American Journal of
Preventive Medicine

RESEARCH ARTICLE

Overprescribing of Opioids to Adults by Dentists in the U.S., 2011–2015

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Introduction: Dentists prescribe 1 in 10 opioid prescriptions in the U.S. When opioids are necessary, national guidelines recommend the prescription of low-dose opioids for a short duration. This study assesses the appropriate prescribing of opioids by dentists before guideline implementation.

Methods: The authors performed a cross-sectional analysis of a population-based sample of 542,958 U.S. commercial dental patient visits between 2011 and 2015 within the Truven Health MarketScan Research Databases (data analysis October 2018–April 2019). Patients with recent hospitalization, active cancer treatment, or chronic pain conditions were excluded. Prescription opioids were ascertained using pharmacy claims data with standardized morphine equivalents and recorded days' supply. Appropriate prescribing was determined from the 2016 Centers for Disease Control and Prevention guidelines for pain management based on a recommended 3 days' supply of opioid medication and anticipated post-procedural pain.

Results: Twenty-nine percent of prescribed opioids exceeded the recommended morphine equivalents for appropriate management of acute pain. Approximately half (53%) exceeded the recommended days' supply. Patients aged 18–34 years, men, patients residing in the Southern U.S., and those receiving oxycodone were most likely to have opioids prescribed inappropriately. The proportion of opioids that exceed the recommended morphine equivalents increased over the study period, whereas opioids exceeding the recommended days' supply remained unchanged.

Conclusions: Between 1 in 4 and 1 in 2 opioids prescribed to adult dental patients are overprescribed. Judicious opioid-prescribing interventions should be tailored to oral health conditions and dentists.

INTRODUCTION

Dentists prescribe 1 in 10 opioids in the U.S. and are one of the top prescribers (12%) after family physicians (15%).[1–3] Relative to other nations with similar dental care practices, the proportion of prescriptions written by U.S. dentists for opioids is approximately 37 times higher.[4]

Most of the postoperative dental pain is acute in nature and accompanied by tissue injury and inflammation. Per the American Dental Association, nonopioid analgesics such as nonsteroidal anti-inflammatory drugs should be considered the drug of choice for acute routine

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0749-3797/$36.00
https://doi.org/10.1016/j.amepre.2019.11.006

pain management.[5] Inconsistent with this guidance, dentists frequently recommend and prescribe opioids over nonsteroidal anti-inflammatory drugs; the most frequently prescribed analgesic for managing pain after third-molar extractions are opioid combinations (e.g., hydrocodone/acetaminophen).[6–8]

From 1996 through 2015, dental opioids increased significantly.[9,10] Urgent attention and evidence-based guidance are needed to address the ensuing opioid epidemic. As one of the top prescribers of these medicines with a high potential for misuse, dentists have an opportunity to contribute to curbing this public health crisis. The aim of this study is to determine the extent to which opioids following dental visits exceed current guidance on the acute management of dental procedure-related pain. The 2016 Centers for Disease Control and Prevention (CDC) guidelines for pain management recommend limiting opioids to a 3 days' supply for most patients with acute pain. This is the largest study of U.S. commercial dental plan visits describing the overprescribing of opioids.

METHODS

A cross-sectional analysis was conducted of a retrospective cohort of adults receiving dental care from 2011 to 2015 at 1 or more visits in the Truven Health MarketScan Commercial Claims and Encounters, Medicare Supplemental, and Coordination of Benefits Research Databases. This national sample of patients receiving outpatient medical, hospital, and prescription coverage is representative of the commercially insured U.S. population.[11–14] Dental visits included in this study were a convenience sample of 8 million people with enrollment in health plans covering medical and dental visits and prescriptions.[15] Information available at the patient level includes age, sex, inpatient and outpatient diagnoses (per ICD-9/10), medical procedures (per Current Procedural Terminology and Healthcare Common Procedure Coding System claims), dental procedure claims (Comprehensive Dental Terminology [CDT]), and prescription dispensings. This study followed the STROBE reporting guideline. The University of Illinois at Chicago IRB determined this study to be exempt from review and informed consent.

Study Population

More than 1.4 million dental visits were identified among adult patients aged ≥18 years that concurrently had a new prescription for opioid-containing analgesics on the same date of service. Patients receiving dental services were also required to have 12 months of prior continuous enrollment in their health plan, including medical and prescription drug benefits. Dental visit CDT codes were aggregated into categories per a standardized coding structure established by the American Dental Association. Because multiple CDTs could be coded for a visit, the analyses assessed visits with a specific CDT category compared with visits without the CDT category. For all the analyses, ICD-9s before October 1, 2015 were converted to ICD-10 per CDC guidance.[16]

To restrict the study population to patients with opioid prescriptions provided by a dentist, the following validated exclusion criteria were applied: (1) medical provider visit occurring within 7 days prior; (2) patients with any hospice encounter in the last year[17]; (3) any baseline diagnoses for chronic pain conditions, sickle cell disease or trait, and same-day diagnosis of oral pain[18–21]; and (4) cancer patients receiving chemotherapy within 30 days before the dental visit.[22,23] Dental visits with recurrent opioids were further restricted to incident opioid analgesic use excluding prescriptions identified to be refilled or reissued.[24,25] Liquid opioid medications and those missing quantity or strength of the medication dispensed were excluded[26] (Appendix Figure 1, available online).

Measures

Information on dispensed opioids was determined from automated pharmacy claims, including the name, strength, metric quantity, and days' supply documented in the prescription claim. The potency of different opioid agents was standardized using morphine milligram equivalents (MMEs).[27] Visits associated with multiple opioid dispensing on the same date of a dental visit (n=2,008) were similarly converted to MMEs and combined to assess study outcome measures.

