Published in final edited form as:

J Rural Health. 2021 January ; 37(1): 103–113. doi:10.1111/jrh.12418.

Exploring the Impact of ACA on Rural-Urban Disparity in Oral Health Services Among US Noninstitutionalized Adults

Wei-Chen Lee, PhD^{1,*}, Chih-Ying Li, PhD, OTR², Hani Serag, MD, MPH¹, Maryam Tabrizi, DMD, MPH³, Yong-Fang Kuo, PhD⁴

¹Office of Health Policy and Legislative Affairs, University of Texas Medical Branch, Galveston, Texas

²Department of Occupational Therapy, University of Texas Medical Branch, Galveston, Texas

³Department of General Practice and Dental Public Health, University of Texas Health Science Center at Houston, Houston, Texas

⁴Department of Preventive Medicine and Community Health and Office of Biostatistics, University of Texas Medical Branch, Galveston, Texas

Abstract

Purpose: To explore the effect of the Affordable Care Act (ACA) on rural disparities in oral health services utilization based on disability status.

Methods: Comparing the 2011–2013 with the 2014–2016 Medical Expenditure Panel Survey, the study estimated the impacts of ACA on the likelihood of having preventive checkup and utilization of dental treatments in adults older than 18.

Findings: The sample consists of 216,184 noninstitutionalized adults with 14.5% living in rural areas. There was a slight improvement in the receipt of oral health services after ACA, but the improvement was not statistically significant. Disability remains a barrier to receiving preventive oral health checkups, and living in rural areas is a barrier for both utilization of preventive checkups and dental treatments.

Conclusions: Unmet needs for preventive checkups may result in unnecessary, costly dental treatments. More strategies are needed to reduce the disparities in oral health services.

Keywords

Affordable Care Act; health disparities; oral health; prevention; rural

Untreated oral health conditions are associated with an increased incidence of stroke, coronary heart diseases, and cerebral infection.¹ Poor oral health is also a barrier to proper speaking and eating, and subsequently, reduces quality of life. Globally, the FDI World

*For further information, contact: Wei-Chen Lee, PhD, Office of Health Policy and Legislative Affairs, University of Texas Medical Branch, 301 University Blvd, Galveston, TX 77555-0920; weilee@utmb.edu.

Disclosures: The study acquired the approval of the Institutional Review Board at University of Texas Medical Branch (#19-003). The study also has complied with all requirements to use confidential files mandated by the Agency for Healthcare Research and Quality (AHRQ). No conflicts of interest or other disclosures exist.

Dental Federation and World Health Organization (WHO) jointly developed the Global Oral Health Goals 2020 to address inequalities in oral health.² Nationally, both Healthy People 2020³ and Rural Healthy People 2020⁴ aim to increase access to oral health preventive and curative services. Although the aforementioned initiatives have increased the awareness of oral health, variations still persistent in the access to, and the utilization of, oral health services between rural and urban populations.¹

Utilization of preventive and clinical services for rural populations is of particular interest due to their lower health literacy, lack of insurance, shortage of the health care workforce, inadequate access to care, and worse socioeconomic conditions compared to urban populations.⁴ These factors often result in rural patients seeking care in an emergency room after a problem becomes more severe.¹ Furthermore, as a fluoridated water system is costly, rural communities often rely on unfluoridated well water, increasing the possibility of having dental caries.⁵ Rural populations are also more likely to have unhealthy social behaviors, such as tobacco use.⁴ Despite the high risk of oral health diseases, only limited rural populations receive at least 1 preventive oral health checkup per year.⁶

People with disabilities are also less likely to receive preventive care than those without disabilities.^{7,8} Using longitudinal national data, a study found that people with physical disabilities had higher unmet care needs than those without physical disabilities.⁹ Significant disparities in oral health services remained, even after controlling for the presence of dental insurance for adults with disabilities.¹⁰ The majority of disparity studies use cross-sectional data. In addition, the impact of rural-urban differences on dental care disparities for people with disabilities remained largely unexplored.

The purchase of dental benefits increased through the Affordable Care Act (ACA) and the federally facilitated marketplace during 2013.^{11–13} Although a dental insurance plan is not mandatory for adults under the ACA, the dependent policy along with the expanded private dental benefits motivated adults aged 19–25 to purchase a dental insurance plan.^{11,14} The same study¹⁴ also reported a slight improvement in access to health care among people with physical disabilities, but no study has further explored these changes in rural residents with disabilities. However, the effects of ACA on rural disparities in dental care utilization remain unknown. Our study is the first one designed to assess the impact of implementation of the ACA on the rural disparity in the receipt of oral health services, comparing adults with and without disabilities. We hypothesized that living in rural areas aggravated the oral health disparity for people with disabilities, but that disparity could be reduced after ACA. By examining the changes over 6 years, we also hoped to identify strategies to address the unmet needs for coming years.

