NBER WORKING PAPER SERIES

AGING OUT OF COVERAGE: LESSONS FROM THE WEST VIRGINIA $1,000 ADULT DENTAL BENEFIT

Daniel S. Grossman
Kole T. Reddig
Jane Ruseski
Fotinos Panagakos

Working Paper 35844
http://www.nber.org/papers/w35844

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
October 2026

This project received funding from CareQuest Institute for Oral Health (G 2208 17549). We thank Jenny Williams, Ashlee Sowards, Shyama Mahakalanda, Shawna Chapman, Rebecca Gillam, Johnathan Herczyk, and participants at the University of Melbourne brown bag seminar for helpful comments. We also thank the West Virginia University Health Affairs Institute and West Virginia Bureau for Medical Services for providing Medicaid data and for helpful discussions about the data. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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Aging Out of Coverage: Lessons from the West Virginia $1,000 Adult Dental Benefit
Daniel S. Grossman, Kole T. Reddig, Jane Ruseski, and Fotinos Panagakos
NBER Working Paper No. 35844
October 2026
JEL No. H75, I1, I12, I13, I18

ABSTRACT

This paper studies the utilization of dental services during the recent implementation of an adult (age 21 and over) Medicaid dental benefit in West Virginia. We analyze claims data and find: 1) before implementation, quarterly utilization of preventative and restorative services falls from 8% at age 20 to virtually 0% at age 21; 2) post-implementation, utilization falls from 8% at age 20 to 5% at age 21, implying a net increase of 50% of baseline utilization; 3) the net effect of the dental benefit is significantly larger in counties with a larger number of oral health care provider practices. Our results provide evidence that public health insurance expansions are dampened in markets with a limited supply of provider practices.

Daniel S. Grossman
West Virginia University
John Chambers College
of Business and Economics
and NBER
daniel.grossman@mail.wvu.edu

Kole T. Reddig
West Virginia University
John Chambers College
of Business and Economics
kole.reddig@mail.wvu.edu

Jane Ruseski
West Virginia University
John Chambers College
of Business and Economics
jane.ruseski@mail.wvu.edu

Fotinos Panagakos
Pacific Northwest University
of Health Sciences
School of Dental Medicine
fpanagakos@pnwu.edu

1 Introduction

Increasing access to and utilization of healthcare in underserved communities is an ongoing challenge for policymakers in the United States. Poor oral health is prevalent among low-income and rural populations, making access to oral health care services especially relevant (Vujicic, 2014; Vujicic, Buchmueller, & Klein, 2016; Caldwell, Lee, & Cagney, 2017; Northridge, Kumar, & Kaur, 2020). Oral health is closely related to overall health and health expenditure (Nasseh, Vujicic, & Glick, 2017; Peres et al., 2019) and other socioeconomic outcomes, including employment (Kieffer et al., 2022; Halasa-Rappel, Tschampl, Foley, Dellapenna, & Shepard, 2019; Moeller, Singhal, Al-Dajani, Gomaa, & Quiñonez, 2015; Glied & Neidell, 2010).

In this paper, we examine changes in dental service utilization following the implementation of the West Virginia Medicaid Adult Dental Benefit (ADB) in 2021. Until 2021, West Virginia Medicaid covered preventative and restorative dental services only for children (under age 21), with dental coverage for adults (those age 21 and over) limited to emergency procedures with prior authorization. Otherwise, West Virginians enrolled in Medicaid aged out of dental benefits at age 21, leaving nearly one-third of all adults in the state to either pay for the entirety of their non-emergency (e.g., cleanings, fillings) dental care or forego care entirely.

The 2021 ADB expanded coverage for preventative and restorative dental services to adults up to a maximum of $1,000 per year. To increase utilization, the benefit was updated in 2024 to cover services up to $2,000 every two years.[1] We analyze Medicaid claims data and find that per-quarter utilization rates of Medicaid beneficiaries drop from about eight percent at age 20 to zero percent at age 21 in the absence of an adult benefit. After implementation of the ADB in 2021, utilization rates still drop from age 20 to 21, but from eight percent to about five percent. The difference-in-differences (DID) estimate of the overall effect of the ADB is an increase in quarterly utilization by 4.5 percentage points, a 50% increase given the baseline utilization rate.

Following the principles of the mixed-economy model of Sloan, Mitchell, & Cromwell (1978), we investigate the main mechanism driving utilization changes: provider participation. A separate DID analysis estimates that a one percent increase in the number of dental practices serving adult Medicaid beneficiaries in a county is associated with an additional 0.5 percentage points of utilization from the ADB. These results indicate that while the ADB policy intended to increase access to dental services, these services are supply-constrained in West Virginia. This policy was

[1] While WV later increased its Medicaid benefit, findings from early implementation could inform other states offering benefits with similar caps. The updated benefit is outside the scope of our present study.

significantly more effective in markets with more dental practices.

Using administrative data, we directly observe participation in Medicaid and the universe of dental claims reimbursed by Medicaid for the entire state of West Virginia. By focusing on the age-related cutoff for services, we create a more similar comparison group for treated individuals after the implementation of the ABD than previous studies. Our work speaks directly to the costs of the ABD in terms of utilization and also points out an important policy consideration for dental expansions in general: that supply-side constraints must be addressed as well to induce additional utilization of dental care.

1.1 Related Literature

This study joins a large literature analyzing the effect of expanding health insurance coverage—particularly Medicaid—on health service utilization. These studies include Sloan et al. (1978), who contribute the seminal model of provider participation in Medicaid; Cutler & Gruber (1996), who study the effect of Medicaid expansions on both public and private insurance; and Finkelstein et al. (2012), who study the Oregon Health Insurance Experiment. More recently Neprash, Zink, Sheridan, & Hempstead (2021) and Miller, Johnson, & Wherry (2021) study the effect of the Medicaid expansion of the Affordable Care Act on utilization and mortality, respectively.

Furthermore, we contribute to a niche within this literature that studies the effect of insurance expansions on dental service utilization, and the determinants of dental service supply and demand. Several recent studies focus on demand-side outcomes. Choi (2011) uses survey data from the Behavior Risk Factor Surveillance System and estimates that adult Medicaid dental benefits increase yearly dental utilization by 5.9 percentage points. Decker & Lipton (2015), using the National Health Interview Survey (NHIS), estimate enrollment in Medicaid increases oral healthcare utilization by 12.9 percentage points. Baicker, Allen, Wright, Taubman, & Finkelstein (2018) study the effect of Medicaid enrollment on unmet dental care needs through the Oregon Health Insurance Experiment and find a similarly-sized effect of about 13 percentage points. Danagoulian & Wilk (2022) study the effect of COVID-era stay-at-home orders on dental utilization with SafeGraph foot-traffic data and estimate a decline of 12.3-14.5%. Danagoulian & Wilk (2022) also use Michigan Medicaid dental claims data and find a three percentage point decline in yearly child utilization.

On the supply side, Decker (2011) combines data on Medicaid dental reimbursement amounts with data from the NHIS and estimates a $10/service increase in Medicaid payment is associated

with a 3.9 percentage point increase in utilization. Buchmueller, Orzol, & Shore-Sheppard (2015) combine reimbursement data with data from the Survey of Income and Program Participation and estimate a $10/service increase in Medicaid payment increases utilization rates by 1.3 percentage points. Buchmueller et al. (2016) use responses to the Survey of Dental Practices and estimate provider participation in Medicaid is five percentage points higher in states that offer an adult dental benefit.

Other related studies include Wall, Vujicic, & Nasseh (2012) who study dental care utilization by age and insurance coverage, and find that utilization is substantially lower with public insurance. Nasseh, Vujicic, & Glick (2017) estimate the effect of periodontal disease intervention on health care costs, finding evidence of significant non-dental health spillover. Finally, Vujicic et al. (2016) use the NHIS and find that dental care is the most common kind of health care to skip due to high costs. Concerning outcomes, expansions of adult benefits increase utilization of dental services among adults and decrease untreated tooth decay (Elani, Kawachi, & Sommers, 2021; Lyu, Shane, & Wehby, 2020), decrease racial disparities in utilization (Wehby, Lyu, & Shane, 2022) while *increasing* tooth loss (Semprini & Wehby, 2022).

Taken together, this literature suggests that lack of dental insurance coverage severely restricts dental care receipt and that differential Medicaid reimbursements lead to lower utilization, likely through supply side constraints. Our study set up allows us to test these hypotheses using more recent data in a state with a particularly large share of Medicaid beneficiaries.

1.2 Background

Medicaid is the public insurance program for low-income individuals in the United States. Each state administers its own Medicaid program, so insurance benefits, provider reimbursements, and health outcomes vary substantially across states (Zuckerman, Skopec, & Epstein, 2017; Miller, Johnson, & Wherry, 2021). This variation applies to dental health services as well. For example, CareQuest (2023) categorizes 9 out of 51 states and D.C. as offering "extensive benefits overall" for dental services to adults. Alabama Medicaid, at the other extreme, offers no dental benefits to adults. Medicaid dental benefits for children less than 21 years old, however, are more uniform, as Federal law requires state Medicaid programs to provide a comprehensive set of dental benefits determined by the Early Periodic Screening, Diagnostic, and Treatment (EPSDT) benefit.

