept discounted fees	**1.20***	0.03	**1.08**	0.32	**0.86**	0.54	**0.68**	0.11
	Percent of dentists who accept public insurance	**1.8***	<.0001	**1.34***	0.003	**1.55***	0.04	**0.88**	0.59
	Percent of dentists and office staff who speak English only	**0.75**	0.45	**0.98**	0.96	**0.94**	0.95	**1.60**	0.66
Hypothesis 4	Public safety-net dentist to population ratio (per 5,000)	**1.01**	0.38	**1.01**	0.09	**0.87**	0.18	**0.86**	0.19
Hypothesis 5	Dentist to population ratio (per 5,000)	**0.97***	0.0004	**1.00**	0.85	**0.95**	0.10	**0.99**	0.79

Notes. Each row represents a series of four models with the same dependent variable. The control variables in the adjusted models are described under methods.

Exhibit 15. Odds of Unmet Need within the Past Year for White Respondents.

Model corresponding with:		ADULT Unadjusted		ADULT Adjusted		TEEN/CHILD Unadjusted		TEEN/CHILD Adjusted	
		OR	p value	OR	p value	OR	p value	OR	p value
Hypothesis 1	Percent of dentists over age 60	**1.18**	0.24	**0.92**	0.55	**3.09***	0.01	**2.44***	0.048
	Percent of dentists who graduated within past 5 years	**0.88**	0.49	**1.11**	0.50	**0.70**	0.51	**0.77**	0.62
	Percent of nonwhite dentists	**1.22**	0.19	**0.97**	0.83	**0.79**	0.65	**0.65**	0.40
	Percent of generalist dentists	**1.32**	0.09	**0.88**	0.46	**2.00**	0.21	**1.03**	0.96
	Percent of female dentists	**0.62***	<.0001	**0.71***	0.003	**0.32***	0.01	**0.35***	0.01
Hypothesis 2	Average number of dental visits in a week	**1.00**	0.99	**1.01**	0.86	**0.99**	0.87	**0.98**	0.80
	Percent of dentists who own or are partner in dental practice	**1.47***	0.001	**1.26**	0.06	**2.02**	0.10	**1.70**	0.20
	Percent of dentists who employ a dental hygienist	**0.80***	0.01	**0.83**	0.06	**1.96***	0.03	**1.88**	0.05
	Percent of dentists who employ 2 or more dental assistants	**1.21**	0.05	**1.17**	0.11	**1.14**	0.69	**1.04**	0.92
	Percent of dentists who have multiple practice locations	**1.03**	0.84	**1.22**	0.10	**0.58**	0.21	**0.68**	0.36
	Percent of dentists reporting being busy or overworked	**1.32***	0.02	**1.19**	0.13	**1.47**	0.27	**1.17**	0.65
	Percent of dentists who report lower than median appointment length (45 min)	**1.23***	0.03	**1.04**	0.70	**1.12**	0.71	**0.87**	0.66
	Percent of dentists who report lower than median wait time for an appointment (5 days)	**0.68***	<.0001	**0.78***	0.01	**0.83**	0.55	**0.91**	0.77
Hypothesis 3	Percent of dentists who accept discounted fees	**1.05**	0.60	**0.98**	0.84	**0.52***	0.03	**0.46***	0.01
	Percent of dentists who accept public insurance	**1.56***	<.0001	**1.08**	0.42	**1.19**	0.49	**0.82**	0.52
	Percent of dentists and office staff who speak English only	**2.28***	0.02	**1.47**	0.24	**2.44**	0.33	**1.27**	0.81
Hypothesis 4	Public safety-net dentist to population ratio (per 5,000)	**0.99**	0.32	**1.00**	0.87	**0.88**	0.27	**0.84**	0.23
Hypothesis 5	Dentist to population ratio (per 5,000)	**0.96***	<.0001	**0.99**	0.45	**1.02**	0.56	**1.05**	0.05

Notes. Each row represents a series of four models with the same dependent variable. The control variables in the adjusted models are described under methods.

Exhibit 16. Odds of Unmet Need within the Past Year for African American Respondents.