Methods

Data Source

We drew the data from the 6-year Medical Expenditure Panel Survey (MEPS), a nationally representative survey of US noninstitutionalized individuals administered by the Agency for Healthcare Research and Quality (AHRQ).¹⁵ A part of the data was obtained from the confidential files through a formal application,¹⁶ and another part from the 2011–2016

full-year consolidated files available to the public. We used 6 different full-year consolidated files instead of panel data, because the full-year consolidated file was designed to collect data from 2 different cohorts to maximize the representation of the national population. More details about the sampling method can be found in the user manual.¹⁵

MEPS sampled households from a subsample of the National Health Interview Survey. Each household survey has a corresponding geographic cluster at which the household is located. MEPS classified the location into a binary variable to indicate whether a person lived in a metropolitan statistical area (MSA) or in a rural area (non-MSA).¹⁵ Each participant self-reported the presence of Activities of Daily Living, Instrumental Activities of Daily Living, functional limitations (8 questions, such as difficulty using fingers to grasp objects), or activity limitations (3 questions if a person was unable to work at a job, do housework, or go to school).¹⁵ Respondents responded “Yes” or “No” for each question to indicate what disability they have. Then, MEPS used total responses to generate an overall, binary variable to determine whether or not a person has any of the aforementioned limitations. In each full year of data, adults older than 18 were drawn and then we merged 6 years of data as the final study sample. However, around 3% of adults without valid information on their disability status were excluded. We also excluded survey participants older than 18 but pregnant, as they would require different specialty care (eg, Ob/Gyn).

Outcome Measures

MEPS collects information on utilization of a variety of health care services, but also the receipt of preventive care or screening examinations.¹⁵ For preventive oral checkup, responses could be twice a year or more, once a year, less than once a year, never go to dentist, or missing (~1% of total sample). We recoded the variable into a binary outcome: at least 1 preventive checkup in 1 year (= 1) or not (= 0). For dental treatment, we used the original continuous outcome: the number of dental treatment visits per person per year.

Independent Variables

The dichotomous variable (MSA vs rural) was the primary independent variable in this study.¹⁵ Since 2013, the geographic information has been no longer available to the public. We applied for the 2011–2016 confidential files to supplement this information. In the MEPS, an urbanized area has a population of at least 50,000 and consists of an urban nucleus with a population density of 1,000 persons per square mile and adjoining territory with at least 500 persons per square mile.¹⁷

Both year and disability were independent variables used to predict the study outcomes. We used the original disability variable: with (= 1) and without (= 0) disability. Based on our literature review finding with respect to the potential impact of ACA on the purchase of a dental insurance plan, we also coded the year as a binary variable: 2011–2013 (= 0) and 2014–2016 (= 1).

Covariates

We referred to Andersen’s model for individual use of health care¹⁸ to develop 12 covariates as follows: (1) predisposing characteristics: state, age (18–44, 45–64, and 65+ years), gender

(female or male), race and ethnicity (Hispanic, non-Hispanic white, non-Hispanic black, non-Hispanic Asian, or other), and marital status (not married or married); (2) enabling factors: education (lower than high school, high school, bachelor's, and above), poverty level (from 1 = poor [under 125% poverty line] to 4 = high income [equal to or greater than 400% of poverty]), and travel time to usual source of care (USC) (1 = 0–30 minutes, 2 = 31–60 minutes, 3 = 60+ minutes, to 4 = no USC); and (3) health care needs: perceived physical health status (from 1 = poor to 3 = excellent), perceived mental health status (1 = poor to 3 = excellent), total number of medical conditions (from the following: high blood pressure, heart disease, stroke, emphysema, chronic bronchitis, high cholesterol, cancer, diabetes, joint pain, arthritis, asthma, and attention deficit hyperactivity disorder), and the level of pain (1 = not at all to 4 = extremely painful). The categories were collapsed in several covariates. For example, a list of chronic condition variables was set to “1” (Yes) if a condition was recorded/reported by the individual. Then, we calculated the total number of chronic conditions of each individual and recoded their total number into a variable with 4 categories: 0 (no chronic conditions), 1–2, 3–4, or 5+ conditions.

Sampling Weights

For each year of the consolidated files, MEPS has generated both household-level and person-level weight variables to reflect its multistage sample design and produce national estimates.¹⁵ Each household has a corresponding household-level weight, but it could also have more than 1 person-level weight if more than 1 person is eligible to participate in the survey. Variables used in developing person-level weights are census region, MSA status, race/ethnicity, sex, and age. Next, MEPS also suggests that users adopt the Taylor-series linearization method to calculate appropriate standard errors. MEPS has 2 variables that serve to identify the sampling strata and sampling units required by the variance estimation program: *varstr* and *varpsu*. Each year, the MEPS file has 165 variance strata, each with 2 or 3 sampling units.