Historical data were evaluated to determine if opioid prescriptions concurrent with dental visits were consistent with appropriate acute pain management using 2 approaches. First, the 2016 CDC recommendations for acute pain management were utilized as the definition for dental visit-related pain, defined as the prescribing of no more than 10 mg of hydrocodone/acetaminophen tablets every 6 hours for 3 days.[28] The maximum quantity of this definition (12 tablets) was converted to MMEs, a threshold of no more than 120 MMEs. Of note, the CDC guidelines[28] were published after the study period. Dental visits with prescription opioids were categorized as whether or not they exceed this MME-defined threshold. This definition is referred to as the "MME-based definition" throughout.

Second, using the same CDC guidance, an expert panel from the American Dental Association and a clinical consensus of medical providers and dentists, the appropriate analgesia for post-procedural pain using opioids was defined as 3 days.[5,28] The days' supply documented in the prescription data was used to identify opioids exceeding this amount irrespective of specific opioid agents (e.g., hydrocodone, codeine). This definition is referred to as the "days' supply definition" throughout.

Multiple sensitivity analyses were performed, varying the criteria for appropriate opioid prescribing within a plausible range under less conservative conditions. Given that the CDC guideline[28] was published after the study period (2011–2015), sensitivity analyses were conducted varying the definition of opioid overprescribing based on recommendations available in the dental literature during the study period.[29] The first definition was based on the maximum recommendation in the dental literature limiting opioids to a 2 days' supply. The second definition stratified the anticipated pain from post-dental procedure(s) into severe (e.g., bony impaction surgery), moderate (e.g., tooth implants), and minimal (e.g., routine endodontics). Only the visits anticipating severe or moderate pain were recommended to receive opioids with a 2 days' supply (or 80 MMEs) and 1 day's supply (or 40 MMEs), respectively.[29] Oral pain may occur before a dental visit (and may be the reason for the visit)

or after the dental visit because of complications. Thus, a sensitivity analysis broadened the range of days between the opioid prescription date and the dental visit to 7 days before or after the visit (versus only same-day prescriptions). Because dental visits occurring close to each other are typically connected (e.g., a tooth requiring extraction is identified at one visit but is extracted at a second visit), all dental visits occurring within 7 days of each other were combined into a single observation, or an "episode of care," similar to previously established methods.[30] In the sensitivity analysis, clustering visits into episodes of care excluded 5,393 visits. A subanalysis considered federal regulatory changes that occurred over the study period; hydrocodone was rescheduled in October 2014 from Schedule III to Schedule II (not allowing telephone/e-prescribing, refills, and >30-day supply).[31] For the 3 most common opioids prescribed (hydrocodone, oxycodone, codeine), trends in days' supply and number of tablets or capsules dispensed per prescription were described.

Statistical Analysis

The characteristics of dental visits meeting the study criteria were collected from the Truven database from 2011 to 2015. In addition, information was collected on the specific dental procedures attributed by CDT codes, previsit medical conditions, and healthcare utilization, including services received from primary care and specialist providers. The data analysis occurred between October 2018 and April 2019. Missing data (222 observations) were included in the analysis and labeled in the multivariable analysis as unknown. The medians of continuous variables were compared using the Wilcoxon rank-sum test. Categorical variables were compared between groups using the chi-squared test. Multivariable generalized estimating equations were used to model the association between patient and visit characteristics and dental visit opioid prescribing. Covariates significant in the univariate analysis were included in the multivariable model. AORs and robust 95% CIs were calculated for characteristics associated with inappropriate prescribing of opioids using a first-order autoregressive matrix to account for the correlation of multiple visits.[32] Marginal effects were estimated for each explanatory variable at the mean value of other variables in the model. Multicollinearity was assessed with the variance inflation factor and eigenvalues. SAS, version 9.4 was used for all the analyses. A priori hypothesis tests were performed with a two-tailed α level of 0.05. Findings were considered statistically significant at $p<0.001$ to account for up to 50 multiple comparisons and maintain a family-wise Type I error rate of 0.05, following the approach of Bonferroni.[33]

RESULTS

The sample included a total 542,598 dental visits, wherein 48% of patients were female and had a median age of 46 (IQR=33–56) years (Table 1). More than 70% of the dental visits were located in the Southern (44%) and Midwestern (27%) U.S. Half of the dental visits had diagnostic (50%) or oral and maxillofacial surgery (53%) dental procedure codes. Interestingly, 29.6% of opioids were prescribed when the pain intensity post-dental procedure was expected to be mild (Table 1).

Using the MME-based definition, 29.3% of dental visits had a concurrent opioid exceeding the recommendation (Table 1). When comparing visits where the recommended MMEs were exceeded to those that did not, the visits with overprescribing occurred most frequently in men and in younger patients (median age, 43 and 47 years). Visits where the recommended MMEs were exceeded were more likely in patients who were male, aged 18–34 years, and residing in the South than in those who received appropriate opioids. The 2 groups differed regarding the dental procedures received. The MME exceeding group had fewer patients with a diagnostic visit and more patients with an oral/maxillofacial surgery visit. Anticipated post-procedural pain post-dental visit was categorized as severe more frequently in the MME exceeding group and less frequent when the anticipated pain was categorized as mild. Overall, the prescribed opioids were primarily hydrocodone-containing agents (76%), followed by codeine (12%) and oxycodone (10%). The use of these agents differed significantly between groups. In the MME exceeding group, 23% received oxycodone and 4% received codeine compared with 4% oxycodone and 15% codeine in the group that did not exceed the MME threshold ($p<0.001$ for both).

