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Adolescent Oral Health: An Intersectionality Approach to Testing Perceived Barriers to Utilization

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Abstract

Objective: Despite prevalence of community water fluoridation and dental sealants, approximately 20 percent of adolescents and young adults throughout the world have untreated dental caries. These conditions are exacerbated by the declining proportion of young adults receiving oral health care. Studies have identified five primary barriers to oral health utilization—income, insurance/Medicaid, fear, health awareness and transportation—but estimates of their relative magnitudes is often confounded by the intersectionality of disadvantage and other social circumstances.

Methods: This study examines adolescent oral health utilization controlling for the intersectionality of demographics, social position and need. Using CART decisions tree and hurdle models, this study identified the systematic process of oral health receipt and evaluated those factors that contribute most to oral health utilization.

Results: Results showed that number of local dentists, health literacy and fear contributed significantly to receipt of care. However, insurance status was the primary determinant.

Conclusions: This study underscores the importance of Medicaid revision to ensure equitable access to oral health care for individuals of all income levels. Furthermore, it notes that many barriers may exist simultaneously thus any long-term solution would require a fundamental change in socio-economic circumstance.

Keywords: Adolescence, Insurance, Healthcare, Treatment

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I. Introduction:

Due to financial or insurance limitations, one out of every 16 children and adolescents in the United States—4.6 million—does not receive needed oral health care. This lack of care has left untreated dental caries as the most prevalent unmet health need in young people in the United States.[1-4] This problem is not exclusive to the US, in fact, studies in Europe and Southeast Asia have shown that the lack of oral health care often leads to problem such as dental caries, erosion, trauma, periodontal disease, tooth positioning and malocclusion and emergence of wisdom teeth in young adults and these problems persist and often worsen over time.[5,6] Failure of adolescents to receive annual dental visits, according to studies, was found to be associated with gender, ethnicity, age, perception of health, insurance, family income and parent education.[7]

While the Department of Health and Human Services cited five primary reasons for the lack of oral health care utilization—lack of dental insurance/difficulty with Medicaid, fear of dental visits, transportation, cost and lack of oral health knowledge/literacy, no single, nationally representative study has tested all five barriers simultaneously for adolescents in any part of the world.[8,9] More importantly, no comprehensive study of adolescent oral health has studied these barriers using appropriate control for the intersectionality of demographics, social position and need. Intersectionality—an assertion that disadvantage

is the results of multiple sources of oppression interacting simultaneously— has informed considerable research on health but has not been applied to young adult oral health utilization.[10, 11] This study applies the theory of intersectionality under the assumption that lack of care arises from a constellation of interrelated and intersecting social roles.[12,13]

This paper examines oral health utilization among young adults in the US. However, given the similarities between adolescent oral health in the US and other areas, results are likely generalizable to other populations. It contributes to the current body of literature by testing the five proposed barriers to oral health utilization in a single model. To control for multicollinearity, variance heterogeneity and inflated standard errors, estimation accounts for the intersectionality of socio-demographic states and oral health utilization. Results from panel data analysis reveal that income, or lack thereof, is the primary barrier to oral health care utilization. Respondents who work, have insurance and earn higher incomes are most likely to receive oral health care, while those without regular employment earning lower income are unlikely to purchase insurance or receive oral health care.

II. Methods:

A variety of factors to have been identified as non-need determinants of oral health utilization [14-17] including age, [18, 19] gender, [20-22] SES, [22-24] ethnicity, [25-28] marital status, [29] parental status, [29, 12] and location [19]. In fact, dental service utilization is likely a factor of multiple things, occurring simultaneously. [30-33] Using previous literature as a guide, this study included all relevant demographic, environmental and social controls available in the data. Details regarding the data elements and their formulation are provided below.