Until 2021, West Virginia Medicaid covered only emergency dental services (such as tooth extraction) and required prior authorization for adult beneficiaries. Starting January 2021, Sen-

ate Bill 648 enacted by the West Virginia Legislature granted expanded Medicaid coverage that includes preventive and restorative dental services for beneficiaries aged 21 and older (Code of West Virginia Section §9-5-12a, 2020).

The political origin of this expansion in public insurance benefit was nonpartisan and passed the West Virginia Senate 32-2 and House of Delegates 85-15. In a policy brief published by the West Virginia Center on Budget and Policy, Allen & Boettner (2020) argued that the adult dental benefit would have widespread effectiveness, providing dental insurance to over 300,000 adults with poor oral health and limited utilization of dental care. They also argued that more than 75% of the costs would be covered by matching funds paid through Federal Medical Assistance Percentage (FMAP), and gave an estimate from the American Dental Association (ADA) that West Virginia would have to pay an additional $15.2 million in state funds to provide dental benefits to adult Medicaid beneficiaries. This adult dental benefit was initially capped at $1000 per year in 2021; in July 2024, the benefit cap increased to $2000 every two years to allow adult Medicaid beneficiaries to receive care (such as a dental prosthesis) with a large up-front cost (Code of West Virginia Section §9-5-12a, 2024).[2]

The implementation of the ADB in January 2021 is less than a year after West Virginia dental practices were shut down for the beginning of the COVID-19 pandemic. On March 24, 2020, Governor Jim Justice issued a stay-at-home order limiting non-essential activities including non-emergency dental procedures. On May 4, the order was replaced with a safer-at-home order allowing dental procedures with proper precautions. Dental services provision was diminished due to COVID-19 outside of these dates, but (as indicated in Figure 3) the effect is centered in the second quarter of 2020.

2 Conceptual Framework

The mechanisms behind utilization and health outcome changes caused by public health insurance expansions have been the topic of health economics research for decades. We adopt the framework of Sloan, Mitchell, & Cromwell (1978) because of its application in prior literature regarding insurance expansions that may have effects driven by both the demand and supply sides of the market. For example, Garthwaite (2012) applies the Sloan et al. (1978) framework to a public expansion in children's health insurance, and Carey, Miller, & Wherry (2020) and

[2]We note that this 2024 change is outside the scope of our analysis period.

Neprash, Zink, Sheridan, & Hempstead (2021) address the effects of the Medicaid expansion and associated reimbursement rate increase.

Our empirical analysis estimates the effect of the ADB on utilization of Medicaid beneficiaries, but it does not address the *spillover* effect of the ADB on utilization of beneficiaries with non-Medicaid (i.e privately insured and uninsured) payers.[3] The mixed-economy model of Sloan et al. (1978) is nonetheless appropriate to generate empirical predictions for the directly affected population of dental practices serving the Medicaid population. As we detail below, the marginal revenue of a dental practice depends on the insurance of the marginal patient treated. This means that generating predictions for changes in behavior at the practice-level requires modeling decisions for all levels of output, including when the marginal patient is not insured by Medicaid.

Our application of Sloan et al. (1978)'s model concludes that limited increases in utilization observed in data are the consequence of limited supply of dental services for the adult Medicaid population and low reimbursement for said services. Specifically, most dental practices do not participate in Medicaid, and so the reimbursement-rate for services provided to the marginal patient did not increase for most dental practices. Thus, most providers make the decision to not increase output. Ultimately, the model predicts that the effects of the ADB are limited to low-marginal cost practices that were already treating children and adults insured by Medicaid.

In our framework, we consider the profit maximization problem of a dental practice facing demand for dental services from populations with different payers (insurers, private or Medicaid; or individuals, if not insured). Before implementation of the adult dental benefit, privately insured adults and children offered the highest reimbursement-rate per service, followed by children insured by Medicaid, and finally uninsured adults and children and adults with Medicaid offer the lowest reimbursement for dental services.[4]

As in Sloan et al. (1978), we define the dental practice's marginal revenue in terms of the reimbursement-rate per patient. The model is simplified, such that we assume patients are only distinguished by their payer: private insurance, Medicaid, or uninsured/self-pay. Otherwise, patients are identical.

Marginal revenue for patients that are privately insured is downward sloping as in Figure 1. Before the ADB was implemented in West Virginia, marginal revenue slopes downward up to

[3]This is a necessary limitation given that our data only covers Medicaid patients.

[4]Medicaid reimbursements to physicians range from 50% to 70% of private insurance and Medicare reimbursements (Zuckerman & Goin, 2012; Zuckerman et al., 2017). Note that, in general, children's Medicaid reimbursements are closer to parity.

the point that the marginal patient is a child insured by Medicaid. At this point, the dentist's marginal revenue curve flattens, representing the constant reimbursement offered by Medicaid for dental services provided to children. Finally, only after the marginal patient is no longer a child insured by Medicaid, the marginal revenue curve begins to slope downward again, representing reimbursement from uninsured individuals and adults insured by Medicaid but who have no dental benefits, aside from emergency services.

Figure 1 depicts the marginal revenue curve of the dental practice described above as MR, as well as the marginal revenue curve post-implementation of the Adult Dental Benefit, labeled MR^{ADB}. After the implementation of the adult benefit, the population of dental patients without

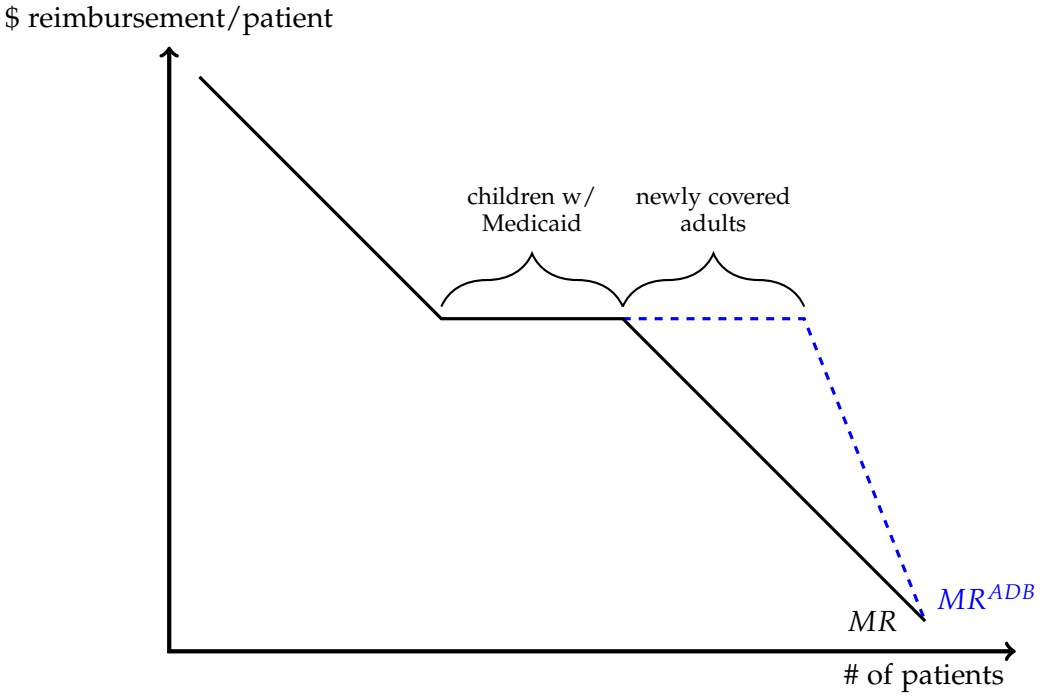


Figure 1: This figure displays the marginal revenue curves of a dental practice before and after implementation of the adult benefit, labeled MR and MR^{ADB}, respectively.

dental benefits decreases in size as adults insured by Medicaid are now covered. This extends the constant portion of the marginal revenue curve to the right. Those patients left uninsured for dental benefits remain in the now-steeper rightmost portion of the marginal revenue curve. The pre and post ADB implementation marginal revenue curves meet at the same point along the horizontal axis. This is drawn so that the population of dental patients (with positive willingness-to-pay) across all insurers is constant. This makes the post-implementation marginal revenue curve steeper for the region of output that represents uninsured adults.

