Journal of Dental Research
2021, Vol. 100(9) 928–934

DOI: 10.1177/00220345211007448
journals.sagepub.com/home/jdr

Dental Services and Health Outcomes in the New York State Medicaid Program

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Abstract

Previous reports suggest that periodontal treatment is associated with improved health care outcomes and reduced costs. Using data from the New York State Medicaid program, rates of emergency department (ED) use and inpatient admissions (IPs), as well as costs for ED, IPs, pharmacy, and total health care, were studied to determine the association of preventive dental care to health care outcomes. Utilization of dental services in the first 2 y (July 2012–June 2014) was compared to health care outcomes in the final year (July 2014–June 2015). Costs and utilization for members who did not receive dental services (No Dental) were compared to those who received any dental care (Any Dental), any preventive dental care (PDC), PDC without an extraction and/or endodontic treatment (PDC without Ext/Endo), PDC with an Ext/Endo (PDC with Ext/Endo), or Ext/Endo without PDC (Ext/Endo without PDC). Propensity scores were used to adjust for potential confounders. After adjustment, ED rate ratios were significantly lower for PDC and PDC without Ext/Endo but higher for the Any Dental and Ext/Endo without PDC. IP ratios were lower for all treatment groups except Ext/Endo without PDC. ED costs differed little compared to the No Dental group except for Ext/Endo without PDC. For IPs, costs per member were significantly lower for all groups (−$262.91 [95% confidence interval (CI), −325.40 to −200.42] to −$379.82 [95% CI, −451.27 to −308.37]) except for Ext/Endo without PDC. For total health care costs, Ext/Endo without PDC had a significantly greater total health care cost ($530.50 [95% CI, 156.99–904.01]). Each additional PDC visit was associated with a 3% reduction in the relative risk for ED and 9% reduction for IPs. Costs also decreased for total health care (−$235.64 [95% CI, −299.95 to −171.33]) and IP (−$181.39 [95% CI, −208.73 to −154.05]). In conclusion, an association between PDC and improved health care outcomes was observed, with the opposite association for Ext/Endo without PDC.

Keywords: preventive dental care, dental infections, health care outcomes, health services, cost savings, populations at risk

Introduction

A large body of evidence has identified oral infection and the resulting inflammatory response as risk factors for certain noncommunicable chronic diseases (NCDs; Beck et al. 2019). Previous research has focused primarily on periodontitis (Chapple et al. 2013; Tonetti et al. 2013; Hegde and Awan 2019), but evidence also suggests that endodontic infection contributes to the oral disease burden that affects general health outcomes (Caplan et al. 2006; Petersen et al. 2014).

Following identification of the association of periodontal disease with an increased risk of certain NCDs, treatment studies sought to identify whether conservative periodontal treatment led to improved health care outcomes. Often surrogate markers for disease status were evaluated, demonstrating improvement with conservative therapy (Teeuw et al. 2014; Teshome and Yitayeh 2016; Baeza et al. 2020). Subsequently, studies analyzing commercial insurance data have examined the association of conservative periodontal treatment and medical outcomes and expenditures for persons with noncommunicable chronic diseases (Jeffcoat et al. 2014; Nasseh et al. 2017; Smits et al. 2020). These reports found improved health care outcomes and reduced health care costs when periodontal treatment was provided. Nevertheless, the initial report (Jeffcoat et al. 2014) has been challenged based on concerns about methodology, including the definition of cases and controls, the treatment provided, differences in the size of the

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groups, and lack of definition of disease severity (Sheiham 2015).

In this study, New York State (NYS) Medicaid data were used to examine the relationship between receipt of dental services and all-cause emergency department (ED) visits and inpatient admissions (IPs), as well as ED, IP, pharmacy, and total health care costs within an adult Medicaid population. Medicaid is a state and federally sponsored health care program for low-income individuals. Analysis of the NYS Medicaid program offers distinct advantages since it has one of the most extensive adult dental benefit packages of any Medicaid program in the United States. In addition, with approximately 4 million adult members, the NYS Medicaid population is large, is racially and ethnically diverse, and has a high prevalence of comorbidities and oral disease. The aim of this study was to determine if preventive dental care was associated with improved health outcomes in a publicly insured population. The hypothesis was that receiving preventive dental care is associated with reduced ED and IP utilization, as well as reduced health care costs.