Data and Key Indicators

a. *Survey:* Analysis utilizes data from the National Longitudinal Study of Adolescent to Adult Health (Add Health)—a longitudinal study of adolescents in grades 7-12 during the 1994-95 school year followed into young adulthood with five in-home interviews. Add Health combines longitudinal survey data on respondents' social, economic, and physical characteristics well-being with contextual data on the family, neighborhood, school and biological data, providing a unique opportunity to study how behavior and genetics interact as adolescents enter young adulthood. This study utilizes data from Waves I through V which contain consistent survey elements allowing longitudinal assessment of like environmental, behavioral, and demographic characteristics. Mean values for all covariates are provided in Table Ia.

b. Insurance: Evidence suggests that the gap in dental care utilization between those with health insurance and those without any insurance has widened since 2002.[34] However, for the purpose of this study, the sample was limited to those respondents over age 18 at the time they were interviewed. Below age 18, respondents can be eligible for the Children's Health Insurance Program (CHIP). CHIP provides low-cost health insurance coverage to children in families that earn too much money to qualify for Medicaid but are unable to be covered by private plans to ensure that CHIP eligibility did not bias results, eligible respondents were not included.

	Mean score (sd)	Range
Age	23.5 (0.0)	18 – 30
Female	0.5 (0.0)	0 – 1
Black	0.2 (0.0)	0 – 1
Visited Dentist within last Year	0.6 (0.0)	0 – 1
Total dental visits	2.2 (0.0)	0 – 4
Employed	0.8 (0.0)	0 – 1
Rural resident	0.2 (0.0)	0 – 1
Self – reported health	2.2 (0.0)	1 – 5
Medicaid	0.0 (0.0)	0 – 1
Insurance	0.8 (0.0)	0 – 1
Months with Insurance Last Year	9.2 (0.1)	0 – 12
In school	0.3 (0.0)	0 – 1
Physical check-up last year	0.7 (0.0)	0 – 1
Income	22.0 (0.9)	0 – 1000

Table I. Covariate means for young adult oral health utilization

Add Health respondents who were not eligible for CHIP did report their current insurance status as: own private insurance, Medicaid, Indian Health Service, through military service, covered by parent's insurance or no insurance. They also listed how many months, out of the last 12, they were covered by some type of health insurance. On average, 75 percent of respondents were covered by some sort of insurance during nine out of the last 12 months. The majority had private health coverage, with less than five percent receiving Medicaid.

Medicaid has been cited as one of the key drivers of the observed differences in dental care utilization. Medicaid programs in most states offer little or no dental benefits because states are not mandated to provide dental coverage for to adults.[35] Low-income adults who qualify for Medicaid likely have limited dental benefits, and these benefits vary widely across states.[36]

While Medicaid provide little or no dental coverage, the number of dentists and dental specialists who accept Medicaid has been declining over the past 30 years, while the number of individuals enrolled in Medicaid has increased, particularly since passage of the Affordable

Care Act.[37] As seen in Figure I, the percentage of dentist accepting any social assistance payments has steadily declined according to data from the American Dental Association's Health Policy Institute despite a 2000 warning from the Office of the Surgeon General (OSG) identifying the condition of oral health in the United States as an epidemic.

c. Oral Health Care Utilization: In each Add Health wave, respondents indicate the last time they had a dental exam by a dentist or hygienist