The lessons of this mixed economy model come with finding the profit maximizing patient volume for dental practices at varying levels of marginal cost. We depict this in Figure 2. The

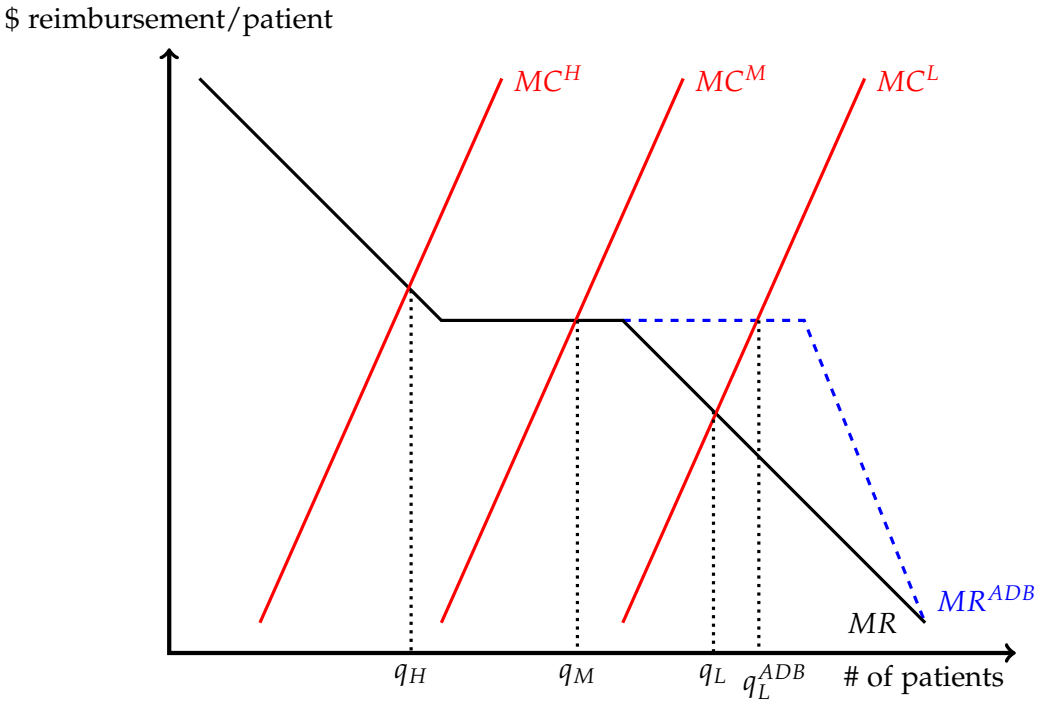


Figure 2: This figure displays the profit maximizing levels of output of dental practices with high, medium, and low marginal costs. Only low marginal cost practices change their output post ADB implementation, from q_L to q_L^{ADB}.

curves MC^H, MC^M, and MC^L represent the varying marginal cost functions of dental practices with high, medium, and low marginal costs. Marginal cost is shown as increasing in the number of patients treated to represent resource constraints–in particular, an inelastic labor supply. Specifically, if the supply of labor from dentists is inelastic, then the marginal cost curves for dental practices would be relatively steep.

As indicated by Sloan et al. (1978) and similar studies, participation of dental practices in Medicaid post-expansion depends on their marginal cost. High marginal cost dentists stop providing services before the marginal patient is covered by Medicaid. Medium marginal cost practices, whose cost curve is labeled MC^M, are also unaffected by the expansion because the expansion *does not change the marginal revenue of the marginal patient* they treat.[5]

For low-cost dental practices, labeled MC^L, the marginal revenue of services increases post-

[5]Technically, children enrolled in Medicaid offer a slightly higher reimbursement for a similar service furnished to an adult on Medicaid. While the difference in payment is small, this ultimately implies that crowd-out of children is even less likely.

implementation of the Adult Dental Benefit. Figure 2 depicts the solution to these profit maximization problems with the points q_H, q_M, and q_L. Output is unchanged or decreasing post-implementation of the benefit for medium- and high-cost practices, but lowest-cost practices increase provision of dental care up to the point where the new (dashed) marginal revenue curve MR^{ADB} intersects their cost curve MC^L at q_L^{ADB}.

The conclusions of applying the Sloan et al. (1978) model in Figures 1 and 2 are that the effects of the adult dental benefit are likely limited to dental practices that were already treating children insured by Medicaid, adults insured by Medicaid but without a dental benefit (e.g., providing emergency dental services to these individuals), and uninsured individuals offering low average reimbursement. Following these conclusions, we investigate the impact of the ADB across counties by creating a measure of low-marginal cost dental practices pre-implementation of the ADB. We use the natural log of the number of unique dental practices that provide care to at least 10 adult Medicaid beneficiaries who live in county c in 2019. This captures exactly the group of practices with low marginal cost (MC_L in Figure 2) that are ex-ante most likely to increase their dental care supply to Medicaid beneficiaries affected by the ADB.

3 Empirical Methods

3.1 Data

To investigate adult Medicaid beneficiaries' dental use, we use the universe of Medicaid claims data from January 1, 2019 to December 31, 2022 for all WV Medicaid beneficiaries born between 1992 and 2005. We focus on these cohorts because we are particularly interested in individuals around age 21 at the time of the ADB. This includes several cohorts (1992-1999) that aged out of coverage before the ADB was implemented as well as others (2000+) that never lost dental coverage.[6] These data are provided by the WV Bureau of Medical Services, part of the Department of Health and Human Resources and include both medical and dental claims, separately by outpatient, inpatient and pharmacy visit. We classify dental claims using all Current Dental Terminology (CDT) procedure codes during this time period (CDT: "DXXXX").[7] These claims data include ZIP Code and county of residence, race/ethnicity, date of birth, date of death, and

[6]These cohorts were between the ages 15-28 at the time of the ADB implementation in 2021. We explore the sensitivity of our results to using fewer cohorts in Table A3.

[7]While these claims contain detailed CDT codes, they do not consistently contain International Classification of Diseases codes, precluding subanalyses by specific dental diagnoses. Diagnoses appear on fewer than 1% of claims with a listed CDT code.

sex. They also include internal revenue codes for payment within the Medicaid system, which allows us to identify and control for anonymized provider practice fixed effects.[8]

Because the dataset primarily captures the COVID-19 pandemic period, there is not significant attrition from the analysis sample, as the Medicaid Continuous Enrollment Provision of the Families First Coronavirus Response Act of 2020 prevented the disenrollment of Medicaid beneficiaries from February 2020 until March 2023. For robustness, we estimate effects using only continuously enrolled individuals (see Table 2) and using a balanced panel of all individuals enrolled in Medicaid over the analysis period (see Table A1).

Our main specifications exclude data from the second quarter of 2020 (2020q2) due to transitory differential effects on individuals under 21 during the COVID-19 lockdown period.[9] Omitting 2020q2 does not materially affect our DID estimates, but it clarifies pre-period trends in our event study analyses. Tables 2 and A1 present robustness checks for samples that include 2020q2 and exclude 2020q2 and 2020q3, respectively .

We focus on four separate outcomes: all dental procedures, dental procedures covered starting in 2021, and these covered dental procedures categorized as preventive or restorative.[10] We create binary variables for each outcome representing any receipt of that group of codes in a given quarter-year observation for a given individual with contemporaneous enrollment in West Virginia Medicaid.

3.2 Statistical Analysis

To measure the effect of the ADB on dental service use, we compare dental service utilization across individuals and time (in quarters). We estimate the DID model:

$$y_{it} = \alpha_i + \alpha_t + \alpha_{age} + \beta \cdot \mathbb{1}\{age(i,t) \geq 21\} \cdot \mathbb{1}\{t \geq 2021q1\} + \varepsilon_{it} \tag{1}$$

where i indexes Medicaid beneficiaries, t indexes quarters, and $age(i,t)$ is the age (in years) of individual i in quarter t. Accordingly, α_i, α_t, and $\alpha_{age} \equiv \alpha_{age(i,t)}$ are fixed-effects for individuals, time, and age. The outcome variable y_{it} takes the value of 1 if there is utilization of a dental service by person i during quarter t, and ε_{it} is an idiosyncratic residual. The parameter β is the

[8] These codes do not uniquely identify specific individual providers, but do uniquely identify provider practices.

[9] See Figure 3 later in this section in our discussion of identification for visual evidence.

[10] Specific CDT codes for each outcome is available at https://dhhr.wv.gov/bms/Pages/Chapter-505-Dental-Services-.aspx and procedures covered starting in 2021 refer to the start of adult coverage for these procedures.

treatment effect on utilization of the ADB.[11]

Standard errors are clustered at the birth year level, which is the level of treatment (Abadie et al., 2022) to account for serial correlation. We separately compute standard errors clustered at the individual level and the county level for robustness—see Table A2. While individual fixed effects models are our preferred specifications, we alternatively include five digit ZIP Code and county fixed effects instead of individual fixed effects. These alternate specifications allow us to control for time invariant aspects of one's neighborhood, such as the general availability of dental services to the extent this is fixed over time.[12] Results for these alternative specifications are presented with other robustness checks in Table 2.

3.2.1 Expanded Analysis using Oral Health Care Supply

To explore potential mechanisms, we also estimate a DID model where the treatment effect depends on the supply of dental practices already participating in adult Medicaid near the patient. This expanded analysis is informed by our application of the Sloan et al. (1978) model in Section 2, which predicts that dental practices that already serve the Medicaid population are the ones most likely to increase output after the ADB is implemented.

Formally, let $Practices_{c,2019}$ denote the number of dental practices that furnish services to 10 or more adult Medicaid patients in 2019 living in county $c = c(i,t)$. We estimate

$$y_{it} = \alpha_i + \alpha_t + \alpha_{age} + \mathbb{1}\{age(i,t) \geq 21\} \cdot \mathbb{1}\{t \geq 2021q1\} \left(\beta_0 + \beta_1 \log\left(Practices_{c,2019}\right)\right) + \varepsilon_{it}\,, \quad (2)$$

where β_1 is the proportion increase in the effect of the adult dental benefit in counties with 1 percent more dental practices. All other variables are the same as in Equation 1.