Methods

A retrospective cohort analysis was conducted using NYS Medicaid fee-for-service (FFS) claim and Medicaid managed care encounter data from July 1, 2012, through June 30, 2015. The eligible population included adults 40 to 62 y of age as of July 1, 2012, who remained enrolled in Medicaid throughout the 2102 to 2015 study period. The age range was selected so that in year 3, the maximum age of participants would be 64 y. In the United States, Medicare health coverage generally begins at 65 y of age, and in NYS Medicaid, there are just under 1 million members who are eligible for both Medicaid and Medicare (referred to as "dual eligibles"). Since inpatient and emergency department utilization is paid for by Medicare, these transactions for dual eligibles will not be in NYS Medicaid claim and encounter data. Therefore, dual eligibles were excluded from this study. Pregnant women (n = 12,565), residents of nursing homes or other institutionalized settings (n = 20,067), or members meeting both criteria (n = 482) were also excluded from this study. The study protocol was submitted to the NYS Department of Health (NYSDOH) Institutional Review Board, which determined the study did not qualify as research involving human subjects. This study followed RECORD guidelines (https://record-statement.org/checklist.php).

The comparison of outcomes of interest was based on utilization of dental services from July 1, 2012, to June 30, 2014. Members with Any Dental care,[1] any preventive dental care[2] (PDC), preventive dental care without an extraction and/or endodontic treatment[3] (PDC without Ext/Endo), preventive dental care and an extraction and/or endodontic treatment (PDC and Ext/Endo), and an extraction and/or endodontic treatment without preventive dental care (Ext/Endo without PDC) were compared to members who did not receive dental services. Procedure codes for dental services were used to assign members to a dental utilization group. Assignment to the groups was not mutually exclusive. Outcomes in year 3 (July 1, 2014–June 30, 2015) included rate of all-cause ED visits, rate of all-cause IP admissions, and the average cost per member of ED, IPs, pharmacy, and adjusted total health care (total costs minus dental costs). Costs were defined as the sum amount paid across Medicaid FFS and Medicaid managed care (MMC) programs.

Demographic variables included age group, race/ethnicity, sex, region of residence, receipt of cash assistance from NYS (cash), receipt of supplemental security income (SSI), and the type of Medicaid coverage program[4] (MMC or FFS). The inclusion of cash assistance serves as a proxy for socioeconomic status within Medicaid. Medicaid data were also used to determine the number of months of Medicaid enrollment prior to July 1, 2012; eligibility for long-term care (LTC) services[5]; obtainment of an annual well-visit (AWV[6]) as a proxy for medical adherence; attribution to a patient-centered medical home (PCMH) recognized by the National Committee for Quality Assurance (NCQA); and enrollment in a NYS Health Home. PCMHs provide coordinated and integrated care while members in Health Homes have chronic and/or behavioral health needs. Both groups may have better access to dental care and different health care utilization and costs.

The health status of each member was determined using Clinical Risk Group (CRG) assignments made by NYS Medicaid using 3M Clinical Risk Grouping software (3M 2019) and Medicaid claims and encounter data (including diagnoses, procedures, and prescription medications). Since CRG assignments are updated semiannually, the first available assignment during the study period was used. Serious mental illness (SMI) was identified using Episode Diagnostic Categories (EDCs) from 3M's CRG algorithms in combination with diagnosis codes (NYSDOH 2017). Substance use disorders (SUDs)[7] were identified using diagnostic and procedural code data.

All-cause ED and IP rates were compared among dental utilization groups using a negative binominal regression model. ED, IP, and adjusted total costs were analyzed using a linear model. Pharmacy costs were examined using a marginal zero-inflated Poisson model due to the large number of members with no pharmacy costs and the associated severe zero inflation.

To minimize confounding, a propensity score was calculated using logistic regression modeling and entered as an independent variable in the above analyses. Specifically, logistic regression models were used to generate propensity scores for each member within a dental utilization category based on the independent variables found in Table 1. Variables were selected using a stepwise approach and retained if significant ($P \leq 0.05$). Propensity scores were then used to adjust for the associations between dental utilization category and outcomes.

In addition, year 3 outcomes were analyzed for possible trends (a "dose response") with respect to number of PDC visits in the previous 2 y. Members with more than 4 PDC visits within 2 y (n = 4,233), were recoded as 4 to examine possible trends while addressing the concern of outlying values that

Table 1. Univariate Demographics of the Cohort (*N* = 518,689).