Statistical Analyses

We applied person-level weights to produce national estimates of preventive checkup and dental treatment by both MSA/rural and disability status.¹⁵ We compared the demographic characteristics of the pooled 6-year sample by both MSA/rural and disability status. We also analyzed the utilization of oral health services in 2 different time periods. Weighted frequencies, percentages, and 95% confidence intervals were also presented to illustrate the distributions of outcome variables. Chi-square tests were used for categorical variables and Wilcoxon rank-sum tests were used for continuous variables to evaluate the significance of the differences between urban and rural adults with and without disabilities.

We used logistic regression to determine the likelihood of receiving a preventive checkup and a linear regression model with a negative binomial distribution for the number of dental treatment visits. For logistic regression models, we provided OR with *P* values; for linear regression models, we provided coefficients (Coeff.) with *P* values. With survey data, the maximum likelihood assumptions are violated.¹⁹ Therefore, we conducted the Wald Tests instead to examine whether the interactions between MSA, disability, and time on the study outcomes were statistically significant. We further adjusted for all covariates in these

models. To explore any potential mediators of the association between MSA, disability, and time, we also added the covariates one by one to the models. All data analyses were performed employing the class of Stata survey procedures version 15.1 (StataCorp LLC, College Station, Texas) to account for the sample design features. Two-tailed *P* values less than .05 were considered statistically significant.

Sensitivity Analysis

The ACA (ACA, P.L. 111–148) made a number of changes to Medicaid, such as expanding eligibility to adults with incomes up to 138% of the federal poverty level.²⁰ Although purchasing the dental insurance plan remains optional, Medicaid expansion particularly impacted the access to health care for the adult population, which is also our study population. To further examine the potential effect of Medicaid expansion on access to oral health services, we created a new variable to classify the states that started Medicaid expansion during 2014–2016 (= 1, including AK, AR, CA, CO, CT, DE, HI, IL, IN, IA, KY, LA, MD, MA, MI, MN, MT, NV, NH, NJ, NM, NY, OR, PA, RI, VT, WA, WV, DC) or not (= 0).²¹ We adopted the difference-in-difference method and compared the percentage of the population with dental insurance between states with and without expansion.

Results

Our sample consists of 216,184 noninstitutionalized adults (unweighted) with 14.5% living in rural areas. Rural areas had a significantly higher percentage of adults with disability than MSAs (32.9% vs 25.1%). We formally tested the 3-way interaction effect of MSA, disability, and time on our 2 outcomes. In the model to predict preventive checkup, the interaction was significant ($P = .0214$) but not in the model to predict dental treatment ($P = .9156$). After adding the covariates, the effect of 3-way interaction in the model to predict the receipt of preventive checkup also disappeared. Following that, we tested the 2-way interaction between each of the 2 variables among year, disability, and MSA. The effect was significant only before adjustment for other covariates. In sum, MSA, disability, and time did not influence the rate of use of preventive checkup through their 2-way or 3-way interactions. Our final model included only their main effects (ie, MSA, disability, and year as 3 individual independent variables).

Table 1 shows the comparisons of personal characteristics between adults with disability and without disability by geographic areas. Table 1 further indicates the variations in receipt of oral health services between adults with and without disability before and after ACA. Although the percentages of those having at least 1 preventive checkup were higher after ACA for adults both with and without disability, the gap was 17.5% before 2013 (= 58.3%–40.8%) and 14.0% after 2014 (= 59.0%–45.0%) in rural areas. In contrast, that gap increased in urban areas after ACA (10.9% before 2013 but 12.7% after 2014). As to the number of dental treatment visits, we found that the gap between adults with and without disability was larger after ACA in both rural and urban areas.

In our sensitivity analysis, we found that the dental insured population rate increased from 46.9% to 49.4% in states with expansion ($P < .05$), and it increased from 44.3% to 46.4% in states without expansion ($P > .05$). However, we did not find any statistically significant

association between the expansion status and our study outcomes (ie, receipt of preventive checkup or dental care). Namely, the expansion status did not contribute to the utilization of oral health services. Given that our objective was to measure rural-urban disparities rather than state-level variations, we decided to use the dichotomous variable (rural/urban) as our independent variable but adjusted our models for the “state” variable.

Table 2 shows the crude and adjusted models for both outcomes. We present the association between each covariate and 2 respective outcomes in Table 2. However, by the end of the analysis, we focused only on assessing the changes in the association between our 3 independent variables and 2 health care outcomes before and after adjusting for the covariates. After we adjusted for the covariates, the time effect became insignificant ($P = .509$ for preventive checkup and $P = .374$ for dental treatment). Living in an urban area significantly contributed to a higher likelihood of having a preventive checkup and utilizing dental treatment ($P < .001$). Having a disability significantly reduced the likelihood of having a preventive checkup but increased the use of dental treatment ($P < .001$). Next, we added the covariates one by one into the regression models to assess potential mediators. In the preventive checkup model, we found that poverty level diminished the time effect. Those with higher income were more likely to receive preventive checkups. For the model to predict the utilization of dental treatment, we found that adding education or poverty status reduced the time effect. Those with a higher education level or a higher income were more likely to receive dental treatments.