We use the number of dental provider practices in 2019 as a measure of supply so that supply changes induced by the adult dental benefit and by the state-wide COVID shut down do not confound our estimate of the relationship between supply and the policy. Thus, our estimate

[11] Because our utilization outcome y_{it} is binary, all estimates presented are of a linear probability model (LPM). Several recent studies, including Wooldridge (2023) and Chen, Martin, & Wooldridge (2023), have shown that estimating a LPM-DID model yields unbiased estimates of the exact (and not approximate) average treatment effect. Furthermore, non-linear DID models suffer from other issues such as scale-invariance and the so-called "incidental parameters problem" with fixed-effects estimation. Moreover, Delle Site & Parmar (2024) show that a linear probability model is as consistent as a *choice model* like the probit and logit models. We thus conclude that a LPM is the proper model for this application.

[12] While this may be a strong assumption for the long-term, over a shorter 3 year time period, this may do a reasonable job of controlling for access to dental care. Additionally, this controls for the fact that the dental benefit expansion likely did not immediately affect supply of dentists. Also, Medicaid reimbursement rates likely did not immediately affect dentists' willingness to accept new patients.

should be understood as the effect of ex-ante oral health care supply in the *partial* equilibrium where the ADB shifts demand through marginal revenue and supply remains fixed for a given market. We discuss our measure of oral health care supply and present estimates from alternative definitions of the variable in Section 4.

Individuals in our sample are between 14-30 years old. Baseline utilization is 12% of beneficiaries born between 1992 and 2005 who received any dental care in a given quarter. We demonstrated in Figure 3 that this rate of care is decreasing in age. Over 9% of individuals receive care consistent with the diagnostic, preventive and restorative procedures covered by the ADB per quarter, while 7% receive preventive procedures and 4% receive restorative procedures. Slightly less than 2% of beneficiaries receive a tooth extraction per quarter.

3.2.2 Identification

This specification relies on the plausibly exogenous timing of the adult dental benefit implementation for identification of a causal effect. Under conventional assumptions, the estimate of the effect, $\hat{\beta}$, is based on comparisons between adult (treated group) and child (untreated group) utilization before and after 2021. In particular, we identify the effect of the adult dental benefit on quarterly utilization rates if the trends of utilization are the same between adults and children before 2021 (parallel pre-trends) and if there is no spillover between adults and children (stable unit treatment value assumption (SUTVA)).

The standard parallel trends and SUTVA assumptions are potentially improper in this setting. First, to compare utilization trends, we refer to the top panel of Figure 3. Calendar time (in quarters) is on the horizontal axis, and the utilization rates for Medicaid beneficiaries in that quarter are plotted on the vertical axis. Rates are presented by age group: under 21 (untreated) in the red solid series of dots and 21 and over (treated) in the blue hollow series. The trends of these utilization rates before 2021 are different: the under 21 group has a fairly uniform decreasing trend, with a transitory crash in dental utilization in Q2 of 2020, at the beginning of the COVID-19 pandemic in which West Virginia dental practices were closed for non-urgent dental care. In comparison, the 21 and over group has fairly constant utilization at essentially zero over this time period, when only emergency dental services with prior approval were covered by Medicaid.

SUTVA, the assumption that treatment assignment does not affect the potential outcomes of units in the untreated group, is potentially a more serious issue weakening identification. Specif-

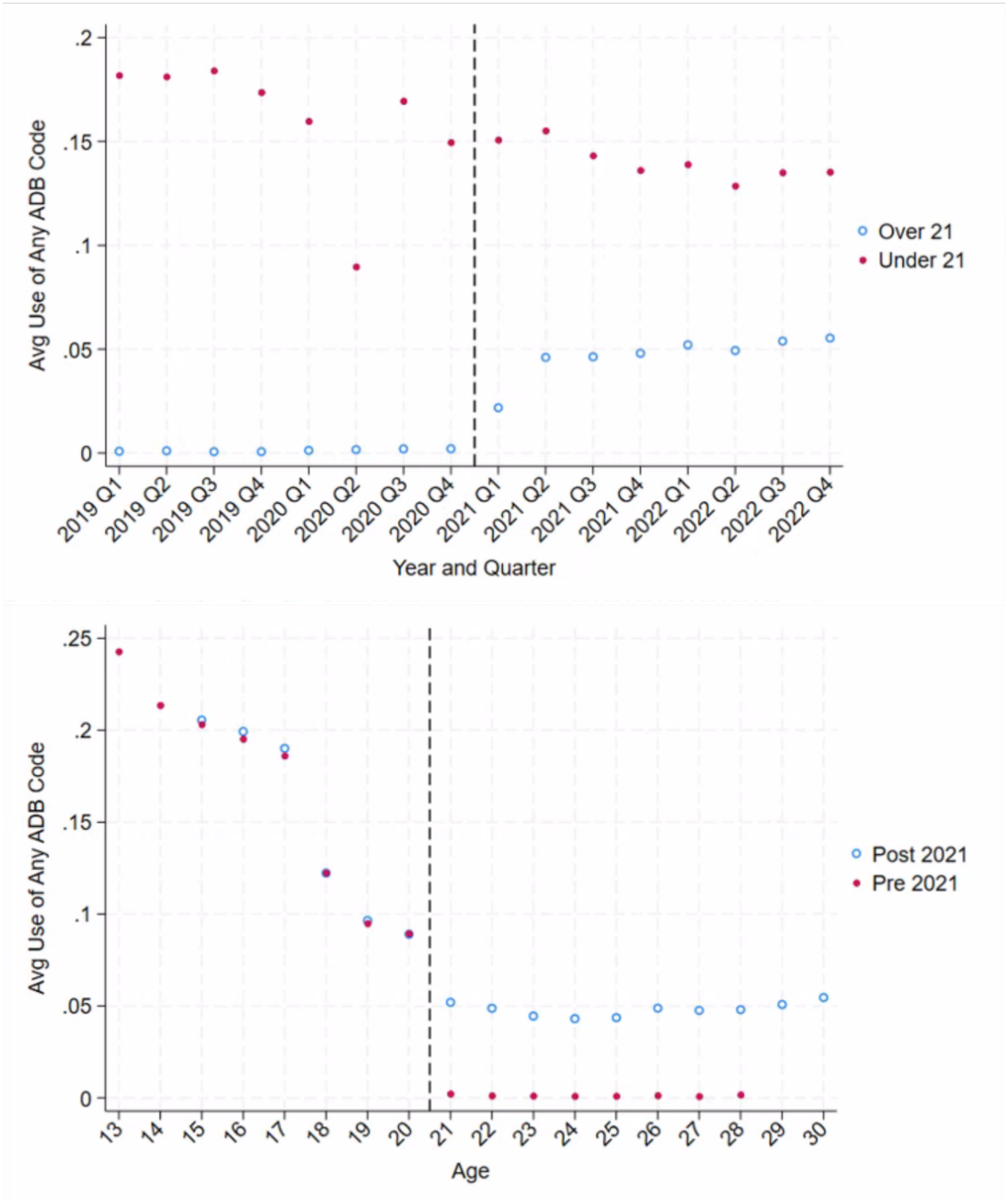


Figure 3: **Utilization Trends by Date and Age.** Source: Author's calculation based on WV Medicaid claims data from 2019-2022. Note that 2020 Q2 refers to April-June 2020, a time period in which lockdowns were in place, which explains the low utilization rate among those under 21. "Avg Use of Any ADB Code" reflects the proportion of Medicaid beneficiaries with a dental claim in a given quarter in the top panel and for a given age in the bottom panel.

ically, spillover may occur between adults and children in this setting from factors on both the demand-side and supply-side of the market for dental care. On the demand-side, a parent who utilizes dental care due to the newly-implemented adult benefit may induce a woodwork effect on their children who otherwise would also not utilize dental care (Venkataramani, Pollack, & Roberts, 2017; Marcus & Zhang, 2024). Furthermore, a Medicaid-enrolled parent whose child is already receiving dental care is *ex-ante* more likely to be affected by the adult benefit implementation.

If the supply of dental services is constrained, then the implementation of the adult dental benefit would have an effect *in equilibrium* beyond Medicaid-enrolled adults. As discussed by Sloan et al. (1978), Garthwaite (2012), and many others, the increase in demand for dental care induced by this policy could result in decreases in equilibrium utilization by adjacent groups, including Medicaid-enrolled children. This, along with the demand-side effects of the adult dental benefit, potentially bias $\hat{\beta}$ in unknown (albeit possibly offsetting) directions.

Fortunately, there are alternative assumptions regarding utilization trends and spillover that are much more plausible in this setting and nonetheless achieve identification of the DID estimate of $\hat{\beta}$ from Equation 1. Specifically, we swap the "unit" and "time" dimensions in this analysis. Now, we assign the age of an individual to the time dimension, and the calendar date of utilization is the unit of analysis assigned to treated and untreated groups. Thus, the eligibility threshold at age 21 is the "post" indicator, and the adult dental benefit implementation date at 2021q1 partitions quarters "treated" by the adult benefit from quarters without an adult benefit. Note that whether calendar time or age is assigned to the time or unit dimension is inconsequential on the actual DID regression (Equation 1) and treatment effect estimates; however, there are different *identifying assumptions* across definitions.