Demographics	*n*	%
Age (end of study), y		
42–52	250,762	48.4
53–64	267,927	51.7
Race/ethnicity		
White, non-Hispanic	129,258	24.9
Black, non-Hispanic	90,913	17.5
Hispanic	108,356	20.9
Other	113,239	21.8
Unknown	76,923	14.8
Sex		
Male	219,501	42.3
Female	299,188	57.7
Region		
Rest of state	160,604	31.0
New York City	358,085	69.0
Program		
Fee-for-service	16,986	3.3
Managed care	501,703	96.7
Months enrolled prior to study		
Mean	62	
Standard deviation	28.2	
Clinical Risk Group		
0 = Healthy nonuser	27,419	5.3
1 = Healthy	63,719	12.3
2 = Significant acute	15,557	3.0
3 = Single minor chronic	34,202	6.6
4 = Minor chronic in multiple organ systems	17,281	3.3
5 = Single dominant or minor chronic	108,778	21.0
6 = Chronic in multiple organ systems	208,822	40.3
7 = Dominant chronic in 3+ organ systems	17,566	3.4
8 = Dominant metastatic malignancies	3,198	0.6
9 = Catastrophic conditions	22,147	4.3
Long-term care		
No	508,975	98.1
Yes	9,714	1.9
Annual well visit		
No	255,595	49.3
Yes	263,094	50.7
Serious mental illness		
No	361,111	69.6
Yes	157,578	30.4
Substance use disorder		
No	440,714	85.0
Yes	77,975	15.0
Cash assistance		
No	353,859	68.2
Yes	164,830	31.8
Supplemental security income		
No	392,976	75.8
Yes	125,713	24.2
Patient-centered medical home		
No	363,414	70.1
Yes	155,275	29.9
Health Home		
No	499,091	96.2
Yes	19,598	3.8

may violate model assumptions. As above, dose-response trends in ED and IP rates were analyzed using a negative binomial model; costs for ED, IPs, and adjusted total health care had a linear model; and pharmacy costs used a marginal zero-inflated Poisson model. All variables in Table 1 were used in propensity score weighting. Individual variables were included in the modeling to determine the change associated with each additional PDC visit. All analyses were conducted in SAS version 9.4 (SAS Institute).

Table 2. Dental Service Categories in Years 1 and 2 (*N* = 518,689).

Dental service Categories[a]	*n*	%
No dental	236,668	45.6
Any dental	282,021	54.4
Any preventive care	215,188	76.3
Preventive care without Ext/Endo services	149,871	69.2
Preventive care and Ext/Endo services	65,317	30.4
Ext/Endo services without preventive care	29,288	10.4

Endo, endodontic; Ext, extraction.
[a]Dental service categories are not mutually exclusive.

Results

A total of 518,689 members met the inclusion criteria (Table 1). Slightly more than half (51.7%) were between the ages of 53 and 64 y, and more than half were female (57.7%). In terms of race/ethnicity, 24.9% of the cohort were White, non-Hispanic, followed by 20.9% Hispanic and 17.5% Black, non-Hispanic. More than two-thirds lived in New York City (69.0%) and had an average of 62 mo of Medicaid enrollment prior to the study, and 96.7% were enrolled in an MMC plan. Nearly one-third (31.8%) received cash assistance from NYS, and 24.2% received SSI.

The population presented with a heavy burden of disease, as nearly two-thirds (64.6%) of the cohort were classified as having a single diagnosis or multiple diagnoses of chronic disease based on CRG categorization of 4, 5, or 6. In addition, 30.4% were diagnosed with serious mental illness, and 15.0% had a substance use disorder. Approximately half of the cohort had an AWV (50.7%) while less than 2% were eligible to receive LTC services. Approximately one-third (29.9%) were attributed to an NCQA-recognized PCMH provider, and 3.8% were enrolled in a NYS Health Home.

Slightly more than half of the study population had at least 1 dental service in the first 2 y (54.4%). Of those, 76.3% had at least 1 PDC (69.2% PDC without Ext/Endo, 30.4% PDC and Ext/Endo). A smaller percentage of those who received dental services (10.4%) had Ext/Endo without a PDC visit (Table 2).