Model corresponding with:		ADULT Unadjusted		ADULT Adjusted		TEEN/CHILD Unadjusted		TEEN/CHILD Adjusted[1]	
		OR	p value	OR	p value	OR	p value	OR	p value
Hypothesis 1	Percent of dentists over age 60	**0.72**	0.23	**1.10**	0.79	**1.46**	0.60		
	Percent of dentists who graduated within past 5 years	**2.2***	0.04	**2.95***	0.008	**1.85**	0.34		
	Percent of nonwhite dentists	**1.21**	0.48	**0.94**	0.90	**1.24**	0.73		
	Percent of generalist dentists	**0.71**	0.47	**0.54**	0.23	**-**[1]	0.002		
	Percent of female dentists	**0.65***	0.04	**0.54***	0.004	**0.65**	0.40		
Hypothesis 2	Average number of dental visits in a week	**0.97**	0.73	**1.00**	0.96	**0.92**	0.49		
	Percent of dentists who own or are partner in dental practice	**1.62***	0.049	**1.67**	0.05	**2.09**	0.23		
	Percent of dentists who employ a dental hygienist	**0.75**	0.18	**0.64**	0.09	**0.79**	0.63		
	Percent of dentists who employ 2 or more dental assistants	**1.31**	0.24	**1.3**	0.26	**0.16***	<.0001		
	Percent of dentists who have multiple practice locations	**0.68**	0.18	**0.72**	0.18	**0.37**	0.08		
	Percent of dentists reporting being busy or overworked	**1.18**	0.59	**1.29**	0.42	**0.29***	0.02		
	Percent of dentists who report lower than median appointment length (45 min)	**0.92**	0.67	**1.02**	0.92	**0.96**	0.94		
	Percent of dentists who report lower than median wait time for an appointment (5 days)	**0.61***	0.03	**0.64**	0.06	**0.51**	0.12		
Hypothesis 3	Percent of dentists who accept discounted fees	**1.24**	0.28	**1.48**	0.06	**2.49***	0.04		
	Percent of dentists who accept public insurance	**1.85***	0.003	**2.03***	0.002	**0.78**	0.55		
	Percent of dentists and office staff who speak English only	**3.54**	0.38	**0.79**	0.88	**0.02**	0.47		
Hypothesis 4	Public safety-net dentist to population ratio (per 5,000)	**0.99**	0.52	**1.00**	0.98	**1.10***	0.009		
Hypothesis 5	Dentist to population ratio (per 5,000)	**0.99**	0.67	**0.99**	0.61	**0.86**	0.06		

[1] No data available due to model non-convergence or sparse data.

Notes. Each row represents a series of four models with the same dependent variable. The control variables in the adjusted models are described under methods.

Exhibit 17. Odds of Unmet Need within the Past Year for Asian American Respondents.

Model corresponding with:		ADULT Unadjusted		ADULT Adjusted		TEEN/CHILD Unadjusted[1]		TEEN/CHILD Adjusted[1]	
		OR	p value	OR	p value	OR	p value	OR	p value
Hypothesis 1	Percent of dentists over age 60	**0.61**	0.17	**0.68**	0.29	**1.92**	0.54		
	Percent of dentists who graduated within past 5 years	**2.45***	0.01	**1.59**	0.23	**1.83**	0.58		
	Percent of nonwhite dentists	**0.33***	0.002	**0.32***	0.001	**0.13**	0.12		
	Percent of generalist dentists	**4.46***	0.0003	**3.5***	0.004	**0.05***	0.003		
	Percent of female dentists	**0.48***	0.01	**0.52***	0.01	**0.03***	<.0001		
Hypothesis 2	Average number of dental visits in a week	**0.97**	0.70	**0.99**	0.95	**0.92**	0.54		
	Percent of dentists who own or are partner in dental practice	**0.73**	0.19	**0.76**	0.27	**0.58**	0.39		
	Percent of dentists who employ a dental hygienist	**0.52***	0.002	**0.12**	0.41	**1.09**	0.89		
	Percent of dentists who employ 2 or more dental assistants	**0.68**	0.07	**0.94**	0.77	**3.66**	0.05		
	Percent of dentists who have multiple practice locations	**1.01**	0.96	**0.87**	0.67	**3.82**	0.06		
	Percent of dentists reporting being busy or overworked	**0.95**	0.85	**1.12**	0.71	**5.43***	0.01		
	Percent of dentists who report lower than median appointment length (45 min)	**0.74**	0.23	**0.71**	0.10	**1.86**	0.29		
	Percent of dentists who report lower than median wait time for an appointment (5 days)	**0.82**	0.41	**0.82**	0.39	**0.15***	0.002		
Hypothesis 3	Percent of dentists who accept discounted fees	**0.97**	0.86	**0.70**	0.08	**0.96**	0.95		
	Percent of dentists who accept public insurance	**1.78***	0.002	**0.98**	0.90	**2.82***	0.04		
	Percent of dentists and office staff who speak English only	**2.60**	0.39	**15.2**	0.03	**1.30**	0.95		
Hypothesis 4	Public safety-net dentist to population ratio (per 5,000)	**1.02**	0.27	**1.01**	0.35	**-**[1]			
Hypothesis 5	Dentist to population ratio (per 5,000)	**0.98**	0.34	**1.00**	0.87	**0.74***	0.002		

