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Effect of Adult Dental Benefit Expansion in Virginia Medicaid on ED Utilization for Non-Traumatic Dental Visits

An Evaluation Report Prepared for the Department of Medical Assistance Services by Virginia Commonwealth University School of Public Health, Department of Health Policy

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Disclaimer

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Table of Contents

Executive Summary

On July 1, 2021, Virginia implemented comprehensive dental coverage for all Medicaid-enrolled adults. The new benefit allows thousands of adult Virginians access to full dental coverage for the first time. Prior research has shown that lack of access to preventive and other outpatient dental care results in greater use of hospital emergency departments for non-traumatic dental conditions. Therefore, it is expected that dental-related ED visits for adult Medicaid members will decrease following the start of the new dental benefit. This report provides the results of an evaluation to assess the effects of the adult dental benefit on dental-related ED use. Using Medicaid administrative claims data, we conducted an analysis of trends in dental-related ED use between July 2019 and June 2023 (2 years before and after the start of the new benefit). The major findings from this analysis are:

- Young adults (ages 21-34) benefitted the most from the new dental benefit in terms of a decrease in dental-related ED visits. There was a modest 6% decrease in dental-related ED use between the year prior to the start of the benefit and the 2nd year after the benefit (1.4 visits per 10,000 members). However, a difference-in-difference analysis suggests a larger impact of the new benefit for young adults – a decrease of 7.5 ED visits per 10,000 members compared to children and youth, who already had dental coverage and were therefore unaffected by the new benefit.

- Most adult members (70%) did not use preventive or other outpatient dental services during the first year of the new benefit, and they experienced a 24% increase in dental-related ED visits during the study period. In contrast, members who used preventive dental care during the first year of the new dental benefit saw no change in dental-related ED visits.

- There has been a general upward trend in dental-related ED visits after a sharp decrease during the start of the COVID-19 pandemic. This is consistent with more general trends in use of the ED among Medicaid members, and may reflect changes in Medicaid member characteristics and health system factors that are external to Medicaid.

In sum, there is compelling evidence that the new adult dental coverage has already benefitted young adults, who have by far the highest rates of dental-related ED visits among all age groups. Greater use of the dental benefit among Medicaid members will likely result in even greater decreases in ED use in the future.

1.0 Introduction

Dental care is the most common unmet health need in the US. Access to oral health remains disparate, and financial barriers are the most common reasons for not obtaining needed dental care among low-income adults (Gupta, 2018). Dental insurance coverage for low-income adults through the Medicaid program varies from state to state and ranges from no benefit to comprehensive coverage. Without dental coverage, many people delay or forego dental care or use hospital emergency departments (EDs) to care for their dental problems. In 2018, there were more than 2 million dental-related ED visits nationally, representing 615.5 visits per 100,000 population (Owen, 2021).

EDs are designed to manage acute, traumatic, and life-threatening injuries. Nontraumatic dental conditions (NTDC), such as dental caries and its sequelae, periodontal disease, are preventable in most cases and should be addressed in dental settings. EDs are neither equipped nor cost-efficient to treat these NTDCs. Evidence shows that these NTDC ED visits often receive pain medication as there are no dental providers in the ED to treat dental problems (Naavaal & Kelekar, 2020). The average hospital charge for an NTDC visit was $992 in 2014, estimating a total cost of $2.4 billion to the US healthcare system (Kelekar and Naavaal, 2019). Over time, these costs have increased by over 60% to $1,887 by 2019, creating a high-cost burden on the health care system (CareQuest, 2022). Data shows that NTDC ED visits are more common among adults ages 25-34 years, uninsured or those who have Medicaid coverage, Black persons, and those who live in rural areas or live in low-income households (CareQuest, 2022). These differences and disparities in the use of ED for dental visits by various groups highlight the barriers to accessing required dental care.

In Virginia, dental benefits for children with Medicaid coverage are covered under the EPDST benefit like all other states; however, dental benefit coverage for adults was limited to

only emergency tooth extraction until June 2021. A 2018 report showed that nearly 16,000 Virginia Medicaid members made nearly 19,000 visits to the ED for dental-related problems (DMAS, 2019). On July 1, 2021, Virginia implemented comprehensive dental coverage for all Medicaid-enrolled adults, expanding the coverage for a variety of dental services. The new benefit allowed thousands of adult Virginians to access full dental coverage for the first time.

Evidence from other states indicate that dental coverage among the Medicaid population has generally been positive, including a reduction in dental-related ED visits. For example, in Minnesota, extending dental coverage to more adults through expanding Medicaid resulted in a nearly 10% decrease in the number of NTDC visits (Laniado, 2017). Another study, using data from 33 states found that states that had expanded Medicaid coverage under the Affordable Care Act and that also had dental coverage had fewer dental-related ED visits compared to Medicaid expansion states that did not have dental coverage (Elani, 2020). An Oregon study found that eliminating Medicaid dental benefits led to a significant increase in dental-related ED use and unmet need (Wallace, 2011).

This report presents findings from an evaluation of Virginia Medicaid's adult dental benefit, specifically to assess changes in dental-related ED visits before and after the benefit was implemented in July 2021. Consistent with findings from other state Medicaid programs with adult dental benefits, we expect a reduction in dental-related ED visits among adults following the start of the adult benefit, relative to the time period preceding the benefit.

2.0 Data and Methods

Data for this report are based on Virginia Medicaid claims and enrollment data, accessed through the Department of Medical Assistance Services (DMAS) Electronic Data Warehouse (EDWS). The time period for most of the analysis of the study is between July 2019 and June 2023, reflecting equal lengths of time (2 years) before and after the adult dental benefit was implemented in July, 2021. Our analysis is restricted to Medicaid members with full benefits, and excludes those with only partial Medicaid benefits (e.g. emergency medical services only).

Dental-related ED visits are defined as ED visits that had a diagnosis code for Non-Traumatic Dental Condition (NTDC) in any diagnosis field (see Appendix A for full list of ICD9 and ICD10 codes used to identify NTDC). Our analysis also includes certain measures of outpatient dental care utilization, based on the comprehensive dental services covered under the adult dental benefit, including preventive, diagnostic and restorative and treatment procedures (Dentaquest, 2024). The Virginia Medicaid dental benefit plan is administered and managed by DentaQuest. They process all dental service claims for Virginia Medicaid members. These claims for dental services are linked to medical service claims and enrollment data in EDWS through Medicaid member ID.

Most of the analysis in this report includes quarterly, semi-annual, and annual estimates based on a cross-section of full-benefit Medicaid members during those time periods. We do not restrict study participants based on length of time enrolled in Medicaid, or whether they enrolled or disenrolled during a particular time period. A separate analysis is based on a cohort of Medicaid members who were continuously enrolled in full benefit Medicaid between January 2021 and June 2023. This analysis examines trends in dental-related ED visits between adult members who utilized the dental benefit during the first year of the benefit and those who did not utilize the benefit.

The report also includes a difference-in-difference analysis to examine more carefully whether there was a decrease in dental-related ED visits following the start of the adult dental benefit for members who were eligible for the benefit, relative to a population who was not affected by the new benefit. For this analysis, we compare young adults (ages 21-34) who were eligible for the new benefit with children and youth (less than 21 years) who already had dental coverage through Medicaid, and therefore were not affected by the benefit. This regression-based analysis also controls for differences between the two groups (as well as changes over time) in sex, race/ethnicity, aid category, and DMAS region. From this analysis, we computed adjusted trends for dental-related ED visits for young adults and children/youth. We also compute the counterfactual – how would dental-related ED visits have changed for young adults if the adult benefit had not been implemented. The main results are summarized in the report. More detail on the methodology for the difference-in-difference analysis, as well as the full results are shown in Appendix B.