All-cause ED and IP unadjusted and adjusted rate ratios in study year 3 were calculated for each of the dental groups (Table 3). After adjustment, ED rate ratios were significantly lower in the PDC without Ext/Endo group compared to the No Dental group (0.97 [95% confidence interval (CI), 0.95–0.98]). Conversely, the Any Dental (1.03 [95% CI, 1.02–1.04]) and Ext/Endo without PDC (1.16 [95% CI, 1.13–1.19]) groups had significantly higher ED rate ratios. However, except for the Ext/Endo without PDC group, IP rate ratios were significantly lower for all treatment groups compared to the No Dental group. Overall, after adjustment, the rate ratios were reduced

Table 3. All-Cause Emergency Department Visit and Inpatient Utilization Unadjusted and Adjusted Rate Ratios (Year 3).[a]

Outcome	Unadjusted	Adjusted	95% CI
Emergency department visits			
Any dental vs. no dental	1.06	1.03	1.02–1.04
Any preventive care vs. no dental	0.92	0.98	0.97–1.00
Preventive care without Ext/Endo vs. no dental	0.84	0.97	0.95–0.98
Preventive care and Ext/Endo vs. no dental	1.10	1.01	0.99–1.03
Ext/Endo without preventive care vs. no dental	1.56	1.16	1.13–1.19
Inpatient admissions			
Any dental vs. no dental	0.93	0.92	0.90–0.94
Any preventive care vs. no dental	0.77	0.87	0.85–0.89
Preventive care without Ext/Endo vs. no dental	0.69	0.86	0.84–0.89
Preventive care and Ext/Endo vs. no dental	0.97	0.89	0.86–0.92
Ext/Endo without preventive care vs. no dental	1.44	1.03	0.99–1.08

Endo, endodontic; Ext, extraction.
[a]Adjusted rate ratios refer to after adjustment by propensity score using regression modeling.

Table 4. Unadjusted Differences and Adjusted Differences in Average Cost per Member by Outcome.

Outcome	Unadjusted	Adjusted	95% CI
Emergency department			
Any dental vs. no dental	$13.96	$6.75	0.69 to 12.81
Any preventive care vs. no dental	−$17.86	−$1.86	−8.33 to 4.61
Preventive care without Ext/Endo vs. no dental	−$34.08	−$3.97	−11.32 to 3.38
Preventive care and Ext/Endo vs. no dental	$19.36	$2.39	−5.70 to 10.47
Ext/Endo without preventive care vs. no dental	$127.03	$33.47	22.06 to 44.87
Inpatient admissions			
Any dental vs. no dental	−$261.54	−$262.91	−325.40 to −200.42
Any preventive care vs. no dental	−$564.62	−$354.09	−418.80 to −289.38
Preventive care without Ext/Endo vs. no dental	−$737.30	−$379.82	−451.27 to −308.37
Preventive care and Ext/Endo vs. no dental	−$168.42	−$304.64	−406.03 to −203.25
Ext/Endo without preventive care vs. no dental	$653.93	−$55.63	−200.39 to 89.13
Pharmacy[a]			
Any dental vs. no dental	0.97	15.97	15.90 to 16.04
Any preventive care vs. no dental	0.74	35.11	34.96 to 35.27
Preventive care without Ext/Endo vs. no dental	0.80	29.92	29.79 to 30.05
Preventive care and Ext/Endo vs. no dental	1.10	0.89	0.89 to 0.90
Ext/Endo without preventive care vs. no dental	1.43	6.30	6.27 to 0.00
Total adjusted health care			
Any dental vs. no dental	$351.59	$71.41	−89.87 to 232.68
Any preventive care vs. no dental	−$796.94	−$81.94	−251.48 to 87.60
Preventive care without Ext/Endo vs. no dental	−$1,504.12	−$159.01	−348.18 to 30.16
Preventive care and Ext/Endo vs. no dental	$825.69	$73.40	−190.57 to 337.36
Ext/Endo without preventive care vs. no dental	$3,190.04	$530.50	156.99 to 904.01

Endo, endodontic; Ext, extraction.
[a]Estimated relative risk associated with specified dental services compared to no dental services.

for all-cause IPs as compared to all-cause ED, particularly among members who received PDC.