[1] No data available due to model non-convergence or sparse data.
Notes. Each row represents a series of four models with the same dependent variable. The control variables in the adjusted models are described under methods.

Exhibit 18. Odds of Unmet Need within the Past Year for Latino Respondents.

Model corresponding with:		ADULT Unadjusted		ADULT Adjusted		TEEN/CHILD Unadjusted		TEEN/CHILD Adjusted	
		OR	p value	OR	p value	OR	p value	OR	p value
Hypothesis 1	Percent of dentists over age 60	**0.87**	0.43	**0.96**	0.83	**0.40***	0.002	**0.42***	0.01
	Percent of dentists who graduated within past 5 years	**0.61***	0.02	**0.82**	0.32	**1.79***	0.04	**1.77***	0.03
	Percent of nonwhite dentists	**0.83**	0.32	**0.92**	0.67	**0.85**	0.54	**0.91**	0.74
	Percent of generalist dentists	**1.13**	0.65	**1.02**	0.95	**0.75**	0.47	**0.71**	0.44
	Percent of female dentists	**0.63***	0.002	**0.7***	0.02	**1.19**	0.40	**1.61***	0.02
Hypothesis 2	Average number of dental visits in a week	**0.99**	0.93	**0.98**	0.81	**0.95**	0.49	**0.95**	0.49
	Percent of dentists who own or are partner in dental practice	**0.71***	0.001	**0.86**	0.19	**1.22**	0.31	**1.10**	0.65
	Percent of dentists who employ a dental hygienist	**0.63***	<.0001	**0.85**	0.26	**1.09**	0.64	**0.97**	0.87
	Percent of dentists who employ 2 or more dental assistants	**0.88**	0.37	**0.97**	0.82	**0.89**	0.54	**1.03**	0.90
	Percent of dentists who have multiple practice locations	**0.56***	0.0001	**0.67***	0.02	**1.32**	0.17	**2.10***	0.001
	Percent of dentists reporting being busy or overworked	**0.73***	0.04	**1.01**	0.93	**1.56***	0.048	**1.78***	0.01
	Percent of dentists who report lower than median appointment length (45 min)	**0.79**	0.08	**0.89**	0.40	**1.00**	0.98	**1.39**	0.19
	Percent of dentists who report lower than median wait time for an appointment (5 days)	**0.62***	0.0002	**0.70***	0.01	**1.30**	0.19	**1.18**	0.43
Hypothesis 3	Percent of dentists who accept discounted fees	**0.78***	0.04	**0.86**	0.20	**0.72***	0.04	**0.62***	0.01
	Percent of dentists who accept public insurance	**0.94**	0.66	**0.89**	0.39	**0.68***	0.02	**0.69**	0.07
	Percent of dentists and office staff who speak English only	**0.60**	0.40	**0.69**	0.69	**0.30**	0.45	**0.28**	0.44
Hypothesis 4	Public safety-net dentist to population ratio (per 5,000)	**1.03***	0.003	**1.04***	0.01	**1.00**	0.88	**0.98**	0.42
Hypothesis 5	Dentist to population ratio (per 5,000)	**0.9***	0.001	**0.96**	0.25	**1.04**	0.10	**1.04**	0.19

Notes. Each row represents a series of four models with the same dependent variable. The control variables in the adjusted models are described under methods.

Exhibit 19. Odds of Unmet Need within the Past Year for American Indian/Alaska Native Respondents.