In generalized estimating equation models (Table 2), the highest odds of receiving opioids exceeding the recommended MMEs for acute dental pain were in patients who were male, aged 18–34 years versus 45–54 years, and in those prescribed oxycodone versus hydrocodone. In comparison to the Midwest, the Northeast and West had lower odds of exceeding the recommended MMEs, whereas the South had higher odds. Opioid overprescribing was more common in those with prosthetic joint implants and immunocompromised conditions[34] compared with those without these conditions and less common in individuals with a documented history of prior substance use. Dental visits with mildly invasive dental procedures (restorative, prosthodontics) had higher odds of opioid overprescribing compared with routine dental visits (diagnostic, preventive, adjunctive, orthodontics). Interestingly, the odds of overprescribing significantly increased from 2011 through 2015. With other covariates held constant at their respective mean values, the model-based predicted probabilities indicated that overprescribing would decrease by >20% if oxycodone was substituted with lower-potency opioids (hydrocodone marginal effects, −22.0, 95% CI= −11.4%, −50.0%; codeine, −32.3, 95% CI= −9.4%, −50.0%).

When defining the appropriate use of opioids according to a documented days' supply (Table 3), 53% of dental visits (30% in mild pain intensity visits) exceeded the recommended days' supply. However, there were fewer differences between groups. Patients who received a

Table 1. Descriptive Characteristics of Dental Visits With Concurrent Opioid Prescriptions by Excess of Morphine Equivalents

Characteristic	Total (N=542,958) *n* (%)	Exceeding the recommended morphine equivalents (*n*=159,063) *n* (%)	Within the recommended morphine equivalents (*n*=383,895) *n* (%)	*p*-value
Age, years				
Median (IQR)	46 (33–56)	43 (29–55)	47 (29–55)	**<0.001**
18–34	154,241 (28.4)	56,003 (35.2)	98,238 (25.6)	**<0.001**
35–44	99,545 (18.3)	28,472 (17.9)	71,073 (18.5)	
45–54	125,622 (23.1)	33,613 (21.1)	92,009 (24.0)	
55–64	121,491 (22.4)	31,473 (19.8)	90,018 (23.4)	
≥65	42,059 (7.7)	9,502 (6.0)	32,557 (8.5)	
Female sex	261,235 (48.1)	73,937 (46.5)	187,298 (48.8)	**<0.001**
Year of dental service				
2011	104,697 (19.3)	31,304 (19.7)	73,393 (19.1)	**<0.001**
2012	121,821 (22.4)	35,480 (22.3)	86,341 (22.5)	
2013	109,169 (20.1)	31,320 (19.7)	77,849 (20.3)	
2014	112,444 (20.7)	31,885 (20.0)	80,559 (21.0)	
2015	94,827 (17.5)	29,074 (18.3)	65,753 (17.1)	
U.S. Census Bureau region[a]				
Northeast	73,263 (13.5)	18,219 (11.5)	55,044 (14.3)	**<0.001**
Midwest	148,031 (27.3)	40,981 (25.8)	107,050 (27.9)	
South	238,756 (44.0)	74,149 (46.6)	164,607 (42.9)	
West	82,686 (15.2)	25,657 (16.1)	57,029 (14.9)	
Dental procedure classification[b]				
Diagnostic	269,138 (49.6)	72,386 (45.5)	196,752 (51.3)	**<0.001**
Preventive	17,809 (3.3)	5,352 (3.4)	12,457 (3.2)	0.024
Restorative	63,077 (11.6)	15,159 (9.5)	47,918 (12.5)	**<0.001**
Oral and maxillofacial surgery	289,999 (53.4)	98,915 (62.2)	191,084 (49.8)	**<0.001**
Periodontics	41,363 (7.6)	10,488 (6.6)	30,875 (8.0)	**<0.001**
Adjunctive general services	52,555 (9.7)	17,892 (11.2)	34,663 (9.0)	**<0.001**
Endodontics	78,334 (14.4)	15,121 (9.5)	63,213 (16.5)	**<0.001**
Implant services	23,879 (4.4)	7,667 (4.8)	16,212 (4.2)	**<0.001**
Prosthodontics	15,186 (2.8)	4,497 (2.8)	10,689 (2.8)	0.384
Orthodontics	280 (0.1)	106 (0.1)	174 (0.0)	0.002
Maxillofacial prosthetics	285 (0.1)	95 (0.1)	190 (0.0)	0.134
Category not available	1,557 (0.3)	411 (0.3)	1,146 (0.3)	**<0.001**
Pain intensity of dental procedures[c]				
Severe	117,436 (21.6)	49,982 (31.4)	67,454 (17.6)	**<0.001**
Moderate	142,594 (26.3)	43,618 (27.4)	98,976 (25.8)	**<0.001**
Mild	160,510 (29.6)	33,868 (21.3)	126,642 (33.0)	**<0.001**
CPT and HCPCS codes	122,418 (22.5)	31,595 (19.9)	90,823 (23.7)	**<0.001**
Union classification				
Nonunion	290,360 (53.5)	86,694 (54.5)	203,666 (53.1)	**<0.001**
Other	131,255 (24.2)	37,368 (23.5)	93,887 (24.5)	
Union	121,343 (22.3)	35,001 (22.0)	86,342 (22.5)	
Employee salary category[d]				
Hourly	233,582 (43.0)	67,561 (42.5)	166,021 (43.2)	**<0.001**
Other	130,146 (24.0)	36,995 (23.3)	93,151 (24.3)	
Salary	179,230 (33.0)	54,507 (34.3)	124,723 (32.5)	
Employment status[e]				
Employed	448,046 (82.5)	134,575 (84.6)	313,471 (81.7)	**<0.001**
Other	37,452 (6.9)	10,682 (6.7)	26,770 (7.0)	
Retired	56,103 (10.3)	13,518 (8.5)	42,585 (11.1)	

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Table 1. Descriptive Characteristics of Dental Visits With Concurrent Opioid Prescriptions by Excess of Morphine Equivalents (*continued*)