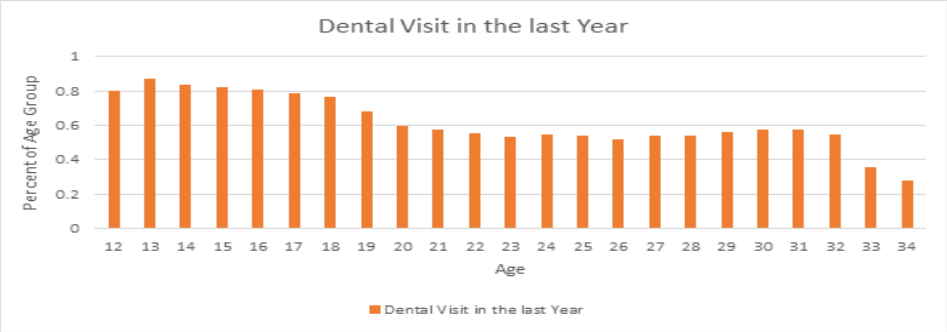

FIgure I

as less than a year ago, one to two years ago, more than two years ago, unable to recall or never. A binary indicator equaled one if respondents had received dental services within the last two years and zero if duration was more than two year ago or never. Unable to recall was coded as a missing response. About 56 percent of respondents had received recent dental care when surveyed. These values were summed over the panel waves to provide an indicator of the regularity of dental care. Waves I through IV occur at irregular intervals; thus, this summation does not indicate total number of utilizations, but rather indicates that respondents had received dental care within one to two years of their survey date. Respondents were asked four times over 12 years about dental services, but, on average, reported on only two out of the four occasions having had recent dental care.

d. Self-Reported Health Status: Respondents classify their health as 1) excellent, 2) very good, 3) average, 4) fair or 5) poor. They most frequently reported having very good health—a score of 2.

e. Physical Exam/Checkup: Similar to oral health care, respondents also report the last time they received last have a physical exam or routine check-up. Their responses include within the last 12 months, one to two years ago, more than two year ago, unable to recall or never. A binary indicator equaled one if respondents had received a checkup within the last two year and zero if duration was more than two year ago or never. Unable to recall was coded as a missing response. Over 60 percent of respondents had received a physical exam within the last two year.

f. Employment/Income: Employment status indicates that in the last 4 weeks, respondents worked for pay outside the home. Nearly 80 percent reported some type of paid employment. The most consistent indicator of income or earnings was the total reported household income before taxes received in the last calendar year. Amounts were provided in thousands and the logarithmic transformation was used for analysis. Values varied widely from $0 to $990,000.

Lack of financial resources is a primary barrier for many young adults in need of oral care, particularly those receiving social assistance.[38] Research indicates that the gap in dental care utilization—defined as whether a person visited a dentist in the previous 12 months—between poor and nonpoor people has increased between 1977 and 1996.[39] Persons with low socioeconomic status (SES) were more likely to report tooth pain and to endure their pain without the benefit of dental care.[40,41]

g. Dentists per 100,000: The number of dentists per 100,000 in the respondent's county of residence indicates the availability of dental care. Values range from zero to 190 with an average of 63. Lack of available care has been cited as a primary barrier for ethnic and other low-income minorities receiving dental care.[42]

h. School Enrollment: If respondents were attending school or currently attending a college, university, or vocational/technical school where you take courses for academic credit in the last year, they were enrolled. If surveyed during a school break, summer, or vacation, they were counted as attending. are enrolled but on school break or vacation, count this as attending. Only 25 percent of the sample was still enrolled in some time of schooling. However, this is an important consideration given that the provision of health services often differs for students. Education has been correlated with oral health utilization. Individuals who higher educational attainment are more likely to receive regular dental care.[43]

i. Demographic Indicators: Age, gender and race were used as demographic indicators. Respondents were 18 to 30 years old with an average age of 24. The sample was 50 percent female and 24 percent black. Children and adolescents become less likely to receive dental care as they age into young adults, particularly if they have never received regular care. Figure II shows the percent of survey respondents who report having seen a dentist in the last 12 months. In the early to middle teens, nearly 80 percent of adolescents have had seen an oral health provider. However, by the mid-20s the proportion has fallen below 60 percent. By the early 30s, only about 40 percent of respondents see a dentist annually. Oral health-related behaviors (e.g. brushing habits, smoking and so on) developed during adolescence are carried over into adulthood and continue to influence (oral) health later in life. This underlines the need for intervention in this age group.[44]

Ethnic minorities have shown that culture, age, language, and economic limitations are their most prevalent barriers to obtaining dental