Both Figures 1 and 2 show that the adjusted outcomes, after controlling for all covariates, increased after 2014. According to Figure 1, disability status was the main barrier to receiving a preventive checkup, whatever the place of residence. Adults with disabilities were less likely to have at least 1 preventive checkup per year, although there was no significant difference between 2011–2013 and 2014–2016. In addition, living in a rural area leads to a larger gap in the likelihood of receiving a preventive checkup between people with and without disability compared to urban adults. According to Figure 2, place of residence was the main barrier to receiving dental treatment. Urban adults received more dental treatments than their rural counterparts, although there was again no significant difference between 2011–2013 and 2014–2016. Unlike in Figure 1, Figure 2 indicated that urban adults with and without disabilities had a larger gap in receipt of dental treatment.

Discussion

Previously, community-dwelling adults with disabilities have been found to have a higher level of unmet needs for oral health services in comparison with institutionalized adults, who may receive routine dental examinations based on the facility regulations.²² By utilizing the MEPS data, our study findings provide a better understanding of the disparities in oral health services among noninstitutionalized individuals. The primary finding of our study is that both study outcomes were improved from the period of 2011–2013 to the period of 2014–2016; however, that improvement was not statistically significant after adjusting for all covariates. Next, our study showed that disability status contributes to less utilization of preventive checkups and more dental treatment. Meanwhile, living in a rural area contributes to lower utilization of both preventive checkups and dental treatment.

What We Found About Rural Disparities

Our finding reflects that a combination of inadequate availability and access to timely oral health services persists in rural areas. In 2002, a study pointed out that adults living in rural areas were more likely to report having unmet dental care needs compared with adults living in urban areas.²³ Almost 2 decades later, our study indicates that the disparities in oral health services remain in rural areas, even after controlling for all covariates. In addition, our study found that rural adults were less likely to receive preventive checkups, regardless of ACA passage or disability status. Between 2014 and 2016, 54.9% of urban adults with disabilities had at least 1 preventive checkup but the number was 45.0% in their rural counterparts, a difference of around 10%. Such a gap is larger than that found in a study targeting children: rural children were about 5% less likely than urban children to receive preventive checkups.²⁴ Without opportunities to maintain oral health, adults living in rural areas may experience disproportionately diminished quality of life as well.

Consistent with previous studies, we also found that people with disabilities did not receive preventive checkups as frequently as those without disabilities, in both rural and urban areas.^{7,8} In our study, living in a rural area aggravated the gap in receiving preventive checkups between adults with and without disabilities. In fact, rural adults with disabilities were the group with the lowest likelihood of receiving preventive checkups. One study pointed out that having a preventive checkup resulted in less subsequent expensive and nonpreventive procedures for the Medicare population.²⁵ Currently, Medicare provides no dental benefits and Medicaid offers minimal benefits depending on each state's policy.²⁶ Adding dental coverage for preventive checkups to those with disabilities living in rural areas is highly recommended, to not only improve oral health, but also to prevent unnecessary, costly emergency dental treatment.¹

What We Found About ACA

Systematic disparities not only profoundly affect the overall health of rural populations, but also make rural areas less attractive to health care professionals, due to generally worse life conditions than in urban areas.^{4,27,28} Yet, this issue could be resolved by increasing the dental benefit coverage to Medicaid.^{14,29} We referred to the literature and assessed 2 outcomes: before 2013 and after 2014. Our study illustrated a positive direction where the utilization of preventive checkups and dental treatments slightly improved over time for adults both with and without disabilities. Although the time effect was not statistically significant after adjusting for education and poverty level, the finding does not discourage the policy development of making dental care more affordable. It instead encourages more implementation of multilevel interventions to address other factors, such as making dental insurance a mandate for every adult. Second, 1 study indicated that, while more adults purchased the dental plan after ACA and needed the services, the dental provider capacity remained unchanged.³⁰ In response to the increasing demand for oral health services, health policies will need to provide incentives for providers to treat patients with disabilities (eg, operating rooms for wheelchair) to sustain the provision of dental services to people with special needs.³¹

Under ACA, the literature has emphasized the multiple positive impacts of Medicaid Expansion,³² but our study controlled for the “state” variable for 2 reasons. First, 1 study pointed out that the states with a higher percentage of rural populations actually did not expand Medicaid.³³ We created a variable to classify states as expansion versus nonexpansion, but that variable did not significantly influence the study outcomes. Next, states with Medicaid expansion offered different levels of dental benefits and states without Medicaid expansion might also offer dental benefits through the 1115 Waiver.^{34–36} Therefore, we focused on exploring the overall impact of ACA but not that of Medicaid expansion.