Characteristic	Total (N=542,958) *n* (%)	Exceeding the recommended morphine equivalents (*n*=159,063) *n* (%)	Within the recommended morphine equivalents (*n*=383,895) *n* (%)	*p*-value
Spouse dependent	1,357 (0.2)	288 (0.2)	1,069 (0.3)	
Industry category[f]				
Goods production (ref)	54,749 (10.1)	16,085 (10.1)	38,664 (10.1)	**<0.001**
Service production	282,876 (52.1)	80,289 (50.5)	202,587 (52.8)	
Missing	205,333 (37.8)	62,689 (39.4)	142,644 (37.2)	
Previsit conditions[g,h]				
Prosthetic joint implant	11,774 (2.2)	3,324 (2.1)	8,450 (2.2)	0.010
Diabetes	57,667 (10.6)	15,177 (9.5)	42,490 (11.1)	**<0.001**
Immunocompromised condition	6,890 (1.3)	1,987 (1.2)	4,903 (1.3)	0.402
Prior substance use disorders	14,041 (2.6)	4,300 (2.7)	9,741 (2.5)	**<0.001**
Preindex health service utilization[i]				
PCP visits, mean (SD)	0.70 (1.36)	0.70 (1.34)	0.70 (1.37)	0.223
Any PCP visits	196,481 (36.2)	57,792 (36.3)	138,689 (36.1)	0.151
Specialist visits, mean (SD)	1.74 (3.19)	1.69 (3.19)	1.76 (3.19)	**<0.001**
Any specialist visits	267,983 (49.4)	76,926 (48.4)	191,057 (49.8)	**<0.001**
ER visits, mean (SD)	0.11 (0.43)	0.11 (0.43)	0.11 (0.43)	**<0.001**
Any ER visits	44,567 (8.2)	13,561 (8.5)	31,006 (8.1)	**<0.001**
Admission, mean (SD)	0.02 (0.15)	0.02 (0.15)	0.02 (0.14)	0.764
Any admission	8,871 (1.6)	2,564 (1.6)	6,307 (1.6)	0.413
Opioid prescribed[j]				
Codeine	64,963 (12.0)	6,316 (4.0)	58,647 (15.3)	**<0.001**
Dihydrocodeine	15 (0.0)	7 (0.0)	8 (0.0)	0.139
Hydrocodone	411,961 (75.9)	113,958 (71.6)	298,003 (77.6)	**<0.001**
Hydromorphone	306 (0.1)	279 (0.2)	27 (0.0)	**<0.001**
Meperidine	1,640 (0.3)	371 (0.2)	1,269 (0.3)	**<0.001**
Morphine	10 (0.0)	10 (0.0)	0 (0.0)	**<0.001**
Oxycodone	52,158 (9.6)	36,866 (23.2)	15,292 (4.0)	**<0.001**
Oxymorphone	1 (0.0)	1 (0.0)	0 (0.0)	0.120
Tapentadol	83 (0.0)	82 (0.1)	1 (0.0)	**<0.001**
Tramadol	13,833 (2.5)	3,058 (1.9)	10,775 (2.8)	**<0.001**

Note: Boldface indicates the statistical significance accounting for up to 50 multiple comparisons and maintaining the family-wise Type I error rate of 0.05.

[a]A total of 222 (0.04%) observations were missing: 165 in the appropriate groups and 57 in the overprescribing group.

[b]The ADA has a standardized system to group CDT codes (dental procedure codes) into categories (shown in the table). There could be multiple procedures performed during the same visit. The ADA does not include CPT and HCPCS codes in their standard ADA dental procedure categories. CPT and HCPCS codes are included in 'Category not available.'

[c]Pain intensity of dental procedures was defined according to Hersh et al.[29] CPT and HCPCS codes were not categorized by Hersh et al.[29] and were categorized separately.

[d]Employee salary category is of the primary beneficiary. Salary includes nonunion, union, and "other" salaried employees. Hourly includes nonunion, union, and "other" hourly employees. Other includes employees not classified as salaried or hourly or where the employee salary category is unknown.

[e]Employment status is of the primary beneficiary. Employed includes employees classified as active full-time and active part-time or seasonal. Retired includes employees classified as early retiree, Medicare eligible retiree, and retiree. Other includes Consolidated Omnibus Budget Reconciliation Act insurance continuee, long-term disability, and other/unknown.

[f]Industries of the employers were categorized according to supersectors as defined by the U.S. Bureau of Labor Statistics. Goods-producing industries include oil and gas extraction, mining, manufacturing of durable goods, manufacturing of nondurable goods, agriculture, forestry, fishing, and construction. Service-producing industries include transportation, communications, utilities, retail trade, finance, insurance, real estate, services, and wholesalers.

[g]The diabetes category includes those with Type 1 and Type 2 diabetes.

[h]Immunocompromised was defined according to previous guidelines from the ADA/AAOS.[34].

[i]Number of health service utilization assessed over the 6-month predental visit period, not accounting for enrollment in dental or medical plans. Outpatient clinic visits were defined with a provider type of nurse practitioners, physician assistant, or medical doctors. Medical doctors with a specialty of internal medicine or family medicine were included as PCP. Other types of clinical encounters were defined as a specialist visit and may include healthcare encounters without a medical provider (e.g., nurse visit or laboratory visit).

[j]There could be multiple opioid dispensing records associated with the same visit (2,008 [0.37%] had >1 opioid associated with the dental visit). Among these visits, 2,004 were associated with 2 different opioid agents and 4 with 3 different opioid agents.

AAOS, American Academy of Orthopaedic Surgeons; ADA, American Dental Association; CDT, Comprehensive Dental Terminology; CPT, Current Procedural Terminology; ER, emergency room; HCPCS, Healthcare Common Procedure Coding System; PCP, primary care providers.