Although a significant reduction in ED rates was observed in some treatment groups (Table 3), average ED cost differences were small and mostly not statistically significant compared to the No Dental group (Table 4). Average ED costs per member were significantly higher for the Any Dental and Ext/Endo without PDC ($6.75 [95% CI, 0.69–12.81] and $33.47 [95% CI, 22.06–44.87], respectively) groups versus the No Dental group. For IPs, average costs per member were significantly lower for all groups compared to No Dental group, ranging from −$262.91 (95% CI, −325.40 to −200.42) to −$379.82 (95% CI, −451.27 to −308.37), except for the Ext/Endo without PDC group. Compared to the No Dental group, the adjusted average pharmacy costs per member showed small but significant increases for all treatment groups except Ext/Endo without PDC. For average total adjusted health care costs, the Ext/Endo without PDC group had significantly greater average total health care cost per member of $530.50 (95% CI, 156.99–904.01).

The number of PDC visits in years 1 and 2 was associated with all-cause ED and IP utilization in year 3 (Table 5). For each additional PDC visit, there was a 3% reduction in the relative risk for ED and a 9% reduction in the risk for IPs. For each

Table 5. Unadjusted and Adjusted Relative Risk and Average Costs for Each Additional Preventive Care Visit in Previous 2y ($N = 518,689$).[a]

Outcome	Unadjusted	Adjusted	95% CI
Utilization relative risk			
Emergency department	0.90	0.97	0.96 to 0.97
Inpatient admissions	0.83	0.91	0.90 to 0.92
Average costs per member			
Emergency department	−$22.56	−$7.58	−10.23 to −4.92
Inpatient admissions	−$336.48	−$181.39	−208.73 to −154.05
Pharmacy	1.01[b]	1.01	1.01 to 1.01
Total adjusted health care	−$739.82	−$235.64	−299.95 to −171.33

[a]Estimate based on truncated version and hence may overestimate the true slope.
[b]Estimated relative risk associated with every 1 PDC visit increase.

additional PDC visit, all average costs were significantly reduced, being most pronounced for total health care (−$235.64 [95% CI, −299.95 to −171.33]) and IPs (−$181.39 [95% CI, −208.73 to −154.05]).

Discussion

This is the first comprehensive study examining the association of specific dental services and ED and IP utilization and health care costs in a publicly insured population. Medicaid members have a heavy disease burden, as evidenced by over 60% of the individuals in this study having at least 1 chronic disease. In addition, more than 20% of those who received dental services had an extraction and/or endodontic therapy, signaling the presence of advanced oral infection. The analysis demonstrated significantly lower ED and IP utilization and health care costs for adults with the provision of dental care services, specifically PDC, compared to members without dental care services. Lower rates of utilization and average cost per member were found for IPs, particularly among members who received PDC services. Furthermore, each additional PDC visit in years 1 and 2 was shown to be associated with significantly lower relative risk for ED and IP utilization and average reduction in cost per member for ED, IP, and total health care costs in the following third year. In contrast, the need for Ext/Endo without PDC was generally associated with higher rates and costs.

Previously published studies have reported beneficial effects of preventive dental care on health care outcomes but with limited adjustment for potential confounders (Jeffcoat et al. 2014; Nasseh et al. 2017). A recent study examined a Dutch cohort of individuals with diabetes who were insured by a private insurance company. Receiving periodontal treatment was associated with reduced diabetes-associated health care expenditures (Smits et al. 2020). When considering the association of preventive dental care with reduced costs, it is interesting to observe that relatively greater decreases in utilization and costs were seen for inpatient admissions as compared to ED visits. Nearly two-thirds of the members in this study presented with at least 1 chronic disease, and hospital costs are the primary driver of total health care costs for persons with chronic diseases, accounting for two-thirds of expenditures (Joo and Liu 2017).

The relationship between the provision of preventive dental care with improved health care outcomes can be challenging to define. Clinical studies indicate that dental treatment, specifically conservative periodontal therapy, can have a beneficial effect on outcomes associated with certain chronic diseases. Conservative periodontal treatment has been associated with a reduction in glycated hemoglobin in persons with diabetes (Teshome and Yitayeh 2016; Baeza et al. 2020), and periodontal treatment has led to improved cardiovascular markers, including endothelial cell function and biochemical markers of atherosclerosis (Teeuw et al. 2014). A logical extension of these studies is that removal of the periodontal biofilm will reduce the local inflammatory burden and ultimately the systemic burden (Fedele et al. 2011; Carrizales-Sepulveda et al. 2018; Furman et al. 2019), eventually leading to improved health care outcomes. This study supports this hypothesis by demonstrating the association of PDC, which is focused on removal of the periodontal biofilm, with reduced ED and IP utilization and costs. Cause and effect, however, cannot be determined from this analysis.