The bottom panel of Figure 3 shows that utilization trends by age before age 21 are very similar before 2021 (untreated) and after 2021 (treated). This means that the counterfactual utilization for age 21 and over in the absence of the adult dental benefit after 2021 would be reliably close to the pre-2021 utilization rates for those ages. To contrast with the typical DID assumptions, we note the top panel of Figure 3 shows the under 21 group has decreasing utilization relative to the 21 and over group, and so the counterfactual utilization of the adult group may be a relative overstatement, biasing the estimate upward.

When time distinguishes the untreated group from the treated group, SUTVA is violated if utilization after 2021 affects utilization before 2021. This would only be the case if utilization or

provider participation changed in anticipation of the adult dental benefit implementation. There is no evidence of this occurring: the bottom panel of Figure 3 shows utilization rates are nearly identical for aged 20 individuals before and after adult implementation in 2021.

Note that approximate treatment effects can be inferred from these plots: in the bottom panel, the red solid dots show that utilization drops from approximately 8% at age 20 to 0% at age 21 pre 2021, while utilization rates still drop at age 21 post 2021, but only to 5%, implying a net effect of the policy of approximately 5 percentage points. Similarly, in the top panel, utilization of those under 21 is at approximately 15% before and after 2021, while utilization increases from zero to about 5%. Thus, the unadjusted net effect of the adult benefit is to increase dental utilization about 5 percentage points.

In short, Figure 3 shows that the trends of utilization *by age* are very similar before and after 2021. This means that the counterfactual utilization for adults in the absence of the adult dental benefit after 2021 would be reliably close to the pre-2021 utilization rates for those ages, implying the treatment effect of the ADB is identified. Accordingly, we first present an event study of the dynamic effects by age (instead of calendar time) where observations before 2021 form the control group and observations in 2021 and later form the treatment group.

Following our assignment of calendar time to the unit dimension and age to the time dimension, we estimate the following event-study to examine the effects of the adult benefit by age:

$$y_{it} = \alpha_i + \alpha_t + \alpha_{age} + \mathbb{1}\{t \geq 2021q1\} \cdot \sum_{\substack{a=15 \\ a \neq 20}}^{28} \beta_a \cdot \mathbb{1}\{age(i,t) = a\} + \varepsilon_{it}\,. \tag{3}$$

Again, α_i, α_t, and α_{age} are fixed effects for individual, quarter, and age, and β_a is the relative increase in utilization for those age a compared to those age 20 before and after implementation of the dental benefit. Standard errors are clustered by birth cohort as before.

4 Results

Figure 4 presents estimates of the event study in Equation 3 using $age(i,t) = 21$ as the time of treatment and $\mathbb{1}\{t \geq 2021q1\}$ to indicate the treatment group. Each panel represents an event study for a different binary outcome: (a) all dental procedures; (b) newly-covered (ADB) procedures only; (c) ADB preventive care only; and (d) ADB restorative care only. This figure plots

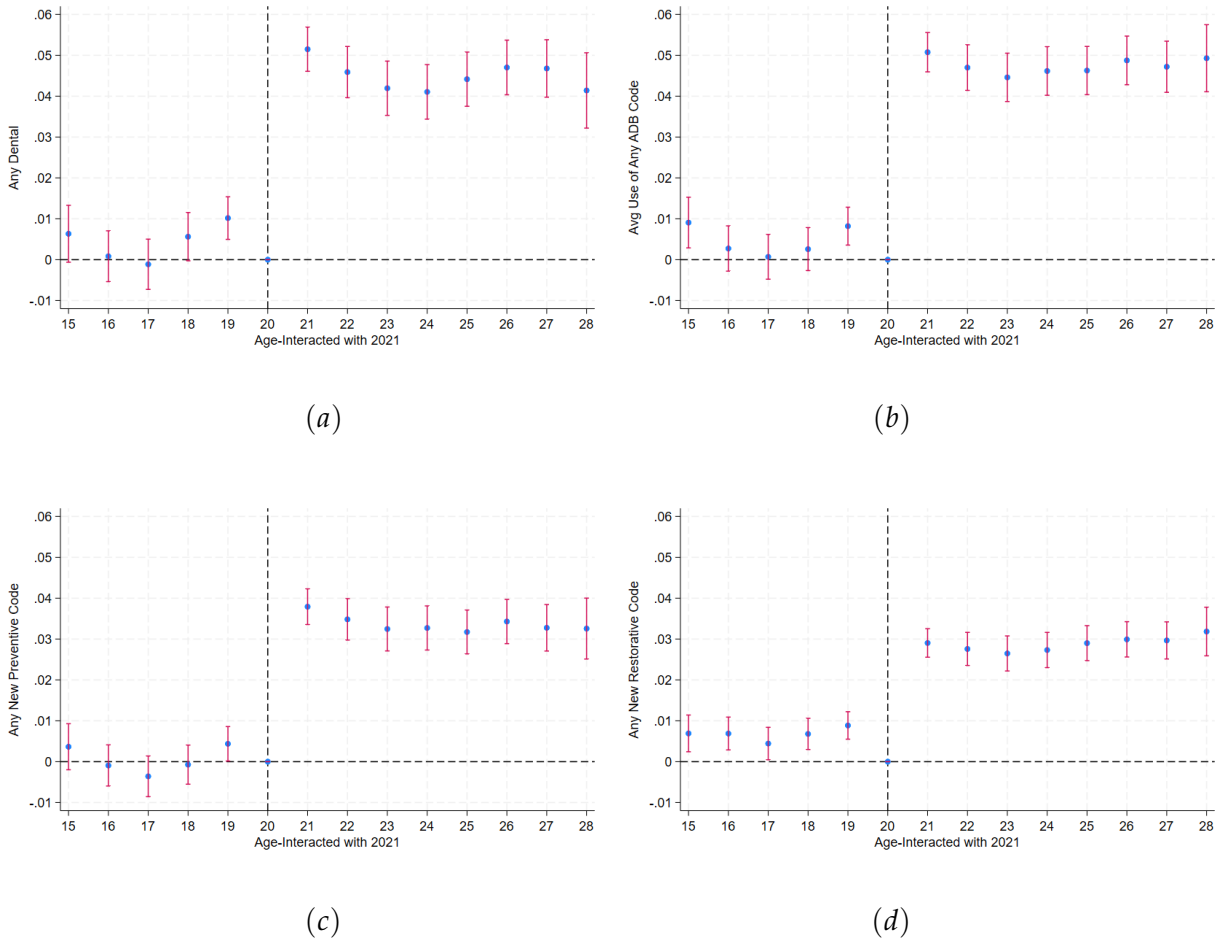


Figure 4: **Event Study.** This figure displays estimates of a linear probability model event study (Equation 3) comparing utilization changes at age 20 to age 21 before and after ADB implementation in 2021. Standard errors are clustered by year of birth; 2020q2 data is omitted from sample. $N = 1,728,624$.

	All		Newly-Covered		Preventative		Restorative	
	Main	Supply Interacted	Main	Supply Interacted	Main	Supply Interacted	Main	Supply Interacted
$\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$	0.0433**	0.0409**	0.0448***	0.0323***	0.0341***	0.0212***	0.0239***	0.0168***
	(0.00210)	(0.00551)	(0.00124)	(0.00463)	(0.00116)	(0.00396)	(0.00102)	(0.00194)
$\log\big(Dentists_{c,2019}\big)$ $\times\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$		0.00105		0.00499**		0.00515***		0.00281***
		(0.00199)		(0.00173)		(0.00151)		(0.000708)
R-squared	0.244	0.244	0.245	0.245	0.198	0.198	0.178	0.178
Cohort Mean	0.120	0.120	0.0927	0.0927	0.0704	0.0704	0.0424	0.0424

Table 1: **DID Estimates.** This table displays DID estimates of the effect of the ADB implementation. For a given outcome cohort (All, Newly-Covered, Preventative, and Restorative), the first column contains a simple treatment effect (Equation 1) and the second column contains the treatment effect estimate that varies by the log number of Dental practices in the county of patient residence (Equation 2). Standard errors are clustered by year of birth and are in parentheses; 2020q2 data is omitted from sample. $N = 1,728,624$.

point estimates with 95% confidence intervals of the difference between utilization rates of a Medicaid beneficiary of a certain age and a beneficiary of age 20 before and after implementation in 2021. For example, in Panel (a) the estimate at $age(i,t) = 21$, $\hat{\beta}_{21} \approx 0.05$ is the average change in utilization going from age 20 to age 21 after benefit implementation minus the change in utilization going from age 20 to age 21 before benefit implementation, thus showing the immediate impact of the ADB on age 21 beneficiaries. The event study results show a mostly flat pre-trend and a large 5 percentage point jump in utilization at age 21 post 2021, relative to the reference group of age 20 in 2021. Note that while the rates of 19 year olds in 2021 appears to be slightly elevated, the jump at age 21 is of a sufficiently large magnitude to rule out pre-trend concerns.[13] We see in Panel (b) that this effect size is driven almost entirely in magnitude by newly covered procedures through the ADB as the jump in utilization at age 21 is also approximately 5 percentage points. Panels (c) and (d) similarly show a stark increase in preventive and restorative procedures at age 21.

Table 1 presents estimates of both DID models, Equation 1 and Equation 2 (defined in Section 3.2), with the same utilization outcome variable definitions as Figure 4.