Table 2. Multivariable Generalized Estimating Equations Models Relating Dental Visit Characteristics With Concurrent Opioid Prescriptions Exceeding the Recommended Morphine Equivalents

Characteristic	OR (95% CI)	*p*-value
Age, years		
18–34	1.486 (1.459, 1.513)	**<0.0001**
35–44	1.109 (1.087, 1.132)	**<0.0001**
45–54 (ref)		
55–64	0.966 (0.947, 0.986)	**0.001**
≥65	0.874 (0.842, 0.906)	**<0.0001**
Female sex (ref=male)	0.918 (0.906, 0.931)	**<0.0001**
Year of visit		
2011 (ref)		
2012	0.962 (0.944, 0.981)	**<0.0001**
2013	0.938 (0.920, 0.957)	**<0.0001**
2014	0.929 (0.910, 0.947)	**<0.0001**
2015	1.049 (1.028, 1.072)	**<0.0001**
Region[a]		
Northeast	0.624 (0.610, 0.639)	**<0.0001**
Midwest (ref)		
South	1.054 (1.037, 1.071)	**<0.0001**
West	0.897 (0.879, 0.916)	**<0.0001**
Unknown	0.652 (0.470, 0.905)	0.0105
Dental procedure groupings[b]		
Routine dental procedures unlikely to be invasive (ref)		
Mildly invasive dental procedure categories	1.063 (1.034, 1.093)	**<0.0001**
Invasive dental procedure categories	1.010 (0.996, 1.024)	0.1803
Union classification		
Nonunion	0.975 (0.957, 0.994)	0.0087
Other	0.954 (0.929, 0.979)	**0.0005**
Union (ref)		
Employee salary category[c]		
Hourly	0.967 (0.950, 0.983)	**<0.0001**
Other	0.939 (0.916, 0.962)	**<0.0001**
Salary (ref)		
Employment status[d]		
Employed (ref)		
Other	0.965 (0.936, 0.995)	0.024
Retired	1.060 (1.028, 1.092)	**0.0002**
Spouse dependent	1.026 (0.891, 1.182)	0.7198
Industry of employer[e]		
Goods production (ref)		
Service production	0.950 (0.936, 0.964)	**<0.0001**
Missing	1.017 (0.987, 1.048)	0.2747
Previsit conditions[f,g]		
Prosthetic joint implant	1.073 (1.025, 1.122)	0.0023
Diabetes	1.015 (0.993, 1.038)	0.1797
Immunocompromised condition	1.097 (1.034, 1.163)	0.002
Prior substance use disorders	0.956 (0.917, 0.996)	0.0316
Preindex health service utilization[h]		
PCP visits (yes/no)	1.011 (0.998, 1.025)	0.0917
Specialist visits (yes/no)	1.002 (0.988, 1.015)	0.8327
ER visits (yes/no)	1.016 (0.992, 1.040)	0.1853
Admission (yes/no)	0.982 (0.933, 1.033)	0.4813

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Table 2. Multivariable Generalized Estimating Equations Models Relating Dental Visit Characteristics With Concurrent Opioid Prescriptions Exceeding the Recommended Morphine Equivalents (*continued*)

Characteristic	OR (95% CI)	*p*-value
Opioid prescribed[i]		
Hydrocodone (ref)		
Oxycodone	6.731 (6.590, 6.875)	**<0.0001**
Codeine	0.298 (0.290, 0.306)	**<0.0001**
Other	0.702 (0.674, 0.732)	**<0.0001**

Note: Boldface indicates statistical significance accounting for up to 50 multiple comparisons and maintaining the family-wise Type I error rate of 0.05.
[a]A total of 222 (0.04%) observations were missing: 165 in the appropriate groups and 57 in the overprescribing group.
[b]The ADA has a standardized system to group CDT codes (dental procedure codes) into categories (shown in the table). There could be multiple procedures performed during the same visit. The ADA does not include CPT and HCPCS codes in their standard ADA dental procedure categories. The ADA CDT categories were grouped into those unlikely to be invasive (diagnostic, preventive, adjunctive, orthodontics), mildly invasive (restorative, prosthodontics) and invasive (oral and maxillofacial surgery, periodontics, endodontics, implant services), and category not available (CPT and HCPCS codes).
[c]Employee salary category is of the primary beneficiary. Salary includes nonunion, union, and "other" salaried employees. Hourly includes nonunion, union, and "other" hourly employees. Other includes employees not classified as salaried or hourly or where the employee salary category is unknown.
[d]Employment status is of the primary beneficiary. Employed includes employees classified as active full-time and active part-time or seasonal. Retired includes employees classified as early retiree, Medicare eligible retiree, and retiree. Other includes Consolidated Omnibus Budget Reconciliation Act insurance continuee, long-term disability, and other/unknown.
[e]Industries of the employers were categorized according to supersectors as defined by the U.S. Bureau of Labor Statistics (www.bls.gov/iag/tgs/iag_index_naics.htm). Goods-producing industries include oil and gas extraction, mining, manufacturing of durable goods, manufacturing of nondurable goods, agriculture, forestry, fishing, and construction. Service-producing industries include transportation, communications, utilities, retail trade, finance, insurance, real estate, services, and wholesalers.
[f]The diabetes category includes those with Type 1 and Type 2 diabetes.
[g]Immunocompromised was defined according to previous guidelines from the ADA/AAOS.[34].
[h]Number of health service utilization assessed over the 6-month predental visit period, not accounting for enrollment in dental or medical plans. Outpatient clinic visits were defined with a provider type of nurse practitioners, physician assistant, or medical doctors. Medical doctors with a specialty of internal medicine or family medicine were included as PCP. Other types of clinical encounters were defined as a specialist visit and may include healthcare encounters without a medical provider (e.g., nurse visit or laboratory visit).
[i]Other opioids include dihydrocodeine, hydromorphone, meperidine, morphine, oxymorphone, tapentadol and tramadol.
AAOS, American Academy of Orthopaedic Surgeons; ADA, American Dental Association; CDT, Comprehensive Dental Terminology; CPT, Current Procedural Terminology; ER, emergency room; HCPCS, Healthcare Common Procedure Coding System; PCP, primary care providers.