In addition to addressing financial challenges, strategies must also address other challenges to treat underserved patients.³⁷ Improving patients’ oral health and the quality of clinical outcomes will likely require coordinating a variety of providers as well as connecting with patients and their caregivers to closely follow each patient.³⁸ Likewise, innovative programs, such as student loan repayment to retain a rural workforce, or applying fluoride varnish in schools, are strongly recommended. For instance, utilizing dental hygienists to perform and promote basic oral hygiene in community settings was found effective to close the gap in the utilization of oral health services between rural and urban areas.^{37,39}

Limitations

Our study did not account for the impact of severity of disability. MEPS did not ask how long the survey participants had disabilities or how severe the disabilities were at the time of the survey. People with more disabilities may experience more barriers to accessing preventive dental checkups and treatment. Although Horner-Johnson and Dobbertin¹⁰ pointed out that people with multiple types of disabilities were less likely to receive dental treatment, we did not have data to examine the effects of severity of disability on the receipt of oral care (geriatric individuals fall into this category). Next, MEPS does not collect information on the quality of the water supply, personal lifestyle characteristics, provider preference, or medical history. Individuals unable to purchase or not interested in using oral hygiene care products might have a higher demand for dental services in the long run. Third, the total number of visits per person per year is around 1 or less than 1 (Table 1). For instance, rural adults without disability on average received 0.76 incidences of dental care during 2011–2013. Dividing the utilization by the type of treatment would result in an even smaller number. We, therefore, did not analyze results by the type of dental treatment received. Finally, studies using the MEPS data are restricted to its binary geographic variable: MSA versus rural. Adopting a gradient of rurality may yield more detailed results. AHRQ declines to release more detailed geographic information in order to protect the privacy of its study participants. In short, the study results must be interpreted with caution and these limitations taken into account.

Conclusions

Our study shows that rural disparities exist in oral health services for noninstitutionalized adults over time, especially in the receipt of preventive checkups. While the overall utilization of oral health services was slightly improved over 6 years, the gap remained

between adults with and without disability. Unmet need for preventive checkups may result in subsequent higher costs of dental/emergency medical services. In light of this finding, more policies to increase the sources and resources of preventive oral care for adults with disabilities living in rural areas are imperative to reduce disparities and promote quality of life for this population.

References

1. National Advisory Committee on Rural Health and Human Services. Improving Oral Health Care Services in Rural America. 2018. Available at: <https://www.hrsa.gov/sites/default/files/hrsa/advisory-committees/rural/publications/2018-Oral-Health-Policy-Brief.pdf>. Accessed February 1, 2019.
2. World Health Organization. Global goals for oral health 2020. *Int Dent J*. 2003;53:285–288. [PubMed: 14560802]
3. Office of Disease Prevention and Health Promotion. Healthy People 2020: Oral Health. 2019. Available at: <https://www.healthypeople.gov/2020/topics-objectives/topic/oral-health/objectives>. Accessed February 1, 2019.
4. Bolin JN, Bellamy G, Ferdinand AO, Kash BA, Helduser JW, eds. Rural Healthy People 2020. Vol. 1. College Station, TX: A&M Health Science Center School of Public Health, Southwest Rural Health Research Center; 2015.
5. Hendryx M, Weiner C, Gurka M. Water Fluoridation and Dental Health Indicators in Rural and Urban Areas of the United States. Policy Brief of West Virginia Rural Health Research Center. 2012. Available at: https://www.ruralhealthresearch.org/mirror/4/478/2011_fluoridation_policy_brief.pdf. Accessed February 1, 2019.
6. Khan A, Thapa JR, Zhang D. Preventive dental checkups and their association with access to usual source of care among rural and urban adult residents. *J Rural Health*. 2017;33:419–426. [PubMed: 28905468]
7. Krahn GL, Walker DK, Correa-De-Araujo R. Persons with disabilities as an unrecognized health disparity population. *Am J Public Health*. 2015;105(Suppl 2):S198–S206. [PubMed: 25689212]
8. Reichard A, Stransky M, Phillips K, McClain M, Drum C. Prevalence and reasons for delaying and foregoing necessary care by the presence and type of disability among working-age adults. *Disabil Health J*. 2017;10(1):39–47. [PubMed: 27771217]
9. Mahmoudi E, Meade MA. Disparities in access to health care among adults with physical disabilities: analysis of a representative national sample for a ten-year period. *Disabil Health J*. 2015;8(2):182–190. [PubMed: 25263459]
10. Horner-Johnson W, Dobbertin K. Dental insurance and dental care among working-age adults: differences by type and complexity of disability. *J Public Health Dent*. 2016;76(4):330–339. [PubMed: 27265883]
11. Nasseh K, Vujicic M. Dental Benefits Coverage Increased for Working-Age Adults in 2014. HPI Research Brief. 2016. Available at: http://www.ada.org/~media/ADA/Science%20and%20Research/HPI/Files/HPIBrief_1016_2.pdf. Accessed February 1, 2019.
12. Shane DM, Ayyagari P. Spillover effects of the Affordable Care Act? Exploring the impact on dental insurance coverage. *Health Serv Res*. 2015;50(4):1109–1124. [PubMed: 25483853]
13. Vujicic M, Yarborough C, Naaseh K. The effect of the Affordable Care Act's expanded coverage policy on access to dental care. *Med Care*. 2014;52(8):715–719. [PubMed: 25023916]
14. Kaye SH. Disability-related disparities in access to health care before (2008–2010) and after (2015–2017) the Affordable Care Act. *Am J Public Health*. 2019;109(7):1015–1024. [PubMed: 31095413]
15. Agency for Healthcare Research and Quality (AHRQ). MEPS HC-192: 2016 Full Year Consolidated Data File. Rockville, MD: AHRQ; 2018.
16. Agency for Healthcare Research and Quality (AHRQ). Restricted Data Files Available at the Data Centers. Rockville, MD: AHRQ; 2018.