The DID estimates based on Equation 1 show that beneficiaries who turned 21 after 2021 were 4.3 percentage points more likely to use any dental service, a 36% increase compared to the baseline rate of dental service use among those under 21 before 2021. For procedures specifically covered by the ADB, the increase was 4.5 percentage point, a nearly 50% increase.

[13] If anything, one can argue the effect is an upper bound of the true effect.

To estimate the relationship between oral health care supply and the ADB's effect on utilization, we include an interaction with $\log(Practices_{c,2019})$, which is the natural log of the number of unique dental *practices* that provide care to at least 10 adult Medicaid beneficiaries who live in county c in 2019.[14] We use adult patients because these dental practices were already providing care to adult Medicaid beneficiaries, and thus entry of Medicaid provider practices due to the ADB does not confound the estimate in later years. Additionally, in constructing this variable, we use the full sample of all adult dental visits, not just those among our birth cohorts 1992-2005.[15]

Table 1 shows a positive relationship between the log number of dental practices in a given area and all dental care utilization for individuals over age 21 in 2021—however, this coefficient is not statistically significant for all dental care. When the outcome is limited to only newly covered procedures, we find that a 1% increase in the number of provider practices operating in a beneficiary's county increases the effect of the ADB by 0.499pp, i.e., an elasticity of 5.4%. The effect of provider practice supply is particularly strong among preventative dental services, where a 1% increase in the number of dental practices implies the effect of the ADB was 0.515 percentage points larger, or 7.3%.

4.1 Robustness Checks

We perform a number of robustness analyses to test the sensitivity of our results to alternate specifications, measurement, and inference decisions. The first of these analyses are shown in Table 2. For reference, we include the results of our main specification in the first block of point estimates (top), standard errors (middle, in parentheses), and sample size (bottom) in Table 2. Recall that the main specification has the following characteristics: observations from 2020q2 are dropped; individual, quarter-year, and age fixed effects are used; includes only individuals enrolled in Medicaid in an unbalanced sample; standard errors are clustered by year of birth; and individuals born between 1992 and 2005 form the estimation sample.

For the first robustness check, we include observations from 2020q2 in the estimation sample. As expected, including this quarter biases our estimates towards zero and away from finding an effect. Nonetheless, these estimates of the effect of the ADB are in the same direction and have similar statistical significance as the sample excluding 2020q2. The effect sizes from this alter-

[14] An important distinction here is that we do not see where a provider practice is located, and, as noted earlier, we cannot uniquely identify a provider, but can identify a provider practice.

[15] The importance of using the full sample here is that it speaks to actual dental supply available to Medicaid adult beneficiaries, not just to those in our specific birth cohorts.

	All	Newly-Covered	Preventative	Restorative
Main Specification (excludes 2020q2)	0.0433***	0.0448***	0.0341***	0.0239***
	(0.00210)	(0.00124)	(0.00116)	(0.00102)
	1,729,721	1,729,721	1,729,721	1,729,721
Includes 2020q2	0.0268***	0.0293***	0.0220***	0.0162***
	(0.00334)	(0.00276)	(0.00210)	(0.00183)
	1,834,637	1,834,637	1,834,637	1,834,637
Excludes 2020q2 and 2020q3	0.0446***	0.0423***	0.0292***	0.0252***
	(0.00224)	(0.00163)	(0.00178)	(0.00117)
	1,620,552	1,620,552	1,620,552	1,620,552
Includes continuously covered 2019-2022 only	0.0515***	0.0533***	0.0403***	0.0272***
	(0.00297)	(0.00222)	(0.00173)	(0.00164)
	935,895	935,895	935,895	935,895
With county fixed effects	0.0451***	0.0460***	0.0354***	0.0244***
	(0.00220)	(0.00150)	(0.00123)	(0.00117)
	1,753,584	1,753,584	1,753,584	1,753,584
With ZIP-5 fixed effects	0.0451***	0.0460***	0.0354***	0.0244***
	(0.00218)	(0.00148)	(0.00121)	(0.00115)
	1,753,014	1,753,014	1,753,014	1,753,014

Table 2: **Robustness Checks (Enrolled Medicaid Beneficiaries).** This table displays DID estimates of the effect of the ADB implementation. Standard errors are in parentheses, below the point estimate and above the sample size. Standard errors are clustered by year of birth. *:$p < 0.05$; **:$p < 0.01$; ***:$p < 0.001$.

native sample are approximately two-thirds as large as those in Table 1. The bias is downward because the stay-at-home orders in 2020q2 greatly depressed children's Medicaid dental usage while having almost no effect on adults' Medicaid dental usage. Thus, in a DID setting, this deflates the initial difference in utilization between children and adults pre-2021.

Next, the third block of estimates in Table 2 excludes observations from both 2020q2 and 2020q3. We perform this check because we see some slight evidence of pent up demand in 2020q3 in the top panel of Figure 3. Limiting our sample in such a way does not affect our results.

To address concerns about mismeasurement associated with dental use outside of Medicaid among individuals joining and leaving Medicaid throughout our sample, the fourth block of estimates in Table 2 uses a sample of continuously covered individuals from 2019 to 2022. This limits the number of observations to approximately half as many as our main specification. Our estimates are 14-18% larger using this continuously-covered sample, and estimates remain statistically significant for all four dependent variables.

The final robustness check presented in Table 2 replaces individual (Medicaid beneficiary) fixed effects with geographic fixed effects. Specifically, we estimate specifications with fixed effects at the county level and the five-digit ZIP code level to capture important time-invariant aspects of dental markets. As shown in blocks four and five of Table 2, geography-based fixed effects do not meaningfully change estimates from that of individual fixed effects.

We conduct several more robustness analyses; the tables containing estimates are allocated to Appendix A for the sake of brevity. First, as an additional test of sample inclusion, we include all quarters for each unique individual ever enrolled in Medicaid to create a balanced panel. That is, in our main specification, an individual is not in the dataset for any quarter in which the state-provided eligibility files listed a beneficiary as not enrolled in Medicaid. We choose to use this unbalanced panel of only contemporaneously enrolled individuals so that we estimate an average treatment effect that is conditional on being enrolled in Medicaid. Clearly, the unconditional treatment effect will be closer to zero, which is confirmed and discussed below.

To create a balanced panel, we attribute zero dental utilization to any quarter a Medicaid beneficiary was not enrolled in Medicaid. Estimates from this balanced panel are presented in Table A1. Including zeros introduces noise and, unsurprisingly, biases our estimates towards zero. All estimates remain statistically significant, just of a smaller magnitude. Excluding observations from 2020q2 (as in our main specification), estimates from a balanced panel are approximately

half the size of our main results. Including 2020q2 and using a balanced panel yields estimates that are one-quarter as large as in our main specification. In each case, the results are still statistically significant, which means that in all specifications, turning 21 after the ADB implementation is associated with increased utilization of dental services.

To test whether our inference is driven by our choice of standard error clustering at the birth cohort level, we create Table A2. We first reprint our main results from Table 1 in the first block. Then, we report results clustered separately at the individual and county levels in blocks two and three. Using these alternate levels to capture serial correlation of our error terms does not materially affect our inference. While county-clustered standard errors are 12% to 112% larger, they do not change our conclusions or statistical significance. Clustered Individual-level standard errors are sized similarly to those in our main analysis. However, we prefer year of birth clustered standard errors given that our treatment is based on age at the time of program implementation in 2021.

As we noted above, our main specification uses cohorts of those born between 1992 and 2005. As an additional check, we limit our inclusion restrictions by narrower windows of birth years and to just individuals aged 19-23 to create a sample right around the age-21 policy shift. The results using this sample are in Table A3. We find very similar results in all cases.

We include several additional measures of dental provider practice supply at the county level and demonstrate our results are robust to these alternate definitions in Table A4. First, recall that our main specification defines $\log(Practices_{c,2019})$ as the natural log of the number of dental practices in 2019 treating at least 10 unique Medicaid enrolled adults (21 and over) that live in a given county. We estimate a specification that uses practice count without taking the natural log, as well as measures that include the natural log of practices treating 10 Medicaid beneficiaries under and/or over age 21 in 2019. We also show results are quite similar whether we limit our measure to at least 5 unique Medicaid beneficiaries in a given county in 2019 compared to our main measure of 10 unique beneficiaries per county-year.

Table A5 displays estimates when using $\log(Practices_{c,2020})$—that is, where we fix our supply measure to 2020 instead of 2019. Results focused on 2020 measures of provider practices at the county level similarly suggested that incumbent practices in areas were associated with an increased effect of utilization post-ADB.

While this provides evidence that provider practice location before the ADB has important ramifications for utilization post-ADB, it also suggests that COVID-related shocks to the dental

market in WV are unlikely to explain our results, nor are they likely to bias our results. Indeed, we find external evidence from the American Dental Association (ADA) Masterfile data that WV had a particularly stable dental workforce from 2019-2022.[16] Nearly 95% of dentists present in 2019 continued to practice in WV over this time period, the 11th highest rate among all states. It is also above the 93.3% average in the US. While this does not prove that WV dental providers were unaffected by COVID, it suggests they were less affected than dental providers in other states and strongly suggests that COVID did not structurally change the dental market in WV during our study period.

As a reassurance, we also directly control for two separate COVID measures in our DID analyses: (1) COVID cases per capita by county-quarter and (2) COVID deaths per capita by county-quarter. Importantly, neither of these measures affects our point estimates from our main analysis. These estimates are in Table A7.