>3 days' supply were similar to those who did not with respect to age and hydrocodone and oxycodone use. In the multivariable analysis (Table 4), the Northeast had decreased odds of exceeding the documented days' supply, and the South had increased odds compared with the Midwest. Male patients were more likely to exceed the documented days' supply.

Using the MME-based definition (Appendix Figure 2A, available online), opioid overprescribing decreased from 2011 to 2014 (from 29.9% to 28.4%), but increased in 2015 (30.7%) exceeding 2011 (p=0.062 after adjusting for the variables in Table 2). This trend was observed for all regions except the Northeast, which experienced a significant decrease (p<0.001) (Appendix Figure 2A, available online). Given the rescheduling of hydrocodone during the study period, a subanalysis excluding hydrocodone-containing agents showed a decrease in the proportion of visits with an opioid overprescribed from 42.2% in 2011 to 37.5% in 2015 (p<0.001) (Appendix Figure 2B, available online). Thus, the 2015 increase in overprescribing for all opioids was driven by an increase in the average number of hydrocodone tablets per prescription in 2015 (mean, 20 tablets/prescription; median, 18 tablets/prescription) compared with 2011–2014 (mean, ~18 tablets/prescription; median, 16 tablets/prescription) (Appendix Table 1, available online) without a corresponding increase in the days' supply (mean, 3.4 days/prescription; median, 3 days' supply/prescription) (Appendix Table 2, available online). Differences in the number of tablets dispensed by year remained even after adjusting for patient age and sex (p<0.001 for quantity, p=0.096 for days' supply in generalized linear models). Using the days' supply definition, there were no differences in the proportion of opioids that exceeded the 3-day threshold overall over the study period (p=0.385 after adjusting for Table 4 variables) (Appendix Figure 2C, available online).

Because the CDC guidelines were implemented after the study period, overprescribing was assessed based on definitions identified in prior studies. Using a recommended equivalent of 2 days of opioids (80 MMEs) in the dental literature,[29] 67.7% of opioids exceeded the 80-mg MME recommendation.[29] Incorporating pain anticipated post-procedure, 87.4% of opioids exceeded the recommendations. In analyses broadening the range of days between the prescription date and the visit to

Table 3. Descriptive Characteristics of Dental Visits With Concurrent Opioid Prescriptions by Excess of Opioid Days' Supply

Characteristic	Total (N=542,958) *n* (%)	Exceeding the recommended days' supply of opioids (*n*=288,933) *n* (%)	Within the recommended days' supply of opioids (*n*=254,025) *n* (%)	*p*-value
Age, years				
Median (IQR)	46 (33–56)	46 (32–56)	47 (33–57)	**<0.001**
Age category, years				
18–34	154,241 (28.4)	82,591 (28.6)	71,650 (28.2)	**<0.001**
35–44	99,545 (18.3)	54,218 (18.8)	45,327 (17.8)	
45–54	125,622 (23.1)	67,798 (23.5)	57,824 (22.8)	
55–64	121,491 (22.4)	63,974 (22.1)	57,517 (22.6)	
≥65	42,059 (7.7)	20,352 (7.0)	21,707 (8.5)	
Female sex	261,235 (48.1)	136,532 (47.3)	124,703 (49.1)	**<0.001**
Year of dental service				
2011	104,697 (19.3)	54,097 (18.7)	50,600 (19.9)	**<0.001**
2012	121,821 (22.4)	65,383 (22.6)	56,438 (22.2)	
2013	109,169 (20.1)	58,377 (20.2)	50,792 (20.0)	
2014	112,444 (20.7)	60,266 (20.9)	52,178 (20.5)	
2015	94,827 (17.5)	50,810 (17.6)	44,017 (17.3)	
Region[a]				
Northeast	73,263 (13.5)	37,102 (12.8)	36,161 (14.2)	**<0.001**
Midwest	148,031 (27.3)	77,746 (26.9)	70,285 (27.7)	
South	238,756 (44.0)	130,091 (45.0)	108,665 (42.8)	
West	82,686 (15.2)	43,885 (15.2)	38,801 (15.3)	
Dental procedure groupings[b]				
Diagnostic	269,138 (49.6)	145,492 (50.4)	123,646 (48.7)	**<0.001**
Preventive	17,809 (3.3)	10,412 (3.6)	7,397 (2.9)	**<0.001**
Restorative	63,077 (11.6)	33,648 (11.6)	29,429 (11.6)	**<0.001**
Oral and maxillofacial surgery	289,999 (53.4)	150,674 (52.1)	139,325 (54.8)	0.487
Periodontics	41,363 (7.6)	21,694 (7.5)	19,669 (7.7)	**<0.001**
Adjunctive general services	52,555 (9.7)	28,298 (9.8)	24,257 (9.5)	**0.001**
Endodontics	78,334 (14.4)	38,230 (13.2)	40,104 (15.8)	0.002
Implant services	23,879 (4.4)	13,453 (4.7)	10,426 (4.1)	**<0.001**
Prosthodontics	15,186 (2.8)	8,398 (2.9)	6,788 (2.7)	**<0.001**
Orthodontics	280 (0.1)	166 (0.1)	114 (0.0)	**<0.001**
Maxillofacial prosthetics	285 (0.1)	139 (0.0)	146 (0.1)	0.042
Grouping not available	1,557 (0.3)	716 (0.2)	841 (0.3)	0.133
Pain intensity of dental procedures[c]				
Severe	117,436 (21.6)	61,234 (21.2)	56,202 (22.1)	**<0.001**
Moderate	142,594 (26.3)	75,938 (26.3)	66,656 (26.2)	**<0.001**
Mild	160,510 (29.6)	80,310 (27.8)	80,200 (31.6)	**<0.001**
CPT and HCPCS codes	122,418 (22.5)	71,451 (24.7)	50,967 (20.1)	**<0.001**
Union classification				
Nonunion	290,360 (53.5)	154,720 (53.5)	135,640 (53.4)	**<0.001**
Other	131,255 (24.2)	67,888 (23.5)	63,367 (24.9)	
Union	121,343 (22.3)	66,325 (23.0)	55,018 (21.7)	
Salary category[d]				
Hourly	233,582 (43.0)	128,402 (44.4)	105,180 (41.4)	**<0.001**
Other	130,146 (24.0)	67,054 (23.2)	63,092 (24.8)	
Salary	179,230 (33.0)	93,477 (32.4)	85,753 (33.8)	