3.0 Findings

3.1 Trends in total number of ED visits.

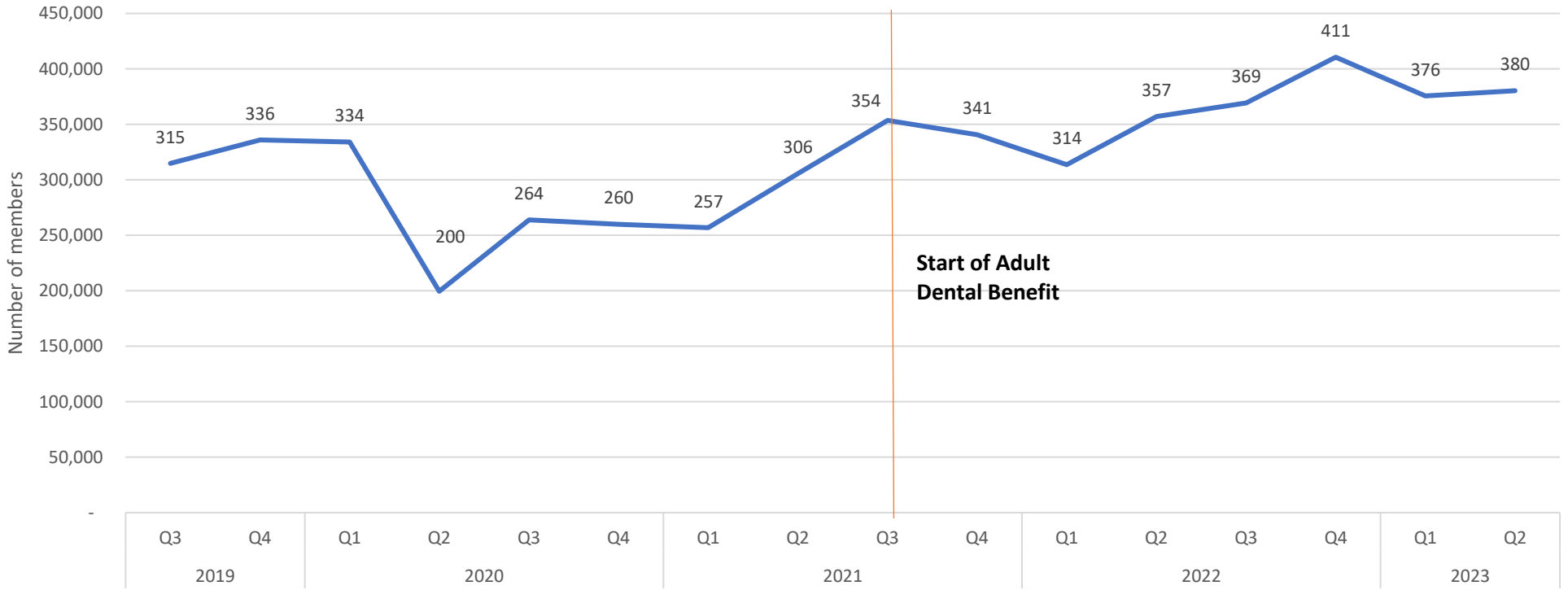
ED visits increased during the study period, with the exception of a sharp decrease in the early part of 2020, likely due to pandemic-related restrictions on health care use (see Figure 1). After decreasing from 334,000 visits from Q1 2020 to 200,000 visits in Q2 2020, the number of ED visits increased through the rest of the study period (with some fluctuation by quarter). This includes an increase from 306,000 visits just prior to the start of the adult dental benefit (Q2 2021) to 380,000 visits by Q2 2023.

Some of the increase in ED visits likely reflects increased enrollment in Medicaid during this period, from about 1.4 million full-benefit Medicaid members in the 3rd quarter of 2019 to 2.1 million in the 3rd quarter of 2023 (findings not shown). To account for increases in enrollment, Figure 2 shows the rate of ED visits per 10,000 Medicaid members. Following the early months of the COVID-19 pandemic, ED visit rates increased to around 1960 visits per 10,000 members in Q3 2021 (the start of the adult dental benefit) and fluctuated thereafter, with no clear trend through Q2 2023.

3.2 Trends in dental-related ED visits.

Trends in the number of dental-related ED visits for Medicaid members were generally consistent with trends in total ED use (see Figure 3). After sharply decreasing to 1,498 visits in Q2, 2020, dental-related ED visits increased steadily before and after the start of the adult dental benefit, to 3,104 visits by Q2 2023. Similar to total ED visit rates, there is less of a clear trend in the time period before and after the adult dental benefit (see Figure 4). The rate of dental-related ED visits began increasing in the three quarters that preceded the adult dental benefit (from 11.2 visits per 10,000 members in Q4 2020 to 13.6 visits by Q3 2021, and then decreased in the period immediately following the dental benefit, before increasing again to 14.6 visits per 10,000 by Q2 2023.

Figure 1. Total number of ED Visits by quarter (in thousands)