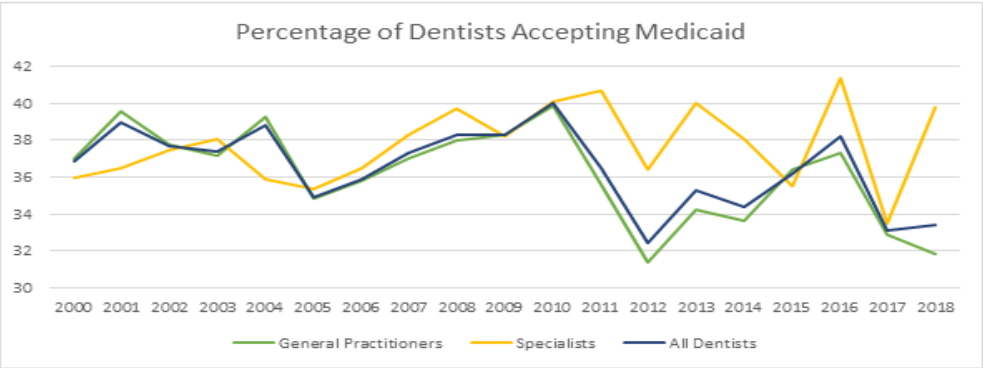

FIgure II

care.45 Studies have shown that poor ethnic minorities and those with less education continued to have much lower rates of dental care utilization than the general population.[46]

Theoretical Framework

Intersectionality conceptualizes individuals as being shaped by the interaction of different social locations that intersect in dynamic and interactive ways to privilege or disadvantage people depending on their characteristics and contexts. [47,48] While there are a multitude of conceptualizations, Weber's (2015) work identified the central theoretical tenets of intersectionality as: contextually specific social constructions, multilevel power relations and simultaneity.[49] Applying this theory to oral health utilization, this analysis considers transportation, fear, insurance and health literacy to be rooted in an individual's social location The interrelated nature of these barriers precludes their individual empirical examination.

This study attempts to account for each barrier within the allowable confines of the Add Health data. While capturing the exact nature of each barrier is not feasible, this study utilizes instruments for each of the five barriers. Insurance is a straightforward application of survey data. The use of school enrollment as an indicator of health literacy stems from the Center for Disease control's school-based initiative, Seal America. Beginning in 1999, the program was launched to increase oral health literacy and prevent dental carries by delivering dental sealant to school children. Income provides a measure of the cost barrier and transportation is instrumented with the number of licensed dentists per 100,000 in the county of residence. The rationale being that the more dentists in an area, the higher the likelihood that there is accessible oral healthcare. Finally, the most challenging barrier to instrument is fear. With no actual indicator of fear of dentists or physicians, this study uses an indicator for the respondent having visited the doctor for a routine checkup. Visiting a physician without an urgent need indicates that they are not afraid for healthcare professional or medical offices.

Empirical Techniques

In order to simultaneously test these social and demographic factors along with the DHHS perceived barriers one cannot simply employ a model of competing risk in which need, and non-need factors are tested simultaneously. This approach fails to account for the fact that the social position interacts in complex ways. Intersectionality theory considers social determinants in terms of multiple, interacting factors from which social disadvantage arises from a combination of interrelated and intersecting social roles.[12,13]

To account for these relationships, this study tests the determinants of oral health utilization to test the five perceived barriers in two unique ways—CART and Hurdle Models.

a. *CART:* Classification and Regression Trees (CART)—a popular machine learning and data mining applications [13, 50, 51] –recursively identifies rules that distinguish between groups who receive and do not receive oral health care. CART has two important advantages: (1) it makes no assumptions about variable distributions or relationships and (2) it can identify complex and unsuspected interactions. CART explores the complex interactions between different social determinants and their impact on oral healthcare use. CART analysis is performed using the *rpart* package and R 3.6.2. The model uses the Gini index, a measure of heterogeneity that reflects the difference across groups in the probability of the outcome, to select decision rules.