(*continued on next page*)

Table 3. Descriptive Characteristics of Dental Visits With Concurrent Opioid Prescriptions by Excess of Opioid Days' Supply (*continued*)

Characteristic	Total (N=542,958) *n* (%)	Exceeding the recommended days' supply of opioids (*n*=288,933) *n* (%)	Within the recommended days' supply of opioids (*n*=254,025) *n* (%)	*p*-value
Employment status[e]				
Employed	448,046 (82.5)	241,274 (83.5)	206,772 (81.4)	**<0.001**
Other	37,452 (6.9)	18,485 (6.4)	18,967 (7.5)	
Retired	56,103 (10.3)	28,517 (9.9)	27,586 (10.9)	
Spouse dependent	1,357 (0.2)	657 (0.2)	700 (0.3)	
Industry category[f]				
Goods production (ref)	54,749 (10.1)	28,909 (10.0)	25,840 (10.2)	**<0.001**
Service production	282,876 (52.1)	149,569 (51.8)	133,307 (52.5)	
Missing	205,333 (37.8)	110,455 (38.2)	94,878 (37.3)	
Previsit conditions[g,h]				**<0.001**
Prosthetic joint implant	11,774 (2.2)	6,153 (2.1)	5,621 (2.2)	**<0.001**
Diabetes	57,667 (10.6)	30,780 (10.7)	26,887 (10.6)	0.036
Immunocompromised condition	6,890 (1.3)	3,670 (1.3)	3,220 (1.3)	0.413
Prior substance use disorders	14,041 (2.6)	8,002 (2.8)	6,039 (2.4)	0.932
Preindex health service utilization[i]				
PCP visits, mean (SD)	0.70 (1.36)	0.68 (1.31)	0.72 (1.42)	**<0.001**
Any PCP visits	196,481 (36.2)	103,543 (35.8)	92,938 (36.6)	**<0.001**
Specialist visits, mean (SD)	1.74 (3.19)	1.68 (3.12)	1.80 (3.26)	**<0.001**
Any specialist visits	267,983 (49.4)	139,972 (48.4)	128,011 (50.4)	**<0.001**
ER visits, mean (SD)	0.11 (0.43)	0.11 (0.44)	0.11 (0.42)	**<0.001**
Any ER visits	44,567 (8.2)	24,185 (8.4)	20,382 (8.0)	**<0.001**
Admission, mean (SD)	0.02 (0.15)	0.02 (0.15)	0.02 (0.15)	0.940
Any admission	8,871 (1.6)	4,716 (1.6)	4,155 (1.6)	0.920
Opioid prescribed[j]				
Codeine	64,963 (12.0)	32,373 (11.2)	32,590 (12.8)	**<0.001**
Dihydrocodeine	15 (0.0)	8 (0.0)	7 (0.0)	**<0.001**
Hydrocodone	411,961 (75.9)	218,817 (75.7)	193,144 (76.0)	0.993
Hydromorphone	306 (0.1)	154 (0.1)	152 (0.1)	0.010
Meperidine	1,640 (0.3)	909 (0.3)	731 (0.3)	0.311
Morphine	10 (0.0)	8 (0.0)	2 (0.0)	0.072
Oxycodone	52,158 (9.6)	29,746 (10.3)	22,412 (8.8)	0.090
Oxymorphone	1 (0.0)	1 (0.0)	0 (0.0)	**<0.001**
Tapentadol	83 (0.0)	54 (0.0)	29 (0.0)	0.348
Tramadol	13,833 (2.5)	8,803 (3.0)	5,030 (2.0)	0.031

Note: Boldface indicates statistical significance accounting for up to 50 multiple comparisons and maintaining the family-wise Type I error rate of 0.05.

[a]A total of 222 (0.04%) observations were missing: 113 in the appropriate groups and 109 in the overprescribing group.

[b]The ADA has a standardized system to group CDT codes (dental procedure codes) into categories (shown in the table). There could be multiple procedures performed during the same visit. The ADA does not include CPT and HCPCS codes in their standard ADA dental procedure categories. CPT and HCPCS codes are included in 'Category not available.'

[c]Pain intensity of dental procedures was defined according to Hersh et al.[29] CPT and HCPCS codes were not categorized by Hersh et al.[29] and were categorized separately.

[d]Employee salary category is of the primary beneficiary. Salary includes nonunion, union and "other" salaried employees. Hourly includes nonunion, union and "other" hourly employees. Other includes employees not classified as salaried or hourly or where the employee salary category is unknown.

[e]Employment status is of the primary beneficiary. Employed includes employees classified as active full-time and active part-time or seasonal. Retired includes employees classified as early retiree, Medicare eligible retiree, and retiree. Other includes Consolidated Omnibus Budget Reconciliation Act insurance continuee, long-term disability, and other/unknown.

[f]Industries of the employers were categorized according to supersectors as defined by the U.S. Bureau of Labor Statistics. Goods-producing industries include oil and gas extraction, mining, manufacturing of durable goods, manufacturing of nondurable goods, agriculture, forestry, fishing, and construction. Service-producing industries include transportation, communications, utilities, retail trade, finance, insurance, real estate, services, and wholesalers.