Additionally, while post-COVID orders reinstating in-person dental visits affected all West Virginia counties simultaneously, the initial conditions affecting these counties were not necessarily uniform. Also, there is no reason to expect dental supply elasticities to affect counties of different characteristics in the same way. To explore this further, we perform an additional analysis sub-setting our sample by metropolitan status of a county. We use the United States Office of Management and Budget (OMB) definition of counties in a metropolitan statistical area to make this distinction. These results are presented in Table A6 and show similar point estimates to those in Table 1 for the main effect of the ADB on dental care utilization at age 21 for both metropolitan and non-metropolitan counties. However, focusing on the interaction term with dental supply, we find a stronger, positive relationship between the log number of dental practices in a given area and dental care utilization for individuals over age 21 in 2021 in metropolitan counties than in non-metropolitan counties. This larger supply elasticity in metropolitan counties is statistically significant for all newly covered dental services. The relationship between supply and utilization of subsidized services remains positive for less-populated counties; however, the point estimates are small compared with those for more-populated counties and are not significantly different from zero.

[16] See https://www.ada.org/resources/research/health-policy-institute/state-level-data.

5 Discussion

Access to dental health care is expensive and limited. It has among the highest reported financial barriers of any type of health care (Vujicic et al., 2016). Following an adult dental benefit expansion in West Virginia in 2021, we show large utilization differences in dental healthcare receipt at age 21 for those who turn 21 before and after the expansion. The implementation of this benefit increased utilization of newly-covered dental care by nearly 50%. Yet, even with the expansion of benefits, the utilization of dental care decreases from age 20 to age 21.

The effect of the adult dental benefit implementation is related to the supply of dental care. Counties with more Medicaid provider practices pre-benefit implementation experienced a larger increase in utilization post implementation. The elasticity of utilization with respect to provider practice supply is over 5%, indicating that policies aimed at facilitating entry of dental providers along with benefit expansion may experience larger utilization increases.

An additional consideration to utilization includes policy design for upfront expensive procedures, such as dentures. West Virginia Medicaid expanded benefits for beneficiaries in 2024 to cover services up to $2,000 every two years (Code of West Virginia Section §9-5-12a, 2024). While this is currently outside the scope of our present study, we plan to explore the effect of this policy flexibility in future work.

The importance of oral health care and its relationship with economic outcomes underscore our results. Previous work has established a positive association between oral health and employment and other socioeconomic outcomes (Kieffer et al., 2022; Halasa-Rappel, Tschampl, Foley, Dellapenna, & Shepard, 2019; Moeller, Singhal, Al-Dajani, Gomaa, & Quiñonez, 2015; Glied & Neidell, 2010). Moreover, those exposed to fluoridated water at birth had less tooth loss and higher earnings, especially among low income women (Glied & Neidell, 2010; Neidell et al., 2010). Because individuals associate poor oral health with lower income and poorer health habits, a lack of oral health care can potentially lead to discriminatory behavior towards those with worse oral health (Moeller et al., 2015).

Recent cuts to Medicaid and increased administrative burden may lead to fewer individuals covered by Medicaid and states bearing a larger responsibility for Medicaid costs.[17] A state's fiscal responsibility for Medicaid may result in the crowding out of dental care in state Medicaid programs' budgets. This could negatively impact adult Medicaid beneficiaries, increasing emer-

[17] See https://www.cnn.com/2025/05/21/politics/medicaid-food-stamps-gop-proposed-cuts.

gency department use for dental services with a disproportionate effect on younger adults and minority groups (Singhal et al., 2015).

Access to care is a significant barrier to both medical and dental care, yet not all expansions of dental care yield similar outcomes. Important aspects of these expansions include supply side constraints such as the adequacy of existing dental infrastructure (see e.g., Singhal et al. (2017)), the Medicaid to private insurance reimbursement ratio, which incentivizes (or disincentivizes) dentists to accept new Medicaid patients (Decker, 2011; Buchmueller et al., 2015), and the extent of institutional knowledge among providers about coverage policies relevant to new patient intake. We find evidence that supply constraints impede not only access to dental services, but also access to high-quality dental care. Areas with a higher density of provider practices are positively associated with providing preventative and restorative services. These findings underscore the importance of coupling Medicaid expansions with targeted provider incentives, both to encourage providers to accept new patients and to attract providers to underserved areas. Without addressing these supply-side changes, the intended benefits of expanded dental coverage are unlikely to be fully realized.

A limitation of our measure of oral health care supply is that it is defined at the county level, though counties of West Virginia might not necessarily represent distinct dental care markets. We argue that the qualitative conclusions of our study hold despite potential imperfect measurement of supply. That is, the expansion of dental benefits for adults on Medicaid in West Virginia had a larger effect on utilization in locations with initially more dental practices treating the Medicaid population.

A Robustness Checks

	All	Newly-Covered	Preventative	Restorative
Main Specification (excludes 2020q2)	0.0227***	0.0233***	0.0183***	0.0124***
	(0.00146)	(0.00098)	(0.000753)	(0.000766)
	2,475,825	2,475,825	2,475,825	2,475,825
Includes 2020q2	0.00995***	0.0116***	0.00906***	0.00656***
	(0.00292)	(0.00254)	(0.00176)	(0.00152)
	2,640,880	2,640,880	2,640,880	2,640,880

Table A1: **Robustness Checks (Balanced Panel).** This table displays DID estimates of the effect of the ADB implementation. Standard errors are in parentheses, below the point estimate and above the sample size. Standard errors are clustered by year of birth. *:$p < 0.05$; **:$p < 0.01$; ***:$p < 0.001$.

	All	Newly-Covered	Preventative	Restorative
Main Specification (SEs clustered by Year of Birth)	0.0433***	0.0448***	0.0341***	0.0239***
	(0.00210)	(0.00124)	(0.00116)	(0.00102)
	1,729,721	1,729,721	1,729,721	1,729,721
SEs clustered by Person	0.0433***	0.0448***	0.0341***	0.0239***
	(0.00157)	(0.00136)	(0.00110)	(0.00104)
	1,729,721	1,729,721	1,729,721	1,729,721
SEs clustered by County	0.0433***	0.0448***	0.0341***	0.0239***
	(0.00242)	(0.00263)	(0.00189)	(0.00177)
	1,729,721	1,729,721	1,729,721	1,729,721

Table A2: **Robustness Checks (Clustering of SEs).** This table displays DID estimates of the effect of the ADB implementation. Standard errors are in parentheses, below the point estimate and above the sample size. *:$p < 0.05$; **:$p < 0.01$; ***:$p < 0.001$.

	All	Newly-Covered	Preventative	Restorative
Main Specification (Born between 1992 and 2005)	0.0433***	0.0448***	0.0341***	0.0239***
	(0.00210)	(0.00124)	(0.00116)	(0.00102)
	1,729,721	1,729,721	1,729,721	1,729,721
Born between 1993 and 2004	0.0440***	0.0452***	0.0347***	0.0238***
	(0.00221)	(0.00127)	(0.00115)	(0.00114)
	1,502,931	1,502,931	1,502,931	1,502,931
Born between 1994 and 2003	0.0438***	0.0453***	0.0347***	0.0241***
	(0.00257)	(0.00150)	(0.00120)	(0.00141)
	1,254,463	1,254,463	1,254,463	1,254,463
Born between 1995 and 2002	0.0431***	0.0448***	0.0340***	0.0241***
	(0.00276)	(0.00145)	(0.000969)	(0.00164)
	997,555	997,555	997,555	997,555
Born between 1996 and 2001	0.0436***	0.0442***	0.0339***	0.0244***
	(0.00305)	(0.00185)	(0.00104)	(0.00184)
	738,114	738,114	738,114	738,114
Born between 1997 and 2000	0.0410***	0.0417***	0.0319***	0.0233***
	(0.000696)	(0.00169)	(0.00148)	(0.000744)
	484,895	484,895	484,895	484,895
Ages 19 to 23 only	0.0434***	0.0433***	0.0330***	0.0243***
	(0.00172)	(0.00114)	(0.00108)	(0.00105)
	532,456	532,456	532,456	532,456

Table A3: **Robustness Checks (Age Cohorts).** This tablee displays DID estimates of the effect of the ADB implementation. Standard errors are in parentheses, below the point estimate and above the sample size. Standard errors are clustered by year of birth. *:$p < 0.05$; **:$p < 0.01$; ***:$p < 0.001$.