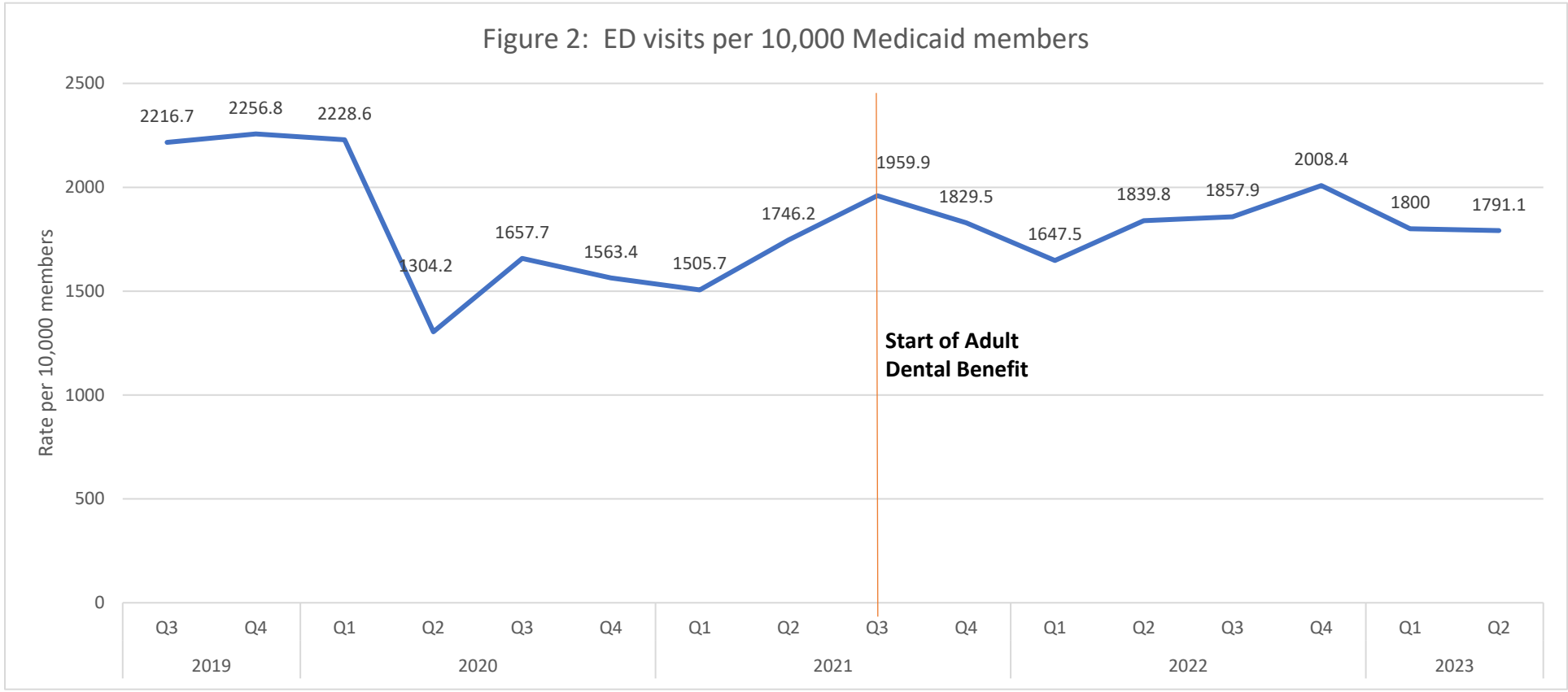


Figure 2: ED visits per 10,000 Medicaid members
Rate per 10,000 members
2500
2000
1500
1000
500
0
2216.7
2256.8
2228.6
1304.2
1657.7
1563.4
1505.7
1746.2
1959.9
1829.5
1647.5
1839.8
1857.9
2008.4
1800
1791.1
Start of Adult Dental Benefit
Q3
Q4
Q1
Q2
Q3
Q4
Q1
Q2
Q3
Q4
Q1
Q2
Q3
Q4
Q1
Q2
2019
2020
2021
2022
2023

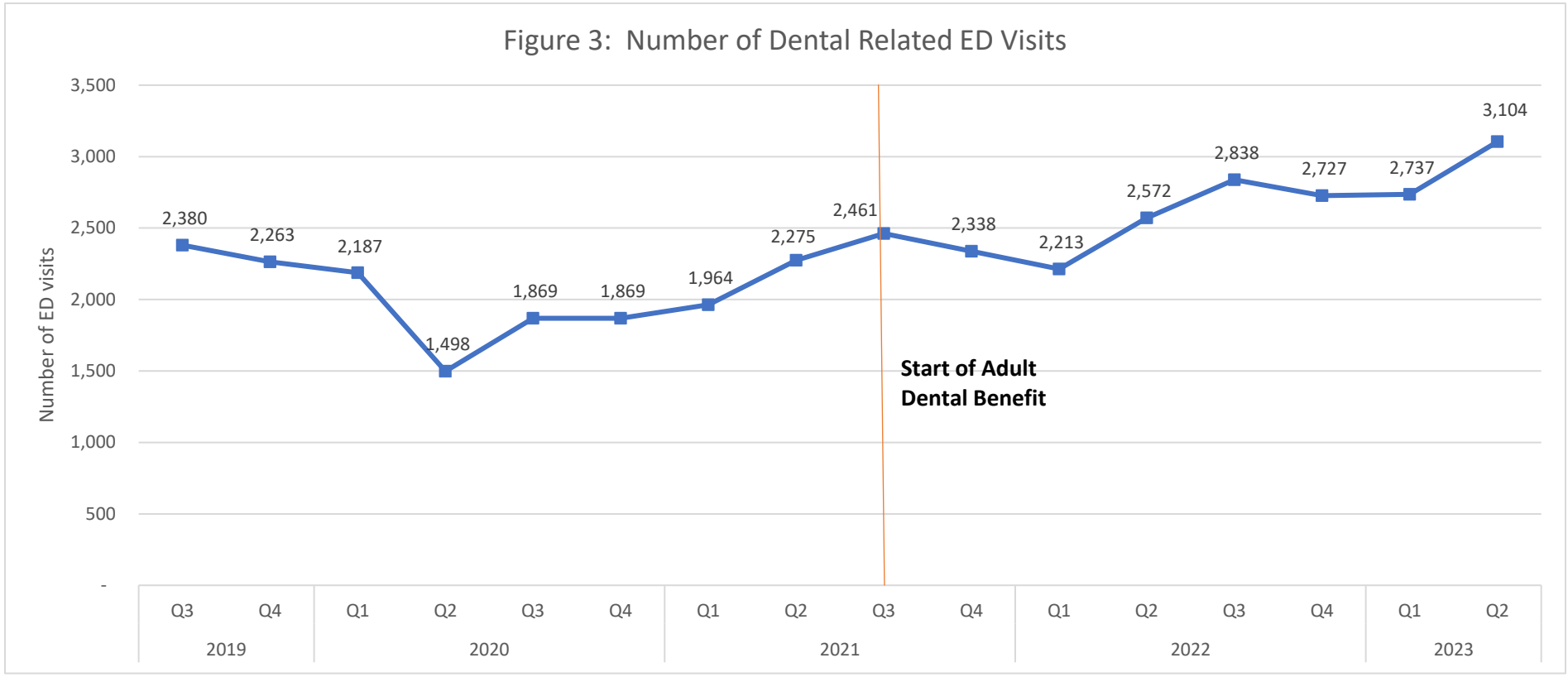
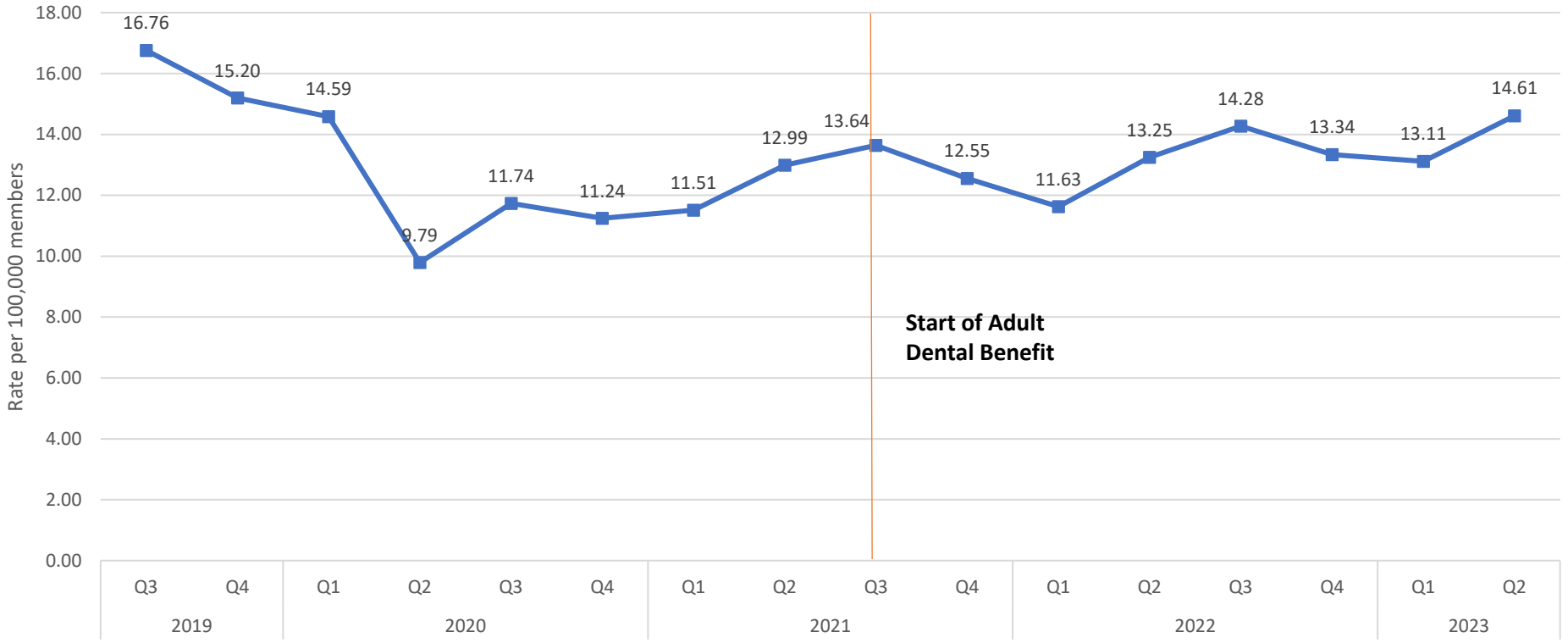