Model corresponding with:		ADULT Unadjusted		ADULT Adjusted		TEEN/CHILD Unadjusted[1]		TEEN/CHILD Adjusted[1]	
		OR	p value	OR	p value	OR	p value	OR	p value
Hypothesis 1	Percent of dentists over age 60	**1.26**	0.70	**1.18**	0.81	**1.44**	0.75		
	Percent of dentists who graduated within past 5 years	**1.74**	0.46	**1.98**	0.42	**0.77**	0.87		
	Percent of nonwhite dentists	**1.23**	0.77	**0.78**	0.78	**0.74**	0.88		
	Percent of generalist dentists	**0.13***	0.03	**0.07***	0.01	**0.07**	0.15		
	Percent of female dentists	**2.61**	0.07	**2.46**	0.14	**0.83**	0.86		
Hypothesis 2	Average number of dental visits in a week	**1.02**	0.91	**0.99**	0.96	**0.84**	0.47		
	Percent of dentists who own or are partner in dental practice	**0.72**	0.56	**0.72**	0.63	**2.92**	0.47		
	Percent of dentists who employ a dental hygienist	**0.48**	0.08	**0.68**	0.48	**0.81**	0.81		
	Percent of dentists who employ 2 or more dental assistants	**0.88**	0.78	**0.80**	0.70	**0.72**	0.70		
	Percent of dentists who have multiple practice locations	**0.96**	0.95	**1.29**	0.71	**0.04***	0.047		
	Percent of dentists reporting being busy or overworked	**0.32***	0.02	**0.25***	0.02	**0.52**	0.58		
	Percent of dentists who report lower than median appointment length (45 min)	**1.74**	0.21	**2.86**	0.05	**1.93**	0.51		
	Percent of dentists who report lower than median wait time for an appointment (5 days)	**0.46**	0.10	**0.20***	0.006	**0.03***	0.002		
Hypothesis 3	Percent of dentists who accept discounted fees	**1.14**	0.77	**0.93**	0.90	**1.28**	0.78		
	Percent of dentists who accept public insurance	**1.99**	0.10	**2.04**	0.20	**-**[1]	0.008		
	Percent of dentists and office staff who speak English only	**0.14**	0.30	**0.38**	0.65	**-**[1]	0.16		
Hypothesis 4	Public safety-net dentist to population ratio (per 5,000)	**0.97**	0.64	**0.93**	0.38	**0.02**	0.12		
Hypothesis 5	Dentist to population ratio (per 5,000)	**1.06**	0.55	**1.15***	0.049	**0.87**	0.41		

[1] No data available due to model non-convergence or sparse data.

Notes. Each row represents a series of four models with the same dependent variable. The control variables in the adjusted models are described under methods.

Chapter Five: Discussion and Policy Implications

Summary of Findings and Conclusions

Hypothesis 1

Impact of supply of dentists who are nearing retirement age on annual visits. The larger supply of dentists nearing retirement age in an MSSA was associated with lower likelihood of an annual visit for adults below 200% FPL, Asian Americans, and Latinos. This hypothesis is confirmed. The findings seem to indicate that the older dentists may have reduced productivity which negatively impacting the underserved.

Impact of supply of dentists who are nearing retirement age on unmet need. The larger supply of dentists nearing retirement age in an MSSA was associated with lower likelihood of unmet need for children below 200% FPL and Latino children, but a higher likelihood of unmet need for white children. These findings partially confirm the hypothesis of reduced productivity but not for the disadvantaged. In fact, the findings indicate that older dentists may be more likely to see underserved children in their practice by virtue of practicing in underserved areas and being more willing to treat children.

Impact of supply of newly graduated dentists on annual visits. The larger supply of dentists who are recent graduates in an MSSA was associated with lower likelihood of an annual visit for children at or above 200%FPL. This finding does not confirm the hypothesis. Younger dentists do not positively impact access for the underserved.

Impact of supply of newly graduated dentists on unmet need. The larger supply of dentists who are recent graduates in an MSSA was associated with higher likelihood of unmet need for children at or above 200% FPL, African American adults and Latino children. These findings are the reverse of hypothesis that newly graduated dentists reduce disparities. The reason for the findings may be that younger dentists working on their own have small practices and lower productivity as a result. Others who work as associates in larger practices may be located in areas with high levels of need.

Impact of supply of dentists who are non-white on annual visits. The larger supply of dentists who are non-white in an MSSA was associated with lower likelihood of an annual visit for African American adults. This finding does not support the hypothesis. The reason for this finding may be lack of racial/ethnic concordance between dentists and patients given that a very small percentage of dentists in California are African American, Latino, or American Indian/Alaska Native. The majority of California dentists are white followed by Asian American. However, the great majority of the California population are white and Latino, followed by Asian Americans and others.