A minimum terminal node size of 30 individuals is required and assigned cost weights of ((1–P)/P) (where P is the prevalence, in this case of oral care-seeking) to cases and 1 to non-cases. This weighting scheme yields equal sums of weights for cases and non-cases, and therefore assigns equal importance to sensitivity and specificity. After fitting, the trees were 'pruned' by retaining the set of decision rules that minimized the cross-validated error. The CART analysis modelled the receiving oral health care as the outcome. To account for the complex design of Add Health, analysis applied longitudinal sampling weights by the Carolina Population Center, rescaled to have a mean of 1.

b. *Hurdle Model:* Utilization of oral health care has two characteristics that are important in selecting an estimation method. First, the distribution of the number of oral care visits can take only non-negative integer values, which means that some individuals had no visits during the survey, whereas others had single or multiple visits. The second characteristic is the two-part decision-making process, where the first part relates to the patient who decides whether to contact the oral health provider and the second to the decision to repeat the visit. These attributed calls for the application of count data models.[52] In standard Poisson and negative binomial models, this two-part characteristic is ignored, which may lead to inconsistent parameter estimates and hence misinterpretation.

However, one limitation of standard count models is that the zeros and the nonzeros (positives) are assumed to come from the same data-generating process. With hurdle models, these two processes are not constrained to be the same. The basic idea is that a Bernoulli probability governs the binary outcome of whether a count variate has a zero or positive realization. If the realization is positive, the hurdle is crossed, and the conditional distribution of the positives is governed by a truncated-at-zero count data model. Hurdle models differ from zero-inflated models which measure the response variable as a mixture of a Bernoulli distribution and a Poisson distribution (or any other count distribution supported on non-negative integers).

The basic idea of this model is that the data-generating process is driven by two different sets of parameters. Hurdle models allow for a systematic difference in the statistical process governing 'the hurdle,' i.e. whether an individual has any oral care and the statistical process governing the frequency of oral care given at least one visit. The likelihood function is therefore the product of the likelihood function for the binary process (a logit) and the likelihood function of a truncated-at-zero model for strictly positive counts or visits (a truncated-at-zero negative binomial). The two-part Hurdle model adjusts for the difference in those that receive care and those that do not before assessing the frequency of care. [53-56]

By separating the decision of any care from the frequency of care, it may be possible to assess whether income, for example, has its effect largely through the initiation process or the frequency of treatment. However, this model, does have limitations.[57] For example, it lacks specific information on the supply side of the oral health care sector. While the number of dentists per 100,000 people in the respondent's county of residence is used as an indicator of supply, the second stage of decision make may suffer from unobserved heterogeneity if this this value is not an accurate measure of the proximity of dental care. The hurdle model utilizes the countreg package in R 3.6.2.

III. Results:

CART: The classification tree for oral health service utilization includes decision rules based on four of the eight social determinants—gender, health status, insurance and age (Figure III). Individuals with insurance, good/very good health, below age 22 and who are female are more likely to use oral health services. Although CART decision rules do not necessarily reflect meaningful or replicable difference, the tree implies that insurance and health status play an important role, particularly among older individuals (>22.5) and men. In terms of overall fit,