Figure 3: Number of Dental Related ED Visits
Number of ED visits
3,500
3,000
2,500
2,000
1,500
1,000
500
-
2,380
2,263
2,187
1,498
1,869
1,869
1,964
2,275
2,461
2,338
2,213
2,572
2,838
2,727
2,737
3,104
Start of Adult Dental Benefit
Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2 Q3 Q4 Q1 Q2
2019
2020
2021
2022
2023

Figure 4: Dental-related ED visits per 10,000 Medicaid members

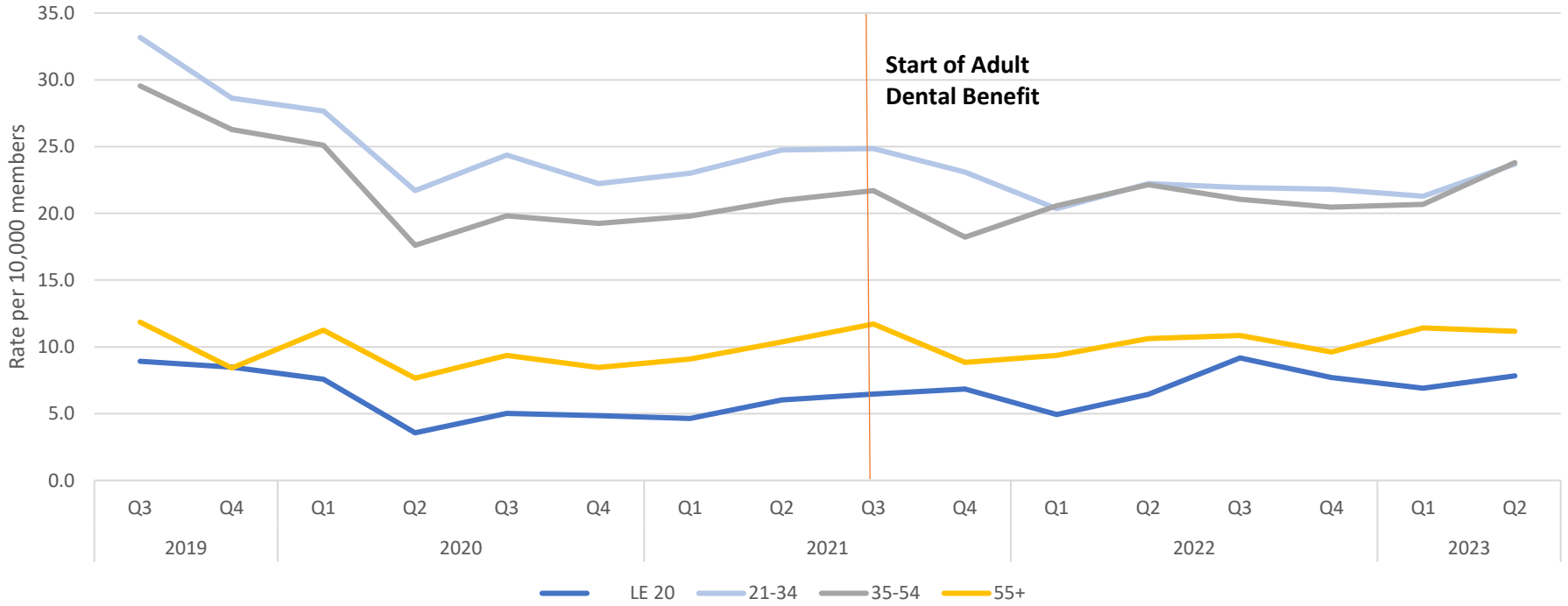


Differences by age. Figure 5 shows trends in the rate of dental-related ED visits by age group. The primary interest is comparing trends in dental-related ED visits for members ages 20 or younger – who already had Medicaid dental coverage prior to the adult benefit – with adult age groups. Such comparisons are helpful because we assume that groups not affected by the adult benefit (children and youth) are affected by the same secular trends (e.g. COVID-19) as age groups eligible for the adult benefit. Therefore, divergent trends in dental-related ED visits for adults relative to children and youth following implementation of the adult benefit may be indicative of the effect of the benefit.

Rates of dental-related ED visits vary substantially by age. For example, children and youth had the lowest rate of dental-related ED visits in Q2 2023 (7.8 visits per 10,000 members), while adults ages 21-34 had the highest rate of dental-related ED visits (23.7 visits per 10,000 members). Trends in dental-related ED visits between Q3 2019 and Q2 2023 also differ by age group. For children and youth, visits per 10,000 members decreased in the first half of the time period (from 8.9 in Q3 2019 to 4.6 in Q1 2021) before increasing during the second half of the time period to 7.8 by Q2 2023. Adults ages 21-34 and 35-54 see a steady decrease through the end of 2021 and beginning of 2022, while mostly holding steady during the rest of the time period. As with children and youth, older adults (ages 55 and over) see some decrease during the first part of the time period, with increases during the second part of the time period.

Table 1 summarizes the changes in ED visits by age group, showing annual averages in dental-related ED visit rates for the two fiscal years prior to the adult benefit, and the two years following the benefit. We focus primarily on the changes between the year immediately prior to the adult benefit (Q3 2020 to Q2 2021) and the first and second years after the benefit. Among all members, there was an increase of 0.9 ED visits per 10,000 members between the year prior to the benefit and the year following the benefit, and an increase of 1.9 visits during the 2nd year of the benefit. There are substantial differences by age, however, with the ED visit

Figure 5: Number of Dental-Related ED visits per 10,000 Medicaid members, by age



rate increasing the most among children and youth (2.7 visits per 10,000 members between the year prior to the benefit and the second year of the benefit), while actually decreasing among younger adults (-1.4 visits per 10,000 members during the same time period).

Because children and youth had dental coverage throughout the study period and were unaffected by the implementation of the adult benefit, it is useful to show the *relative* change in ED visit rates for adults, computed as the difference between the change for children and youth and the change for the individual adult age groups. This shows a relative decrease of 4.1 ED visits per 10,000 members for ages 21-34 between the year prior to the adult benefit and the 2nd year of the benefit, and a relative decrease of 1.2 and 1.3 visits per 10,000 members for the older age groups, respectively.

Table 1. Summary of changes in the rate of non-traumatic dental ED visits (per 10,000 members) by age, after implementation of adult dental benefit.

	Baseline period 1 (Q3 – 2019 to Q2 2020)	**Baseline period 2** (Q3-2020 to Q2-2021)	**Post period 1** (Q3-2021 to Q2-2022)	**Post period 2** (Q3-2022 to Q2-2023)	**Change between baseline period 2 and post period 1**	**Change between baseline period 2 and post period 2**	**Relative change for adults compared to children[1]**
All persons	14.0	11.9	12.8	13.8	+0.9	+1.9	
Age							
LE 20	7.1	5.1	6.2	7.8	+1.1	+2.7	--
21-34	27.6	23.6	22.6	22.2	-1.0	-1.4	**-4.1**
35-54	24.4	20.0	20.7	21.5	+0.7	+1.5	**-1.2**
GE 55	9.7	9.3	10.1	10.7	+0.8	+1.4	**-1.3**

[1]Reflects the difference between the change for children and youth (not affected by the new benefit) and the change for adults.