Impact of supply of dentists who are non-white on unmet need. The larger supply of dentists who are non-white in an MSSA was associated with lower likelihood of unmet need for children at or above 200% FPL and Asian American adults. These findings confirm the hypothesis.

Impact of supply of dentists who are generalists on annual visits. The larger supply of dentists who are generalists in an MSSA was associated with higher likelihood of an annual visit for children below 200% FPL and Latino children. These findings confirm the hypothesis and indicate that more generalist dentists may alleviate disparities in visits for underserved children because it is easier to find a dentist who sees underserved children.

Impact of supply of dentists who are generalists on unmet need. The larger supply of dentists who are generalists in an MSSA was associated with higher likelihood of unmet need for Asian American adults. This finding does not confirm the hypothesis and indicates a reverse effect that expected for one underserved group. The reason for this finding is not immediately apparent.

Impact of supply of dentists who are female on annual visits. The larger supply of dentists who are female in an MSSA was associated with higher likelihood of an annual visit for both adults and children overall, for children at or above 200% FPL and for white adults. These findings do not confirm the hypothesis that female dentist lead to lower visits for the underserved. However, the findings indicated a strong association with higher likelihood of a visit for better served populations. The findings may indicate differentials in female dentists' provision of preventive care and their willingness to treat children.

Impact of supply of dentists who are female on unmet need. The larger supply of dentists who are female in an MSSA was associated with lower likelihood of unmet need for children overall, adults at or above 200% FPL, white children and adults, and African American, Asian American, and Latino adults. These findings also are the reverse of what was hypothesized. Female dentist may be more willing to provide care to some underserved populations, even if their work weeks may be shorter.

Hypothesis 2

Impact of supply of visits per dentist (average number of visits per week) on annual visits. There were no significant independent associations for this indicator. This hypothesis is not confirmed.

Impact of supply of productive visits per week on unmet need. There were no significant independent associations for this indicator. This hypothesis is not confirmed.

Impact of supply of dentists who own or are partners in their practice on annual visits. There were no significant independent associations for this indicator. This hypothesis is not confirmed.

Impact of supply of dentists who own or are partners in their practice on unmet need. The larger supply of dentists who own or are partners in their practice in an MSSA was associated with higher likelihood of unmet need for children at or above 200% FPL. This hypothesis is not confirmed. The reason for the observed impact among the higher income population is not immediately apparent.

Impact of supply of dentists who employ hygienists on annual visits. There were no significant independent associations for this indicator. This hypothesis is not confirmed.

Impact of supply of dentists who employ hygienists on unmet need. The larger supply of dentists who employ at least one hygienist in an MSSA was associated with lower likelihood of unmet need for adults at or above 200% FPL. This hypothesis is not confirmed. However, it most likely reflects the higher level of demand for preventive care among higher income populations.

Impact of supply of dentists who employ two or more dental assistants on annual visits. The larger supply of dentists who employ two or more dental assistants in an MSSA was associated with lower likelihood of an annual visit for children overall, children at or above 200% FPL, and white adults. This hypothesis is not confirmed. However, these findings indicate that there may be differentials in types of care provided in general and to better served populations by dentists with more dental assistants. The higher number of dental assistants in a practice is found to be associated with provision of less preventive care and more aesthetic care in other research.

Impact of supply of dentists who employ two or more dental assistants on unmet need. There were no significant independent associations for this indicator. This hypothesis is not confirmed.

Impact of supply of dentists who have more than one practice location on annual visits. The larger supply of dentists who have more than one practice location in an MSSA was associated with higher likelihood of an annual visit for adults below 200% FPL. This hypothesis is not confirmed and the finding is the reverse of what was expected. Multiple locations appears to increase availability of dental care in more areas, even if that availability may be restricted to less than full-time presence of a dentist. This finding indicates that even limited access in some areas improves access to dental care for low income populations.

Impact of supply of dentists who have more than one practice location on unmet need. The larger supply of dentists who have more than one practice location in an MSSA was associated with lower likelihood of unmet need for Latino adults and a higher likelihood for Latino children. This hypothesis is partially confirmed. The limited time spent by dentists in a second or more locations may be spent providing care to adults rather than children. Other research indicates that dentists are less willing to provide care to young children.