An alternate hypothesis argues that individuals who seek preventive dental care also lead a healthier lifestyle, including eating a healthier diet, being physical active, and avoidance of smoking, which may in turn contribute to reduced health care utilization rates and costs (Doughty et al. 2017; Ruegsegger and Booth 2018). It is important to note, however, that in this study, annual well visits were included in the propensity score as a confounder. Furthermore, the propensity scores that were generated included consideration of the CRG classification of all members. Therefore, the health status of all individuals in this study was included as a potential confounding variable.

Additional strengths of this study include the size and diversity of the cohort, inclusion of members both with and without NCDs, and propensity score weighting to control for many potential confounding variables that may bias estimates of the association between dental care services and health care utilization and costs. This research used an existing database, and as such, all relevant and available variables were considered. However, data regarding diet, smoking history, and

weight/body mass index were not available. Furthermore, dental claims and encounter data lack dental diagnostic codes to determine the nature of the oral disease.

To ensure a comprehensive analysis representative of the scope of dental services in NYS Medicaid, the entire group of individuals who received any dental services in the initial 3-y period (Any Dental care) was evaluated. This group demonstrated modestly lower improvement in rates and costs, but not as pronounced as groups defined specifically with PDC. This was expected since 75% of the Any Dental group received PDC. Furthermore, we examined the effect of receiving restorative dental care on health outcomes, but no associations were seen (data not shown).

NYS Medicaid provides health care coverage for over 6 million New Yorkers, with an annual budget of more than $76 billion (NYS Division of the Budget 2020). The findings reported here suggest the possibility of both improved health care outcomes and significant savings associated with the provision of dental services to a publicly insured population with heavy systemic disease burden. Considering the morbidity and mortality associated with chronic diseases (Chapel et al. 2017), integration of dental care into new models of care for persons with a heavy burden of disease should be considered (Milani and Lavie 2015; Southerland et al. 2016; Lamster and Myers-Wright 2017).

In conclusion, we observed that accessing preventive dental care by a large cohort of publicly insured individuals in New York State was associated with better health care outcomes, most notably for the rates and costs of inpatient admissions. This association was not observed when a dental extraction or endodontic therapy, both indicative of a severe dental infection, was performed. These findings are intriguing and should generate further investigation into these associations.

Author Contributions

I.B. Lamster, contributed to conception, design, data acquisition, analysis, and interpretation, drafted and critically revised the manuscript; K.P. Malloy, contributed to conception, design, data acquisition, analysis, and interpretation, critically revised the manuscript; P.M. DiMura, B. Cheng, contributed to design, data acquisition, analysis, and interpretation, critically revised the manuscript; V.L. Wagner, J. Matson, A. Proj, S.N. Abel, contributed to conception, and data interpretation, critically revised the manuscript; Y. Xi, contributed to data acquisition and analysis, critically revised the manuscript; M.C. Alfano, contributed to conception and data interpretation, critically revised the manuscript. All authors gave final approval and agree to be accountable for all aspects of the work.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This research was supported in part by the John A. Hartford Foundation, the Santa Fe Group, and the DentaQuest Foundation.

Notes

1. Identified using all 2016 dental *Current Procedural and Terminology* (*CPT*) codes.
2. Preventive dental care defined as having a record of receiving prophylaxis (D1110), maintenance (D4910), or nonsurgical periodontal therapy (D4341–D4342).
3. Extraction and/or endodontic treatment defined as having received endodontic procedures (D3310–D3999) or dental extractions (D7140–D7250).
4. Based on majority of enrollment months, not continuous enrollment.
5. Evidence of eligibility for noninstitutional LTC services, home health care, intermediate care facilities for individuals with intellectual disability services, or home- and community-based services for 4 consecutive months during the study.
6. *CPT* codes: 99385, 99386, 99387, 99395, 99396, 99397.
7. From the NYSDOH Medicaid Clinical Datamart based on qualification for Identification of Alcohol and Other Drugs (IAD) HEDIS measure for calendar years 2012, 2013, and 2014.

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