3.3 Results of difference-in-difference analyses comparing young adults to children and youth.

While the above analyses are suggestive, they do not show a definitive causal impact of the adult dental benefit on dental-related ED visits. Differences between age groups – especially between children and adults -- as well as changes over time on other characteristics of members not related to the benefit may influence trends in dental-related ED visits. To account for some of these differences, we conducted a difference-in-difference analysis to hold constant differences in demographic characteristics, aid category, and region over time, as well as to account for other secular changes in ED utilization that may be affecting all members. The details for the methodology of the difference-in-difference analysis are explained in the methods section of this report and in Appendix B. For this analysis, we focus on the differences between children and youth (the comparison group) and young adults (ages 21-34). Because children and youth were not affected by the adult dental benefit, their adjusted changes in dental-related ED visits can be used to estimate the "counterfactual" for young adults – that is, how would dental-related ED visits have changed for young adults without the implementation of the adult benefit?

The full model results are shown in Appendix B. The coefficient for the difference-in-difference parameter is -0.0007481 ($p < .0001$), indicating a statistically significant decrease in dental-related ED use for young adults after the adult dental benefit relative to children and youth. Computed as a rate per 10,000 members, this result indicates that *relative to children and youth*, young adults had 7.5 fewer dental-related ED visits per 10,000 members following implementation of the adult dental benefit compared to before the benefit. Figure 6 shows trends in dental-related ED visits, based on adjusted estimates from the model. The blue line reflects the impact of the adult dental benefit for young adults, showing a decrease of 3 to 6 visits per 10,000 members after the start of the new benefit in July, 2021. The dotted blue line estimates the counterfactual for young adults, suggesting there would have been little change in

dental-related visits had the adult dental benefit not been implemented. The difference between these two lines reflects the impact of the adult dental benefit on dental-related ED use among young adults, providing further evidence that the benefit has resulted in reduced dental-related ED utilization.

3.4 Changes in dental-related ED visits among a cohort of adults who used dental services during the first year of the benefit.

We also examined dental-related ED use among a cohort of adults who were continuously enrolled in full Medicaid benefits between January 2021 and June 2023 (members who enrolled or disenrolled during this time period were excluded). Specifically, we compare members in this cohort who used the dental benefit during the first year following its implementation to members who did not use the benefit. Of the 731,626 members in this cohort, 214,596 (29.3%) had a claim for any dental service covered by the new benefit in the first year, including 91,911 (12.1%) who had a claim for a preventive dental service (see Table 3).

In general, members in the cohort who used the dental benefit had higher rates of dental-related ED visits compared to members who did not use the benefit, both before and after the implementation of the benefit. For example, members who had any claim for a dental service had 62.5 ED visits per 10,000 members in the six months prior to the start of the benefit, compared to 36.6 visits among members who used a preventive dental service, and 23.8 visits among members who did not use the dental benefit.

However, dental-related ED use increased among members who did not use the dental benefit, while there was little change among members who used the benefit. Between Jan-June 2021 and Jan-June 2023, the number of dental-related ED visits increased by 24.2% among members who did not use the dental benefit, compared to 1.4% for members who used any dental service, and 0.6% among members who used preventive dental services.

Figure 6. Adjusted estimates of dental-related ED visits for adults ages 21-34 and children and youth ages 20 and under

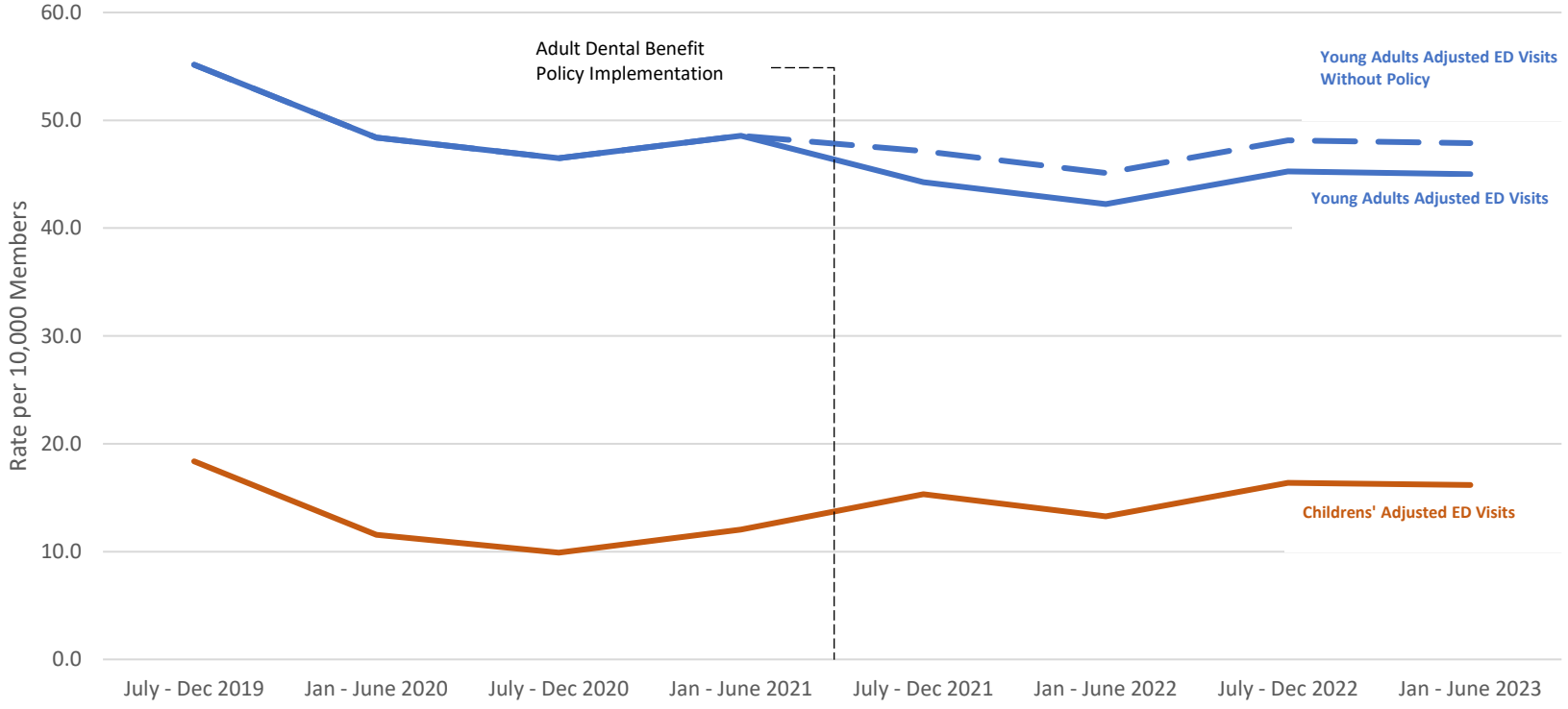


Table 2. Dental related ED use among Medicaid members continuously enrolled between Jan 1 2021 through June 30, 2023.