Impact of supply of dentists who are busy or overworked on annual visits. The larger supply of dentists who are busy or overworked in an MSSA was associated with lower likelihood of an annual visit for adults overall, adults at or above 200% FPL and white and Asian American adults. However, it was associated with a higher likelihood of visits for children at or above 200% FPL. This hypothesis is not confirmed. Busy or overworked dentists are perhaps busy due to higher demand in their area of practice but may also be more busy because they are providing care to better served populations.

Impact of supply of dentists who are busy or overworked on unmet need. The larger supply of dentists who are busy or overworked in an MSSA was associated with lower likelihood of unmet need for adults overall and a higher likelihood of unmet need for children overall, children below 200% FPL, and Latino children. This hypothesis is not confirmed. These findings indicate that in areas with high level of demand, the needs of children in general and underserved children in particular are less likely to be met.

Impact of supply of dentists who have shorter appointments (lower than the median of 45 minutes) on annual visits. The larger supply of dentists who have shorter appointments in an MSSA was associated with higher likelihood of an annual visit for Latino adults. This hypothesis is confirmed. However, the findings may be an indication of practice differences by dentists or demand for care, since shorter appointments may reflect less advanced or intensive treatment.

Impact of supply of dentists who have shorter appointments (lower than the median of 45 minutes) on unmet need. There were no significant independent associations for this indicator. This hypothesis is not confirmed.

Impact of supply of dentists who have long waits for appointments (more than the median of 5 days) on annual visits. The larger supply of dentists who have long waits for appointments in an MSSA was associated with lower likelihood of an annual visit for children overall. This hypothesis is not confirmed in the sense that no differences for underserved populations were observed. However, to the degree that children may be considered underserved, this finding indicates that dentists with long wait times (due to higher demand or fewer work hours or other reasons) do not see many children in their practice.

Impact of supply of dentists who have long waits for appointments (more than the median of 5 days) on unmet need. The larger supply of dentists who have long waits for appointments in an MSSA was associated with lower likelihood of unmet need for adults below 200% FPL and adults at or above 200% FPL and white and Latino adults. This hypothesis is not confirmed and is the reverse of what is expected. The findings may be because the dentists with long wait times are more in demand because they are more likely to accept low income patients or provide discounts.

Hypothesis 3

Impact of supply of dentists who offer discounted fees on annual visits. The larger supply of dentists who offer discounted fees in an MSSA was associated with higher likelihood of an annual visit for adults and children below 200% of FPL and Latino adults. This hypothesis is confirmed. Even though the level of discount provided was not available in this data, the findings indicate the importance of availability of lower cost dental care on improved rates of visits among the underserved.

Impact of supply of dentists who offer discounted fees on unmet need. The larger supply of dentists who offer discounted fees in an MSSA was associated with lower likelihood of unmet need for children overall, children below 200% FPL, white children, and Latino children. This hypothesis is confirmed. However, discounted care seems to also improve access for better served populations as well as the underserved.

Impact of supply of dentists who accept publicly insured patients in their practice on annual visits. The larger supply of dentists who accept publicly insured patients in their practice in an MSSA was associated with lower likelihood of an annual visit for children overall, children below 200% FPL, white adults, and Latino children. This hypothesis is not confirmed. About 40% of dentists in the sample reported accepting publicly insured patients. It appears that this limited group of dentist may prefer adult patients over children.

Impact of supply of dentists who accept publicly insured patients in their practice on unmet need. The larger supply of dentists who accept publicly insured patients in their practice in an MSSA was associated with higher likelihood of unmet need for adults at or above 200% FPL and African American adults. This hypothesis is not confirmed. These findings may reflect the level of demand for dentists who accept public insurance and the shortage of such dentists.

Impact of supply of dentists who had no bilingual/multilingual capacity (dentist and staff spoke English only) on annual visits. The larger supply of dentists who had no bilingual capacity in an MSSA was associated with lower likelihood of an annual visit for adults at or above 200% FPL. This hypothesis is not confirmed.

Impact of supply of dentists who had no bilingual/multilingual capacity (dentist and staff spoke English only) on unmet need. The larger supply of dentists who had no bilingual capacity in an MSSA was associated with higher likelihood of unmet need for adults below 200% of FPL. This hypothesis is confirmed. This finding may indicate the possibility that dentists without bilingual/multilingual capacity do not see as many low-income populations.