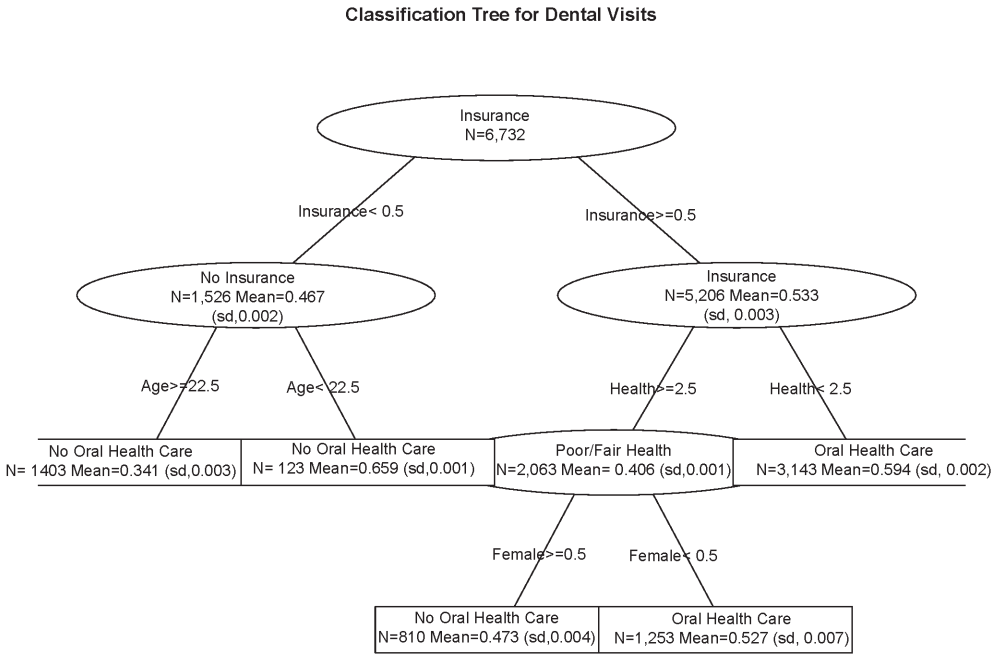

FIgure III

the effectiveness of the tree as a classifier was moderate, with overall agreement of 60%, sensitivity of 82% and specificity of 53%.

Hurdle Model: Estimated coefficients, marginal effects, associated cluster-robust standard errors and measures of model fit are listed in Table II. A positive β means that a unit increase in the associated regressor increases the baseline hazard rate of the state-specific process by [exp (β) – 1] × 100%. The same factors appear significant in both states. Being employed, having insurance and being in good health increases the probability of having oral care as well as the frequency of care. Being female, black or older decreases likelihood of any oral care or more frequent care. The more dentists in the county of residence, the higher the likelihood of dental care and a higher frequency of dental visits. Men appear to have more visits than women, ceteris paribus. Importantly, the average predicted state 1 hazard rate is below the state 2 hazard rate in both models, indicating that the assumption of zero inflation is confirmed.

IV. Discussion:

Since Phase I and II of the Hurdle model estimation are based on different likelihood functions, marginal effects are computed so esti-

	Median	Range	1Q	3Q
Pearson Residual	1.8	142.7 – 110.5	-12.1	14.4
	Marginal Effects	**Estimate**	**Std. Error**	**z value**
Phase 1 - (Truncated Poisson with Log Link):				
Intercept		0.1 *	0.0	-170.0
Female	-0.2	-0.1 *	0.0	-302.0
Health Status	-0.2	0.1 *	0.0	159.9
School Enrollment	0.2	0.1 *	0.0	86.0
Employed	0.1	0.1 *	0.0	246.7
Insurance	0.3	-0.2 *	0.0	-276.6
Black	-0.4	0.0 *	0.0	-38.3
Age	0.0	0.0 *	0.0	3.8
Checkup	0.1	0.0 *	0.0	78.2
Dentists Per 100,000	0.1	0.1 *	0.0	-170.0
Phase 2 - (Censored Negative Binomial with Log Link):				
Intercept		1.8 *	0.0	223.6
Female	-0.2	-0.1 *	0.0	-108.0
Health Status	-0.2	-0.1 *	0.0	-135.8
School Enrollment	0.2	0.0 *	0.0	30.1
Employed	0.1	0.0 *	0.0	27.6
Insurance	0.3	0.2 *	0.0	128.2
Black	-0.5	-0.3 *	0.0	-204.6
Age	0.0	0.0 *	0.0	-100.2
Checkup	0.1	0.2 *	0.0	146.5
Dentists Per 100,000	0.1	0.0 *	0.0	48.5
Log(theta)		8.7 *	1.5	5.9
Dependent Variable: Oral Health Visits				

* P< 0.05

mates will be comparable across phases. Marginal effects between the models show similar effects. The largest contributors to receipt or frequency of care are insurance, health status and race. Blacks have a much lower probability of receiving care at all and lower comparative frequency.