		Number with dental-related ED visit (rates per 10,000 in parentheses)					% change in number of visits between Jan-June 2021 and Jan-June 2023
	n	Jan-June 2021	July-Dec 2021	Jan-June 2022	July-Dec 2022	Jan-June 2023	
All members in cohort[2]	731,626	2,575 (35)	2,651 (36)	2,560 (35)	2,656 (36)	2,892 (40)	+12.3%
Had any dental claim between July 2021 and June 2022.	214,596	1,342 (63)	1,340 (62)	1,255 (58)	1,337 (62)	1,361 (63)	+1.4%
Had preventive dental claim between July 2021 and June 2022[1]	91,911	336 (37)	351 (38)	284 (31)	335 (36)	338 (37)	+0.6%
Did not have any dental claim between July 2021 and June 2022.	517,030	1,233 (24)	1,311 (25)	1,305 (25)	1,319 (26)	1,531 (30)	+24.2%

[1]Based on procedure codes **D1000 — D1999**

[2]The cohort is defined as: age 21 and over as of 01/01/2021, continuously enrolled in full benefit Medicaid between Jan 2021 and June 2023.

3.5 Follow-up dental care after an ED-related dental visit.

Members should receive follow-up care shortly after the dental-related emergency department visit to monitor the condition or continue with treatment started in the ED. Follow-up services include diagnostic, surgical, restorative, preventive, periodontics, and prosthodontic services. Greater access to dental care through the adult dental benefit should increase the rate at which members seek follow-up care. Prior to implementation of comprehensive dental benefit, Virginia Medicaid only offered limited dental care to non-pregnant adults, which primarily just included extractions.

We examine trends in the percent of dental-related ED visits in which there was follow-up for any of these services within 7 or 30 days of the ED visit (see Figure 7). Overall, rates of follow-up were generally low during the study period: In Q2 2023, 11% of ED visits had a follow-up within 7 days, while 20.2% had a follow-up within 30 days. Rates of follow-up fluctuated over the time period, with no clear trend before and after implementation of the adult benefit.

Figure 8 shows annual counts in the number of 30 day follow-up services received between 2019 and 2023, by type of service. The most frequently received follow-up service in 2023 is diagnostic (461) followed by surgical (217) and adjunctive general services (105). There were fewer services for restorations, endodontics, preventive, periodontics, and prosthodontics. However, since these services were not covered prior to the adult dental benefit, they saw the largest percent increase in volumes between the 2021 (the start of the benefit) and 2023.

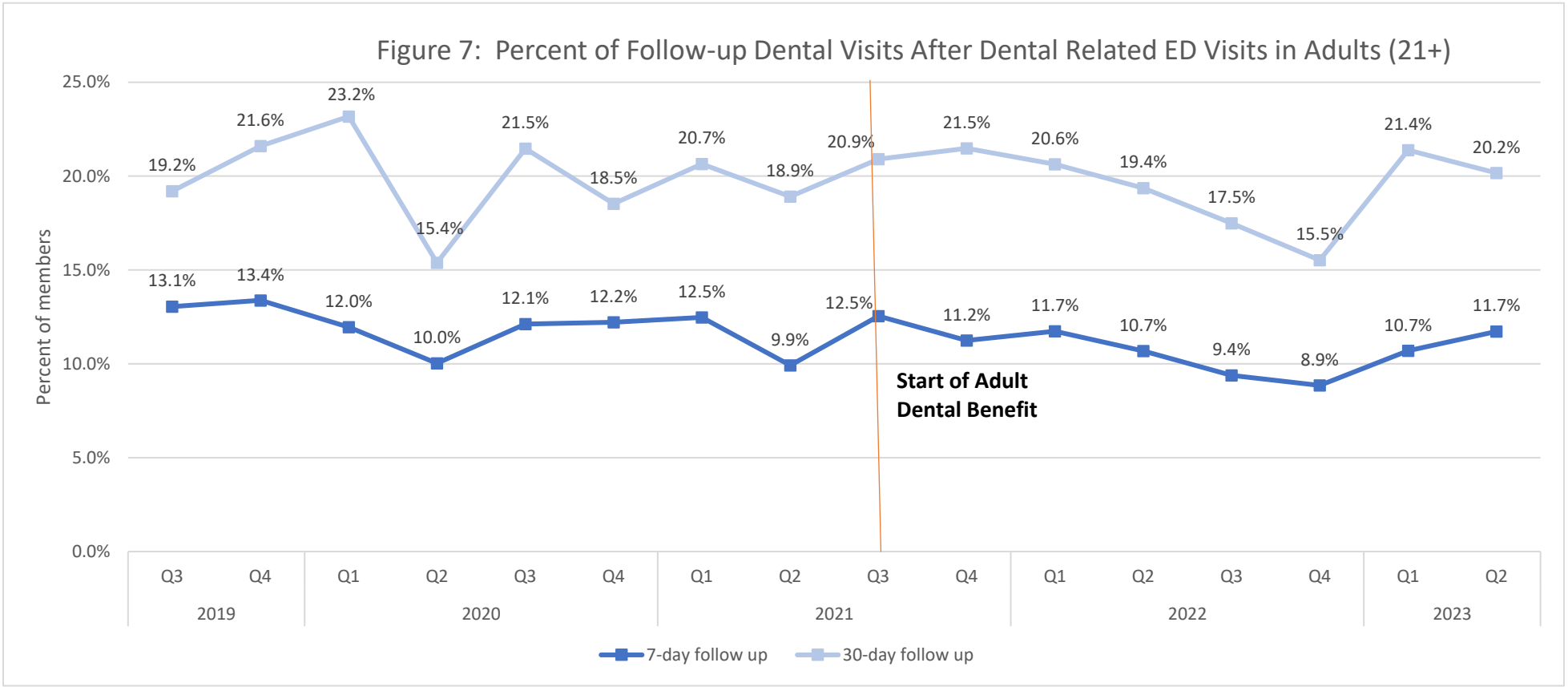
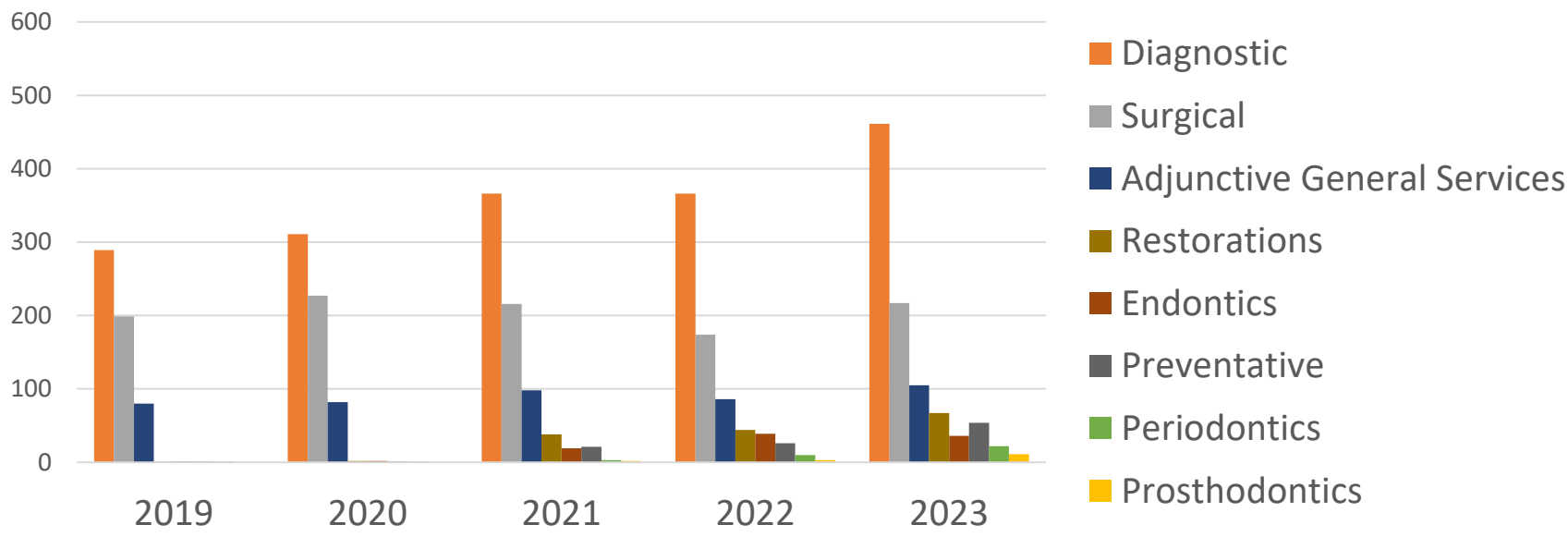