Hypothesis 4

Impact of overall supply of public dentists (full-time equivalent dentist per 5,000 population) on annual visits. The larger supply of public dentists per population in an MSSA was associated with lower likelihood of an annual visit overall and for white adults. This hypothesis is not confirmed and is the reverse of the hypothesis. This finding most likely reflect the high level of demand for care in areas where safety net clinics and dental schools are located.

Impact of overall supply of public dentists (full-time equivalent dentist per 5,000 population) on unmet need. The larger supply of public dentists per population in an MSSA was associated with higher likelihood of unmet need for Latino adults. This hypothesis is not confirmed. This finding most likely reflect the high level of demand for care in areas where safety net clinics and dental schools are located.

Hypothesis 5

Impact of overall supply of private dentists (full-time equivalent dentist per 5,000 population) on annual visits. The larger overall supply of dentists in an MSSA was associated with higher likelihood of an annual visit for adults overall, adults and children at or above 200% FPL, and white adults and white children. This hypothesis is not confirmed. This finding indicates that the overall supply of dentists improves access to care, but not significantly for underserved populations.

Impact of overall supply of private dentists (full-time equivalent dentist per 5,000 population) on unmet need. There were no significant independent associations for this indicator. This hypothesis is not confirmed.

Discussion

A number of themes emerge from the findings. First and foremost, the findings highlight the deficiencies of focusing on traditional measures of supply of dentist such ratio of dentists to population. In this research, we refined the measure of overall supply from licensed dentists to full-time equivalent practicing dentists per 5,000 people in a given MSSA to more accurately assess the availability of these providers. We also created two such measures, one for private practice dentists and one for dentists practicing in community and dental school clinics. Our supply measures had the limitation of no data on dentists in corporate practice, but those dentists are expected to be a small percentage of all practicing dentists in the state. Despite our refined measures of overall supply, our findings confirm that overall supply is not as informative as more specific indicators and have limited policy implications.

A second emerging theme of this research is the differences in impact of supply of dentists on access to dental care of adults and children. Some supply characteristics improve access to care of adults but have a detrimental impact on access to care of children. Others have an impact only on one group rather than the other. The majority of dental care of children is not provided by pediatric dentists, given

their low availability (5% of private practice dentists in the sample were pediatricians) and their higher concentration in Northern California (with lower concentration of non-white and low-income populations). Delivery of dental care for children then depends on willingness of generalist dentists to treat them. Given that children's oral health needs are more often low cost preventive care or fillings, dentists may prefer treating adults who may return better profits. In addition, dentists are less likely to treat young children during training and may subsequently lack sufficient skills and comfort level for providing such care.

Other emerging themes of this research are the role of dentists' personal and business characteristics on access to care of the population overall and the underserved population in particular. While some of the hypotheses proposed were not confirmed, various characteristics such as aspects of demographics, practice structure, and financial indicators predicted access to dental care. These more specific supply measures highlight the fact that the characteristics of the dental health system, including that of its providers, impact the underserved population's access to care in different ways. Examining these characteristics allows us to propose more specific policy options to address disparities.

The importance of discounted care reflects the limitations of current forms of dental coverage. Dental policies are either not provided by all employers or have high premiums in the individual market, leading to high rates of no dental insurance among the public in general and the underserved in particular. Restrictions on benefits and high cost sharing requirements for more advanced dental care mean the need for significant out-of-pocket expenditures for some services. It is not surprising that in such a setting any form of discounted care can improve access to care. However, depending on discounts and charity care is unlikely to be a reliable policy fix, since charitable care is likely to fluctuate with recession and economic decline and will be insufficient.

The problem of dentist participation in public insurance programs such as Medicaid and State Children's Health Insurance program is long standing. Dentist participation was less than half in California at the time that the data for this study was collected and is likely to have dramatically declined since 2009 when the adult dental services were cut from California's Medicaid program. At the time of these data, participating dentists seem to have disfavored children with Medicaid, perhaps due to the low fees paid by the program for children's services. With the discontinuation of the adult benefits, access of children may have improved, though no data are yet available to confirm this issue.

Least but not least, the data highlight the inadequacies of current approaches to measuring demand for dental care. Several measures studied seemed to suggest that demand for care may have been incongruent with supply. While acknowledging the advantages of in-person and national assessment of oral health status, the shortcomings of such methods include high costs and lack of local level estimates.