17. Ingram DD, Franco SJ. 2013. NCHS urban-rural classification scheme for counties. *Vital Health Stat.* 2014; 2(166):2.
18. Aday LA, Andersen RM. A framework for the study of access to medical care. *Health Serv Res.* 1974;9(3):208–220. [PubMed: 4436074]
19. Williams R. Analyzing Complex Survey Data: Some Key Issues to be Aware of. 2018. Available at: <https://www3.nd.edu/~rwilliam/stats3/SvyCautionsX.pdf>. Accessed February 1, 2019.
20. Medicaid and CHIP Payment and Access Commission. Overview of the Affordable Care Act and Medicaid. 2019. Available at: <https://www.macpac.gov/subtopic/overview-of-the-affordable-care-act-and-medicaid/>. Accessed July 1, 2019.
21. Norris LA. State-by-State Guide to Medicaid Expansion, Eligibility, Enrollment and Benefits. 2019. Available at: <https://www.healthinsurance.org/medicaid/>. Accessed February 1, 2019.
22. Horner-Johnson W, Dobbertin K, Beilstein-Wedel E. Disparities in dental care associated with disability and race and ethnicity. *J Am Dent Assoc.* 2015;146(6):366–374. [PubMed: 26025823]
23. Vargas CM, Dye BA, Hayes KL. Oral health status of rural adults in the United States. *J Am Dent Assoc.* 2002;133(12):1672–1681. [PubMed: 12512669]
24. Martin AB, Probst JC, Jones KM. Chartbook: Trends in Rural Children's Oral Health and Access to Care. Columbia, SC: South Carolina Rural Health Research Center Findings Brief; 2017.
25. Moeller JF, Chen H, Manski RJ. Investing in preventive dental care for the Medicare population: a preliminary analysis. *Am J Public Health.* 2010;100(11):2262–2269. [PubMed: 20864712]
26. Oral Health America. Do Medicare & Medicaid Cover Dental Care? 2017. Available at: <https://www.toothwisdom.org/az/article/do-medicare-medicaid-cover-dental-care/>. Accessed July 1, 2019.
27. Stone N, Casey BR. Ch. 15. Promoting oral health in rural communities. In Crosby RA, Wendel ML, Vanderpool RC, Casey BR eds., *Rural Population and Health: Determinants, Disparities, and Solutions*. San Francisco, CA: Jossey-Bass; 2012.
28. Alfero C, Barnhart T, Bertsch D, et al. The Future of Rural Health. 2013. Available at: <https://www.ruralhealthweb.org/getattachment/Advocate/Policy-Documents/FutureofRuralHealthFeb-2013.pdf.aspx?lang=en-US>. Accessed July 1, 2019.
29. Nasseh K, Vujicic M. Health reform in Massachusetts increased dental care use, particularly among the poor. *Health Aff.* 2013;32(9):1639–1645.
30. Singhal A, Damiano P, Sabik L. Medicaid adult dental benefits increase use of dental care, but impact of expansion on dental services use was mixed. *Health Aff.* 2017;36(4):723–733.
31. Langelier M, Moore J, Carter R, Boyd L, Rodat C. An Assessment of Mobile and Portable Dentistry Programs to Improve Population Oral Health. Rensselaer, NY: Oral Health Workforce Research Center, Center for Health Workforce Studies, School of Public Health, SUNY Albany; 2017.
32. Antonisse L, Garfield R, Rudowitz R, Guthy M. The Effects of Medicaid Expansion under the ACA: Updated Findings from a Literature Review. 2019. Available at: <https://www.kff.org/medicaid/issue-brief/the-effects-of-medicaid-expansion-under-the-aca-updated-findings-from-a-literature-review-august-2019/>. Accessed July 1, 2019.
33. Bailey JM. Medicaid Expansion as a Rural Issue: Rural and Urban States and the Expansion Decision. Lyons, NE: Center for Rural Affairs; 2013.
34. Chazin S, Guerra V, McMahon S. Strategies to Improve Dental Benefits for the Medicaid Expansion Population. Center for Health Care Strategies; 2014. Available at: https://www.chcs.org/media/CHCS-Revised-Adult-Dental-Benefits-Brief__021214.pdf. Accessed July 1, 2019.
35. Center for Health Care Strategies. Medicaid Adult Dental Benefits: An Overview. 2018. Available at: https://www.chcs.org/media/Adult-Oral-Health-Fact-Sheet_011618.pdf. Accessed July 1, 2019.
36. Kaiser Family Foundation. Status of State Action on the Medicaid Expansion Decision. 2019. Available at: <https://www.kff.org/health-reform/state-indicator/state-activity-around-expanding-medicaid-under-the-affordable-care-act/?currentTimeframe=0&sortModel=%7B%22colId%22:%22Location%22,%22sort%22:%22asc%22%7D>. Accessed July 1, 2019.
37. Institute of Medicine Board on Health Care Services. The U.S. Oral Health Workforce in the Coming Decade: Workshop Summary. Washington, DC: National Academies Press; 2009.