Limitations: While carefully contrived, these results should be interpreted with caution. Data analysis is based upon survey results. Cognitive theory research has shown that when questionnaire items ask a respondent to recall infrequently occurring events, that the respondent is more likely to count the individual events in his or her memory than to make an estimate of the number.[58-60] In addition, there is greater uncertainty about recalling events that occurred 90 days or more ago.[59] This uncertainty results in a greater number of events being remembered as having occurred than actual number of events having transpired.[61] In other words, respondents tend to overestimate the number of events when a reference period includes a period more distant in time—referred to as telescoping.[62] Overestimation from telescoping may be as high as 32 percent.[62]

Furthermore, social desirability is the conscious or unconscious tendency to answer according to social norms and attitudes about a topic.[63] For example, if society suggests that one should visit the dentist annually, a survey respondent might report a dental visit, even if it did not occur, because he or she does not want to appear outside the norm. Consequently, social desirability in answering would lead to an overestimation of dental visits, especially when a 1-year reference period is included in the item. In contrast, overestimation would be less likely to occur when the reference period included a period shorter than 1 year. While both telescoping and social desirability could have had an impact on results, it was not possible to estimate the degree of impact from either bias.

V. Conclusion:

This study examined how facets of social circumstance function to occlude oral health care utilization among young adults. Drawing from intersectionality theory, analysis frames social disadvantage as the result of inseparable circumstances and characteristics that effect insur-

ance, transportation, affordability, health literacy and fear of oral care simultaneously. Results show that the manifestation of these barriers significantly impacts utilization. The impact, however, is not equitable for all demographic groups. Respondents from the lowest social circumstances, have a higher incidence of barriers and are less likely to receive care.

Estimation takes two forms. First, a CART model iteratively evaluates the decision-making process for oral health care. Gender, insurance, age and health status are the most prevalent barriers with insurance being the primary driver. Second, regression analysis of over-dispersed count data modeled the hazard rate of the first dental visit and the hazard rate of the total number of visits as an endogenously determined system. Regressors could differentially affect the two hazard rates before and after the first event, and the effect on the overall count. This hurdle model shows that, controlling for demographic characteristics, these barriers do significantly relate to oral care utilization. Those barriers that effects receipt of any care (the first visit) are quite similar to those that effects the total number of visits. In other words, respondents who receive at least one dental visit are equally as likely to receive subsequent visits. Age was inversely related to the likelihood of care suggesting that those who had not received oral care relatively early in life were unlikely to ever receive any oral health services.

While analysis showed the those identified barriers do, in fact, reduce the likelihood of oral health care, the ADA has proposed solutions to overcome these impediments and increase access to oral health services in the United States. These solutions would vary in different health systems with varying financing and insurance structures. ADA solutions include: oral health education in public schools, cultural awareness training dental care providers, raising Medicaid fees to at least the 75th percentile of dentists' actual fees, requiring mandatory annual dental examinations for children entering school, recruiting dental school applicants who are from underserved areas and identifying educational resources for dentists on how to provide care to pediatric and patients with special needs. While these proposed solutions would eliminate the intended barrier, they are often compounded by language, education, cultural and ethnic barriers. In many cases, multiple issues are involved.64 To access the necessary care for their dental needs, patients may require transportation, oral health education and/or financial or insurance assistance.65 It is also possible that a single solution might not work for all socio-demographic groups, geographic regions and special populations.

Furthermore, these proposed solutions are barrier specific and fail to account for the fact that many barriers may exist simultaneously for a single individual. A long-term solution would require a fundamental change in socio-economic circumstance. Those barriers to oral care are the barriers to overall health equity and require sustaining, structural alterations that enable all individuals to achieve optimal health.

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