	All		Newly-Covered		Preventative		Restorative	
	Main	Supply Interacted	Main	Supply Interacted	Main	Supply Interacted	Main	Supply Interacted
Panel A. Log Providers Reprinted from Table 1								
$\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$	0.0433***	0.0409***	0.0448***	0.0323***	0.0341***	0.0212***	0.0239***	0.0168***
	(0.00210)	(0.00551)	(0.00124)	(0.00463)	(0.00116)	(0.00396)	(0.00102)	(0.00194)
log # practices in county c with 10+ adult Medicaid visit in 2019 $\times\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$		0.00105		0.00499***		0.00515***		0.00281***
		(0.00199)		(0.00173)		(0.00151)		(0.000708)
Panel B. Provider Count								
$\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$		0.0415***		0.0391***		0.0293***		0.0204***
		(0.00275)		(0.00193)		(0.00156)		(0.00116)
# practices in county c with 10+ adult Medicaid visit in 2019 $\times\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$		0.000123		0.000362***		0.000312***		0.000221***
		(0.000103)		(8.78e-05)		(7.13e-05)		(3.48e-05)
Panel C. Log Providers Using Children and Adults								
$\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$		0.0349***		0.0181**		0.00707		0.00795*
		(0.00924)		(0.00797)		(0.00693)		(0.00412)
log # practices in county c with 10+ adult or child Medicaid visit in 2019 $\times\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$		0.00222		0.00698***		0.00708***		0.00417***
		(0.00233)		(0.00204)		(0.00181)		(0.00106)

Continued on next page

Table A4: **Robustness Checks (Supply Measure 2019).**

TableA4 – continued from previous page

	All	Newly-Covered	Preventative	Restorative
Panel D. Log Providers Using Only Children				
$\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$	0.0369***	0.0219***	0.00967	0.0105**
	(0.00807)	(0.00684)	(0.00605)	(0.00419)
log # practices in county c with 10+ child Medicaid visit in 2019 $\times\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$	0.00175	0.00613***	0.00656***	0.00359***
	(0.00205)	(0.00178)	(0.00161)	(0.00111)
Panel E. Log Providers Using 5 + Visits				
$\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$	0.0428***	0.0301***	0.0193***	0.0141***
	(0.00784)	(0.00657)	(0.00539)	(0.00287)
log # practices in county c with 5+ adult Medicaid visit in 2019 $\times\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$	0.000249	0.00503**	0.00511**	0.00337***
	(0.00259)	(0.00218)	(0.00182)	(0.000992)

Table A4: **Robustness Checks (Supply Measure 2019).** This table displays DID estimates of the effect of the ADB implementation. The first column contains our main specification, then we include an interaction with a measure of dental supply from 2019 in column 2 for each outcome. Standard errors are in parentheses, below the point estimate and are clustered by year of birth. N =1,729,721. *:$p < 0.05$; **:$p < 0.01$; ***:$p < 0.001$.

	All		Newly-Covered		Preventative		Restorative	
	Main	Supply Interacted	Main	Supply Interacted	Main	Supply Interacted	Main	Supply Interacted
Panel A. Log Providers Reprinted from Table 1								
$\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$	0.0433***	0.0408***	0.0448***	0.0291***	0.0341***	0.0194**	0.0239***	0.0141***
	(0.00210)	(0.00627)	(0.00124)	(0.00514)	(0.00116)	(0.00433)	(0.00102)	(0.00226)
log # practices in county c with 10+ adult Medicaid visit in 2020 $\times\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$		0.000984		0.00584***		0.00549***		0.00365***
		(0.00217)		(0.00182)		(0.00156)		(0.000786)
Panel B. Provider Count								
$\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$		0.0415***		0.0392***		0.0294***		0.0203***
		(0.00283)		(0.00197)		(0.00161)		(0.00118)
# practices in county c with 10+ adult Medicaid visit in 2020 $\times\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$		0.000105		0.000299***		0.000254***		0.000190***
		(9.10e-05)		(7.56e-05)		(6.11e-05)		(3.12e-05)
Panel C. Log Providers Using Children and Adults								
$\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$		0.0352***		0.0194**		0.00798		0.00909*
		(0.00905)		(0.00763)		(0.00632)		(0.00428)
log # practices in county c with 10+ adult or child Medicaid visit in 2020 $\times\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$		0.00216		0.00663***		0.00684***		0.00386***
		(0.00224)		(0.00194)		(0.00165)		(0.00110)

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Table A5: **Robustness Checks (Supply Measure 2020).**

TableA5 – continued from previous page

	All	Newly-Covered	Preventative	Restorative
Panel D. Log Providers Using Only Children				
$\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$	0.0352***	0.0193***	0.00729	0.0107**
	(0.00812)	(0.00692)	(0.00558)	(0.00467)
log # practices in county c with 10+ child Medicaid visit in 2020 $\times\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$	0.00224	0.00697***	0.00734***	0.00359***
	(0.00209)	(0.00185)	(0.00154)	(0.00127)
Panel E. Log Providers Using 5 + Visits				
$\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$	0.0444***	0.0347***	0.0224***	0.0153***
	(0.00702)	(0.00584)	(0.00499)	(0.00254)
log # practices in county c with 5+ adult Medicaid visit in 2020 $\times\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$	-0.000299	0.00327*	0.00381**	0.00278***
	(0.00214)	(0.00182)	(0.00157)	(0.000801)

Table A5: **Robustness Checks (Supply Measure 2020).** This table displays DID estimates of the effect of the ADB implementation. The first column contains our main specification, then we include an interaction with a measure of dental supply from 2020 in column 2 for each outcome. Standard errors are in parentheses, below the point estimate and are clustered by year of birth. N =1,729,721. *:$p < 0.05$; **:$p < 0.01$; ***:$p < 0.001$.

	All		Newly-Covered		Preventative		Restorative	
	Main	Supply Interacted	Main	Supply Interacted	Main	Supply Interacted	Main	Supply Interacted
Panel A. Log Providers Reprinted from Table 1								
$\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$	0.0433***	0.0409***	0.0448***	0.0323***	0.0341***	0.0212***	0.0239***	0.0168***
	(0.00210)	(0.00551)	(0.00124)	(0.00463)	(0.00116)	(0.00396)	(0.00102)	(0.00194)
log # practices in county c with 10+ adult Medicaid visit in 2019 $\times\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$		0.00105		0.00499***		0.00515***		0.00281***
		(0.00199)		(0.00173)		(0.00151)		(0.000708)
Panel B. Non-Metro Subsample								
$\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$	0.0405***	0.0495***	0.0444***	0.0433***	0.0325***	0.0289***	0.0243***	0.0223***
	(0.00230)	(0.00698)	(0.00135)	(0.00556)	(0.00139)	(0.00445)	(0.00113)	(0.00476)
log # practices in county c with 10+ adult Medicaid visit in 2019 $\times\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$		-0.00385		0.000621		0.00169		0.000925
		(0.00331)		(0.00254)		(0.00204)		(0.00188)
Panel C. Metro Subsample								
$\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$	0.0456***	0.0375***	0.0450***	0.0171**	0.0353***	0.0130**	0.0236***	0.00617**
	(0.00256)	(0.00800)	(0.00200)	(0.00703)	(0.00151)	(0.00529)	(0.00125)	(0.00219)
log # practices in county c with 10+ adult Medicaid visit in 2019 $\times\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$		0.00291		0.0101***		0.00807***		0.00631***
		(0.00238)		(0.00221)		(0.00177)		(0.000643)

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Table A6: **Robustness Checks (Metro vs. Non Metro 2019).**

TableA6 – continued from previous page

	All	Newly-Covered	Preventative	Restorative

Table A6: **Robustness Checks (Metro vs. Non Metro 2019).** This table displays DID estimates of the effect of the ADB implementation. The first column contains our main specification, then we include an interaction with a measure of dental supply from 2019 in column 2 for each outcome. Panels B and C evaluate these effects separately by whether the county is defined as a metro county based on being part of a metropolitan statistical area as defined by the United States Office of Management and Budget (OMB). Standard errors are in parentheses, below the point estimate and are clustered by year of birth. Panel A: N =1,729,721. Panels B–C split the sample by county metro status; Panel B (Non-Metro): N =743,797; Panel C (Metro): N =984,691. observation counts are reported by column within each panel. *:$p < 0.05$; **:$p < 0.01$; ***:$p < 0.001$.

	All			Newly-Covered			Preventative			Restorative		
	Main Spec	Including Covid Cases	Including Covid Deaths	Main Spec	Including Covid Cases	Including Covid Deaths	Main Spec	Including Covid Cases	Including Covid Deaths	Main Spec	Including Covid Cases	Including Covid Deaths
$\mathbb{1}\{age(i,t)\geq 21\}$ $\times\mathbb{1}\{t\geq 2021\}$	0.0433***	0.0433***	0.0433***	0.0448***	0.0448***	0.0448***	0.0341***	0.0341***	0.0341***	0.0239***	0.0239***	0.0239***
	(0.00210)	(0.00210)	(0.00210)	(0.00124)	(0.00124)	(0.00124)	(0.00116)	(0.00116)	(0.00116)	(0.00102)	(0.00102)	(0.00102)
$COVID_Cases_{ct}$		1.14e-07			2.20e-07			-4.75e-08			-1.84e-07	
		(3.70e-07)			(3.25e-07)			(3.16e-07)			(2.64e-07)	
$COVID_Deaths_{ct}$			1.65e-05			-1.01e-05			-1.58e-05*			1.23e-06
			(1.01e-05)			(1.23e-05)			(7.65e-06)			(1.11e-05)

Table A7: **Robustness Checks (COVID Controls).** This table displays DID estimates of the effect of the ADB implementation. The first column contains our main specification, then we control for Covid Cases by county-quarter in column 2, and Covid Deaths by county-quarter in column 3 for each outcome. Standard errors are in parentheses, below the point estimate and are clustered by year of birth. N =1,729,721. *:$p < 0.05$; **:$p < 0.01$; ***:$p < 0.001$.

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