38. RHI Hub. Oral Health in Rural Communities. 2019. Available at: <https://www.ruralhealthinfo.org/topics/oral-health>. Accessed July 1, 2019.
39. Skinner ELegisBrief: Oral Health Care in Rural America. 2017. Available at: http://www.ncsl.org/documents/legisbriefs/2017/lb_2538.pdf. Accessed July 1, 2019.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Figure 1.
Adjusted Likelihood of Having at Least One Preventive Checkup per Year.

Figure 2.
Adjusted Number of Dental Treatment Visits per Year.

Table 1
Comparisons of Demographics and Unadjusted Outcomes Between People With and Without Disability by Geographic Areas

(%)	Rural			Urban		
	Not Disabled n = 136,587,347	Disabled n = 66,938,771	P value	Not Disabled n = 897,338,809	Disabled n = 301,089,084	P value
Year			.5437			.2620
2011	17.6	16.7		16.0	16.2	
2012	15.9	16.1		16.3	17.1	
2013	16.1	16.1		16.6	16.3	
2014	17.1	18.4		16.7	16.6	
2015	16.5	16.9		17.0	17.0	
2016	16.7	15.9		17.3	16.8	
50 States	~	~	.0004	~	~	<.001
Gender			.0148			<.001
Male	50.7	48.2		51.2	44.9	
Female	49.3	51.8		48.8	55.1	
Age			<.001			<.001
18–44	50.2	15.7		54.7	19.9	
45–64	35.7	39.9		33.8	39.1	
65+	14.2	44.4		11.4	41.0	
Race/ethnicity			<.001			<.001
Hispanic	7.5	3.5		18.5	11.1	
Non-Hispanic White	81.3	84.4		59.4	70.5	
Non-Hispanic Black	75.5	7.1		12.3	12.4	
Non-Hispanic Asian	1.2	0.5		7.4	3.1	
Others	2.4	4.5		2.4	2.8	
Marriage			<.001			<.001
Married	60.4	51.3		52.9	46.7	
Not married	39.6	48.7		47.1	53.3	
Education			<.001			<.001
Lower than high school	23.2	32.3		19.5	24.7	
High school	55.6	54.2		47.1	51.8	

(%)	Rural				Urban			
	Not Disabled n = 136,587,347	Disabled n = 66,938,771	P value	Not Disabled n = 897,338,809	Disabled n = 301,089,084	P value		
Bachelor and above	21.3	13.5		33.4	23.5			
Travel time to USC								
<30 minutes	67.6	72.6	<.001	64.3	77.2	<.001		
31–60	7.1	12.2		4.8	8.1			
60+	2.1	4.2		0.7	1.5			
No USC	23.1	11.0		30.2	13.3			
Poverty			<.001			<.001		
Poor	15.0	29.6		12.9	23.1			
Low income	14.1	18.8		11.8	16.0			
Middle income	34.8	28.0		29.4	27.4			
High income	36.1	23.6		45.9	33.5			
Physical health			<.001			<.001		
Poor/fair	16.0	56.1		14.6	50.2			
Very good	39.8	28.9		35.7	31.4			
Excellent	44.2	15.0		49.7	18.4			
Mental health			<.001			<.001		
Poor/fair	11.3	36.3		9.4	32.5			
Very good	30.0	29.9		25.5	28.5			
Excellent	58.7	33.8		65.1	39.1			
No. of chronic conditions			<.001			<.001		
0	35.1	4.0		39.6	6.4			
1 or 2	40.2	22.6		40.3	25.7			
3 or 4	18.0	32.5		15.3	32.8			
5+	6.7	41.0		4.9	35.1			
Level of pain			<.001			<.001		
Not at all	62.1	19.1		67.7	25.7			
A little	25.8	23.8		22.1	25.7			
Moderate	7.5	19.7		6.2	19.6			
Quite a lot	4.6	37.4		4.0	29.1			
Preventive checkup			<.001			<.001		