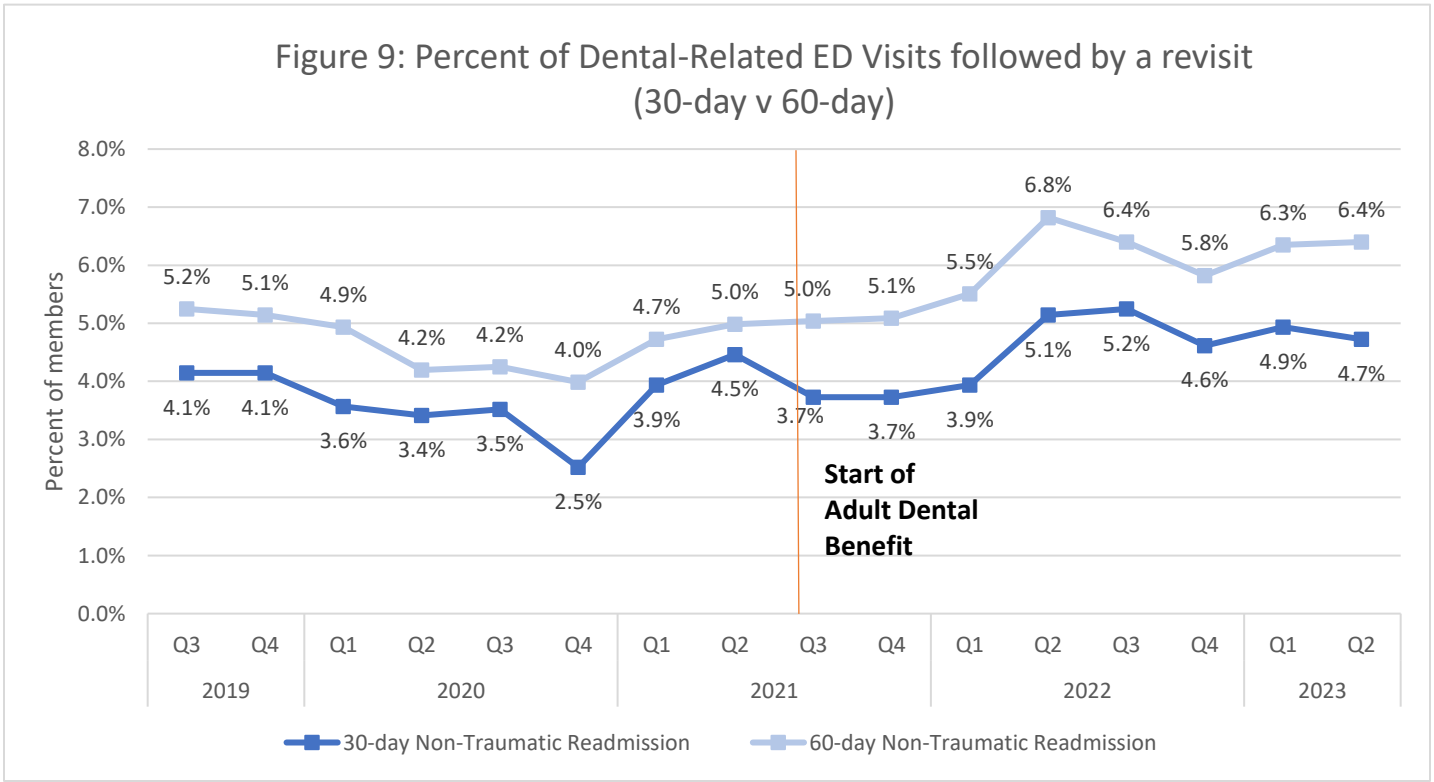
Figure 7: Percent of Follow-up Dental Visits After Dental Related ED Visits in Adults (21+)
Percent of members
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
19.2%
21.6%
23.2%
15.4%
21.5%
18.5%
20.7%
18.9%
20.9%
21.5%
20.6%
19.4%
17.5%
15.5%
21.4%
20.2%
13.1%
13.4%
12.0%
10.0%
12.1%
12.2%
12.5%
9.9%
12.5%
11.2%
11.7%
10.7%
9.4%
8.9%
10.7%
11.7%
Start of Adult Dental Benefit
Q3
Q4
Q1
Q2
Q3
Q4
Q1
Q2
Q3
Q4
Q1
Q2
Q3
Q4
Q1
Q2
2019
2020
2021
2022
2023
7-day follow up
30-day follow up

Figure 8. Number of adult Members who had a 30-day follow up after a dental-related ED visit, by level of care



3.5 ED "revisit" rates.

Lack of follow-up care after a dental-related ED visit may result in a return visit to the ED for a dental problem. The rate of 30 day and 60 day "revisits" to the ED (i.e. the percent of members who had another dental-related ED visit within 30 or 60 days of the original visit) is quite low among Medicaid members (see Figure 9). In Q2 2023, 30 day revisit rates were 4.7%, while 60 day revisit rates were 6.4%. Both 30 day and 60 day revisit rates have been trending upward during the study period, including following the start of the adult dental benefit. It is possible that greater access to dental care providers may lead to more referrals to EDs for urgent conditions experienced after normal business hours.



4.0 Conclusion

This findings in this report provide evidence of a decrease in dental-related ED use following implementation of Virginia Medicaid's adult benefit in July 2021. Evidence of the impact of the adult benefit is especially strong for young adults ages 21-34, who have the highest number of dental-related ED visits among all adults. In the second year of the benefit, ED use decreased by 1.4 visits per 10,000 members among young adults, compared to the year prior to the benefit (a 6% decrease). However, the *relative* decrease is much greater when compared to children and youth, who already had dental coverage, and for whom dental-related ED use increased following the start of the new benefit. The difference-in-difference analysis suggests that absent the adult dental benefit, ED use among young adults would have been largely unchanged.

The analysis of an adult cohort continuously enrolled in Medicaid between January 2021 and June 2023 also provides evidence of the impact of the adult benefit. Among members who did not use the new benefit in the first year (July 2021 to June 2022), dental-related ED visits increased by 24%. Among those who had a claim for preventive dental care, ED visits were unchanged.

Some results provide less clear evidence of the impact of the adult dental benefit. For example, the number of dental-related ED visits increased overall for Virginia Medicaid members during the period of study, including for older adults (ages 35 and over) who are eligible for the adult dental benefit. These upward trends could be related to a number of factors. For example, overall ED use has been trending upward since the height of the COVID-19 pandemic in the first quarter of 2020, so it is possible that the overall increases in dental-related ED visits may be affected by these more general trends. Large increases in Medicaid enrollment during this period due to the Public Health Emergency may have increased prevalence of certain risk factors among Medicaid members that are correlated with ED use.

Also, health system issues external to Medicaid, such as outpatient provider supply and capacity constraints, could affect the likelihood of using EDs if members have difficulty getting appointments with outpatient providers.