Policy Implications

A vicious cycle perpetuates disparities in oral health of underserved populations: oral health status declines with limited access to dental care which in turn leads to further decline of oral health status. Improving access to dental care is the solution most likely to break this cycle and reduce observed disparities in oral health of underserved populations. The policy implications of the findings include but are not limited to the following:

- Understanding the specific aspects of the dental workforce, particularly dentists, is essential in understanding access to care barriers for underserved populations. Such understanding requires collection of data on the dentist workforce beyond the number of actively licensed dentists. Licensing boards can be the vehicle for collecting a number of important characteristics. Such data should be available for continuous monitoring of the impact of public policies or other changes in supply of dental providers on disparities.

- The reasons for more limited access of children in general and underserved children in particular should be closely examined and addressed. Training dentists with very young children can improve their skills and comfort level. Allowing independent practice for alternative providers including dental hygienists may be another way of improving access to care of children.

- Focused intervention in areas with higher concentration of aging or newly graduated dentists is required to improving access to care of underserved populations in those areas. Attracting more experienced dentist of African American or Latino descent or female dentists to underserved areas should also be considered. Efforts to train more African American and Latino dentists should continue.

- A better assessment of dental care needs and demand for dental care among underserved populations is needed. Statewide representative population-based telephone surveys could also be a vehicle to assess demand for dental care at a more local level.

- Part-time presence of dentists in underserved areas is also beneficial, if not optimal. However, better needs assessment at the local level is needed to better understand the solutions for improving access when dentists maybe overwhelmed with demand.

- Data on the level of discounts that improve access to care is needed to better understand the role of discounts on access. Policies that address the ability to pay for care by improving dental insurance coverage and improving benefits should be considered. The 2010 Patient Protection and Affordable Care Act mandated availability of dental policies for children under the Health Benefit Exchange program and should include the same mandate for adult policies.

- Increases in Medicaid fees are a policy solution that is unlikely to be implemented as budget shortages continue to plague the nation. However, improved fees for children services under Medicaid may address the apparent disparities experienced by children with such coverage. In addition, improved payments to safety net providers may also help particularly for Medicaid insured adults in California, though publicly insured patients still have to compete with privately insured and higher income patients for those services.

Limitations

Our assessment of the impact of contextual variables on access to dental care was somewhat hampered by the limitations of analyzing service use across geographic boundaries such as MSSAs, because individuals can travel between MSSA to use dental care elsewhere. Due to the variable population density of urban and rural areas, the travel across MSSA lines is likely to be more common in densely populated urban areas with many more MSSAs in a smaller geographic area than in rural MSSAs. Travel across MSSAs is also more likely for those living at the borders and when safety-net providers are unavailable in the area. Nevertheless, many factors may limit the ability of the underserved populations to travel significant distances to use services, such as language limitations, heavier reliance on public transportation and less flexibility in paid time off from work. These factors are likely to increase the likelihood of using more accessible services in the vicinity of their residence or delay use of services. The overall impact of this limitation on the findings is likely to be the potential underestimation of the impact of the dental care system variables on access to dental care.

Comprehensive data on the universe of dental safety-net providers in the state is not publicly available and requires primary data collection. Low cost or free dental care may be provided by corporate practices, school-based clinics, mobile clinics, hospital-based clinics, VA facilities, public hospitals, and county health facilities. All primary care providers will be included in this study if they report to and are captured in OSHPD data and data we obtained from all dental schools in California. It is expected that the providers included in our study comprise the substantial majority of the providers of low cost dental care and the absence of providers in alternative settings does not limit the generalizability of the data.

Demand or need as a primary determinant of dental care use was not directly measured in this study, since CHIS or the other data sources do not include variables directly measuring this concept. In the absence of a direct measure, smoking status, chronic conditions, and general health status were used as proxies for oral health status; the latter is shown to be significantly and independently associated with perceived oral health need.[37]

The generalizability of the 2003 data may be limited due to the age of the data. Though the relationships identified in this study are likely to hold, barring unforeseen major changes in the dental health delivery system.

The data were sparse in adjusted models of visit in the past year and unmet need in the past year for African American and Asian American children and for many of the American Indian/Alaska Native adults and children and those models did not converge. In the great majority of these cases, however, unadjusted associations between the independent variables and access to dental care are provided in Exhibits and shed some light on the predictors of access for these populations.

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