	Rural			Urban		
	Not Disabled n = 136,587,347	Disabled n = 66,938,771	P value	Not Disabled n = 897,338,809	Disabled n = 301,089,084	P value
(%)						
2011–2013						
Less than once	41.7	59.2		34.7	45.6	
At least once a year	58.3	40.8		65.3	54.4	
2014–2016			<.001			<.001
Less than once	41.0	55.0		32.7	45.4	
At least once a year	59.0	45.0		67.3	54.6	
2011–2013 Avg. dental care visit (95% CI)	0.76 (0.69, 0.84)	0.81 (0.69, 0.93)	.0851	0.87 (0.84, 0.90)	1.01 (0.96, 1.06)	<.001
2014–2016 Avg. dental care visit (95% CI)	0.79 (0.71, 0.88)	0.86 (0.74, 0.99)	.5466	0.89 (0.86, 0.92)	1.05 (1.01, 1.10)	<.001

Table 2

Rural-Urban Differences in Observed and Adjusted Outcomes

	Likelihood of Having at Least One Preventive Checkup per Year			Number of Dental Treatment Visits per Year		
	OR	95% CI	Coeff.	95% CI		
Observed						
Urban/rural	1.45***	(1.34–1.58)	0.15***	(0.06–0.24)		
2014–2016/2011–2013	1.07*	(1.02–1.12)	0.04*	(0.004–0.07)		
Disabled/not	0.60***	(0.57–0.62)	0.15***	(0.11–0.18)		
Adjusted						
(1) Independent variables						
Urban/rural	1.31***	(1.21–1.41)	0.14***	(0.07–0.22)		
2014–2016/2011–2013	1.02	(0.98–1.07)	0.02	(–0.01 to 0.05)		
Disabled/not	0.82***	(0.77–0.86)	0.06**	(0.02–0.10)		
(2) Covariates: predisposing factors						
50 States	~	~	~	~		
Female/male	1.66***	(1.60–1.72)	0.24***	(0.22–0.27)		
Age						
45–64/18–44	0.97	(0.91–1.03)	0.15***	(0.11–0.19)		
65+/18–44	0.87***	(0.81–0.94)	0.27***	(0.21–0.33)		
Race/ethnicity						
White/Hispanic or Latino	0.80**	(0.84–0.96)	0.30***	(0.24–0.36)		
Black/Hispanic or Latino	0.96	(0.89–1.03)	–0.10**	(–0.18 to –0.03)		
Asian/Hispanic or Latino	0.63***	(0.57–0.70)	0.08	(–0.002 to 0.15)		
Other/Hispanic or Latino	0.78**	(0.67–0.91)	0.15***	(0.05–0.25)		
Not married/married	0.84***	(0.80–0.87)	0.003	(–0.03 to 0.04)		
(3) Covariates: enabling factors						
Education						
High school/lower than high school	1.16***	(1.11–1.21)	0.10***	(0.06–0.15)		
Bachelor or above/lower than high	2.34**	(2.19–2.51)	0.43***	(0.39–0.48)		

	Likelihood of Having at Least One Preventive Checkup per Year			Number of Dental Treatment Visits per Year		
	OR	95% CI	Coeff.	95% CI		
Travel time to USC						
31–60/<30 minutes	0.88**	(0.81–0.94)	–0.03	(–0.09 to 0.03)		
60+/<30 minutes	1.04	(0.84–1.28)	–0.06	(–0.19 to 0.08)		
No USC/<30 minutes	0.47***	(0.44–0.49)	–0.44***	(–0.49 to –0.40)		
Poverty status						
Low income/poor	1.11**	(1.03–1.19)	0.06	(–0.005 to 0.13)		
Middle income/poor	1.63***	(1.53–1.73)	0.31***	(0.26–0.37)		
High income/poor	2.87***	(2.68–3.08)	0.57***	(0.51–0.63)		
(4) Covariates: needs factors						
Physical health status						
Very good/poor	1.30***	(1.23–1.38)	0.08**	(0.03–0.12)		
Excellent/poor	1.56***	(1.47–1.65)	0.11***	(0.06–0.15)		
Mental health status						
Very good/poor	1.17***	(1.09–1.24)	0.03	(–0.01 to 0.08)		
Excellent/poor	1.24***	(1.17–1.31)	0.01	(–0.03 to 0.06)		
No. of chronic diseases						
1–2/No chronic disease	1.02	(0.97–1.08)	0.16***	(0.12–0.20)		
3–4/No chronic disease	1.10**	(1.02–1.17)	0.23***	(0.18–0.29)		
5+/No chronic disease	1.02	(0.94–1.11)	0.23***	(0.16–0.30)		
Level of pain						
A little bit pain/no pain	0.97	(0.93–1.01)	0.04*	(0.007–0.07)		
Moderately pain/no pain	0.89**	(0.83–0.95)	–0.01	(–0.06 to 0.04)		
Extremely pain/no pain	0.77***	(0.71–0.83)	–0.10***	(–0.16 to –0.04)		

* $P < .05$;** $P < .01$;*** $P < .001$.