It should also be noted that the majority of adult Medicaid members (70%) did not utilize the new dental benefit in the first year after it started, and only 12.5% utilized preventive dental services. Therefore, overall trends in dental-related ED use reflect in part this relatively low usage of the dental benefit during the first year, since ED use increased among those who did not use the benefit. This suggests that greater penetration of the new benefit among adults (i.e. more utilization of outpatient dental services) could have a greater impact on dental-related ED use in the future.

Nevertheless, there is strong evidence that young adults – who have the highest levels of ED use for dental problems -- are already benefitting from the adult benefit, both in terms of an absolute reduction in dental-related ED visits, and an even greater reduction in ED visits relative to children and youth. As these results reflect only the first two years of the benefit, it is likely that greater use of preventive and other outpatient dental services over time will result in even greater reductions in ED visits.

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Appendix A: ICD9 and ICD10 codes used to identify non-traumatic dental conditions for analysis.

ICD9_CODE	ICD10_CODE	ICD9 Desciption	ICD10 Description
5220	K0402	Pulpitis	Irreversible pulpitis
5289	K1370	Other and unspecified diseases of the oral soft tissues	Unspecified lesions of oral mucosa
52100	K02	Dental caries, unspecified	Dental caries
52460	M26601	Temporomandibular joint disorders, unspecified	Right temproromandibular joint disorder, unspecified
52300	K0500	Acute gingivitis, plaque induced	Acute gingivitis, plaque induced
52460	M2660	Temporomandibular joint disorders, unspecified	Temporomandibular joint disorder, unspecified
5249	M269	Unspecified dentofacial anomalies	Dentofacial anomaly, unspecified
52310	K051	Chronic gingivitis, plaque induced	Chronic gingivitis
5229	K0499	Other and unspecified diseases of pulp and periapical tissues	Other diseases of pulp and periapical tissues
78492	R6884	Jaw pain	Jaw pain
52460	M26602	Temporomandibular joint disorders, unspecified	Left termporomandibular joint disorder, unspecified
5285	K130	Diseases of lips	Disease of lips
	Z012	Dental examination	Encounter for dental examination and cleaning
V722	Z0120	Dental examination	Encounter for dental examination and cleaning without abnormal findings
5289	K134	Other and unspecified diseases of the oral soft tissues	Granuloma and granuloma-like mesions of oral mucosa
5220	K0401	Pulpitis	Reversible pulpitis
5289	K1379	Other and unspecified diseases of the oral soft tissues	Other lesions of oral mucosa
52879	K1324	Other disturbances of oral epithelium, including tongue	Leukokeratosis nicotina palati

	5289	K131	Other and unspecified diseases of the oral soft tissues	Cheek and lip biting
	52310	K0510	Chronic gingivitis, plaque induced	Chronic gingivitis, plaque induced
	52460	M26609	Temporomandibular joint disorders, unspecified	Unspecified TMJ joint disorder, unspecified side
	52300	K050	Acute gingivitis, plaque induced	Acute gingivitis
	5289	K13	Other and unspecified diseases of the oral soft tissues	Other diseases of lip and oral mucosa
	52460	M26603	Temporomandibular joint disorders, unspecified	Bilateral termporomandibular joint disorder, unspecified
	52460	M266	Temporomandibular joint disorders, unspecified	Temporomandibular joint disorders
V723		Z0121	Dental examination	Encounter for dental examination and cleaning with abnormal findings
V585		Z464	Orthodontics aftercare	Encounter for fitting and adjustment of orthodontic device
	5229	K0490	Other and unspecified diseases of pulp and periapical tissues	Unspecified diseases of pulp and periapical tissues
	52879	K1329	Other disturbances of oral epithelium, including tongue	Other disturbances of oral epithelium, including tongue
	5289	K136	Other and unspecified diseases of the oral soft tissues	Irritave hyperplasia of oral mucosa
	5289	K137	Other and unspecified diseases of the oral soft tissues	Other and unspecified lesions of oral mucosa
	5207	K007	Teething syndrome	Teething syndrome
	5220	K04	Pulpitis	Diseases of pulp and periapical tissues
	5299	K149	Unspecified condition of the tongue	Disease of tongue, unspecified
	5259	K089	Unspecified disorder of the teeth and supporting structures	Disorder of teeth and supporting structures, unspecified
	52451	M2651	Abnormal jaw closure	Abnormal jaw closure
	5220	K040	Pulpitis	Pulpitis
	52181	K0381	Cracked tooth	Cracked tooth
	52300	K05	Acute gingivitis, plaque induced	Gingivitis and periodontal diseases

5229	K049	Other and unspecified diseases of pulp and periapical tissues	Other and unspecified diseases of pulp and periapical tissues
5289	K133	Other and unspecified diseases of the oral soft tissues	Hairy leukoplakia

Appendix B: Difference-in-Difference Analysis

The difference-in-difference analysis was based on the following linear probability model:

DentED = age-grp + post_dental + (age-grp * post_dental) + time + gender_cat + race + region

DentED is a time and person-specific continuous variable for the number of dental-related ED visits.

age-group is a time and person-specific binary variable with 1 = 21-34; 0 = 20 or younger

post_dental is a binary variable with 1 = time periods following 7/1/21; 0 = time periods before 7/1/21

age_grp * post_dental is the difference and difference term.

Time refers to the 8 semi-annual time periods identified in the analysis

1 = July 2019 to Dec 2019
2 = Jan 2020 to June 2020
3 = July 2020 to Dec 2020
4 = Jan 2021 to June 2021
5 = July 2021 to Dec 2021
6 = Jan 2022 to June 2022
7 = July 2022 to Dec 2022
8 = Jan 2023 to July 2023

Gender_cat is a time and person-specific binary variable with 1=male; 0=female

Race is a time and person-specific variable with 1=NonHispanic Black; 2=Hispanic; 3=NonHispanic other; 4=NonHispanic White.

Region is a time and person specific variable for DMAS region, including categories for Central, Western/Charlottesville, Northern, Roanoke, Southwest, Tidewater, and Out-of-State regions.

The full model results are shown in Appendix Table 1 below.

Appendix Table 1. Full Results of linear probability model for difference in differences analysis

Variable	Coefficient	Std Error	Significance
Age Group			
Children: 0 - 20 yo	Reference		
Young Adults: 21 - 34 yo	0.0030	0.0001	0.000
Post Dental Benefit			
Pre-Policy Implementation	Reference		
Post-Policy Implementation	0.0004597	0.0000682	0.000
Young Adults X Post Policy	-0.0007481	0.0001025	0.000
Time			
July – Dec 2019	0.0006158	0.0000797	0.000
Jan – June 2020	-0.000067	0.0000731	0.359
July – Dec 2020	-0.0002217	0.0000701	0.002
Jan – June 2021	Reference		
July – Dec 2021	-0.00012	0.0000685	0.080
Jan – June 2022	-0.0003154	0.0000659	0.000
July – Dec 2022	8.76E-06	0.0000663	0.895
Jan – June 2023	Omitted due to multicollinearity		
Gender			
Female	Reference		
Male	-0.000204	0.0000378	0.000
Race			
NH White	Reference		
NH Black	0.0006597	0.0000466	0.000
Hispanic	-0.0003432	0.0000701	0.000
NH Other	-0.0013189	0.0000512	0.000
Eligibility Category			
Low Income Children	Reference		
Non-ABD Adults	0.0007391	0.0000912	0.000
Blind/ Disabled	0.0004349	0.0000908	0.000
Region			
Central	0.0007252	0.0000493	0.000
Western	0.0000531	0.0000573	0.354
Northern	Reference		
Out of State	-0.0005387	0.0001727	0.002
Roanoke	0.0012586	0.0000789	0.000
Southwest	0.0011017	0.0001018	0.000
Tidewater	0.0007139	0.0000537	0.000