[g]The diabetes category includes those with Type 1 and Type 2 diabetes.

7 days before or after the visit (N=537,565 episodes of care), 35.3% exceeded the recommended MMEs (versus 29.3% in the primary analysis) (Appendix Table 3, available online). With respect to the characteristics associated with overprescribing, similar characteristics were associated with exceeding the recommended MMEs and days' supply relative to the primary analysis.

DISCUSSION

In this largest analysis of dental visits with concurrent opioids in the U.S. between 2011 and 2015, a total of 29% of the opioids exceeded the MMEs-recommended for acute pain. With respect to the days' supply, half of opioids co-occurring with dental visits exceeded 3 days—a limit considered sufficient to treat typical oral pain. Incorporating procedures conducted during the dental visit, 87% exceeded recommendations. Though hydrocodone comprised most of the opioids in the cohort, 10% were for high-potency agents at the highest risk of adverse events (e.g., oxycodone). The results also demonstrate that, unlike national trends,[10,35] opioid overprescribing by dentists is not changing and may be increasing.

Although hydrocodone rescheduling was associated with decreases in hydrocodone prescribing nationally,[36] the results suggest that this change resulted in an increase in quantity per prescription by dentists. Nationally, an average increase of 2 tablets of hydrocodone /prescription translates to >14 million additional hydrocodone tablets dispensed to patients after rescheduling to a Schedule II.[4] Taken together with previous reports indicating that half of the opioids prescribed for dental procedures such as tooth extractions are not used, the availability of unused opioids prescribed in this setting is likely increasing and associated with nonmedical opioid use.[37,38] Other studies assessing opioids prescribed by dentists identified that opioids were prescribed where anti-inflammatory agents (e.g., nonsteroidal anti-inflammatory drugs) would have been superior for analgesia and at nonsurgical visits where opioids were not indicated.[10,39] The results support these findings where nearly 1 in 3 opioids were prescribed on the same day of a dental visit where the pain intensity was anticipated to be mild. In this first national analysis determining the proportion of opioids overprescribed by dentists, predictors to target interventions were also identified and went beyond the traditional approach of defining overprescribing exclusively with the days' supply.

Opportunities for action based on study findings are clear. More than one third of the opioids that surpassed the recommended MMEs occurred in those aged 18–34 years, and oxycodone was associated with more than sixfold increased odds of overprescribing. Young adults have the highest rates of deaths related to opioid use with 20% of deaths attributed to opioid-related overdose.[40] Opioids prescribed by dentists have been associated with subsequent persistent opioid use and subsequent substance use disorder,[41] particularly adolescents and young adults, high-risk populations for opioid misuse.[42] Oxycodone, a high-potency opioid, is associated with opioid misuse and drug diversion. Even though nonopioid analgesics have been shown to achieve equivalent or superior pain control for acute oral pain,[43] a recent comparison of opioid prescribing by dentists in the U.S. and England suggests that opioid prescribing by U.S. dentists, especially for high-potency opioids, is excessive.[4]

Interventions that have been shown to be effective in curtailing opioid prescribing by dentists include mandatory query of the state prescription drug monitoring program[1] and pharmacist-delivered audit and feedback.[44] However, dentists have low registration and use of prescription drug monitoring programs.[45,46] Other implementation strategies include education, guidelines, academic detailing, interprofessional pain management, and risk mitigation.[47,48] While these interventions are being disseminated, successful evidence-based interventions for dentists likely require additional research and implementation strategies tailored to the dentist.

Limitations

This study has limitations. The cohort includes a sample of patients with commercial dental insurance in addition to medical and prescription coverage. Thus, results may not be representative of uninsured patients and people with Medicaid and Medicare benefits. Medicare does not generally cover dental care unless supplemental benefits are purchased, and the state provision of dental benefits

[h]Immunocompromised was defined according to previous guidelines from the ADA/AAOS.[34].
[i]Number of health service utilization assessed over the 6-month predental visit period, not accounting for enrollment in dental or medical plans. Outpatient clinic visits were defined with a provider type of nurse practitioners, physician assistant, or medical doctors. Medical doctors with a specialty of internal medicine or family medicine were included as PCP. Other types of clinical encounters were defined as a specialist visit and may include healthcare encounters without a medical provider (e.g., nurse visit or laboratory visit).
[j]There could be multiple opioid dispensing records associated with the same visit (2,008 [0.37%] had >1 opioid associated with the dental visit). Among these visits, 2,004 were associated with 2 different opioid agents and 4 with 3 different opioid agents.
AAOS, American Academy of Orthopaedic Surgeons; ADA, American Dental Association; CDT, Comprehensive Dental Terminology; CPT, Current Procedural Terminology; ER, emergency room; HCPCS, Healthcare Common Procedure Coding System; PCP, primary care providers.

Table 4. Multivariable Generalized Estimating Equations Models Relating Dental Visit Characteristics With Concurrent Opioid Prescriptions Exceeding the Recommended Days' Supply

Characteristic	OR (95% CI)	*p*-value
Age, years		
18–34	0.939 (0.867, 1.017)	0.1244
35–44	0.974 (0.922, 1.028)	0.3358
45–54 (ref)		
55–64	1.007 (0.965, 1.052)	0.7438
≥65	0.990 (0.914, 1.071)	0.7955
Female sex (ref=male)	0.952 (0.936, 0.968)	**<0.0001**
Region[a]		
Northeast	0.917 (0.887, 0.947)	**<0.0001**
Midwest (ref)		
South	1.027 (1.008, 1.047)	0.0066
West	1.018 (0.994, 1.042)	0.145
Unknown	0.765 (0.537, 1.091)	0.1388
Year of visit		
2011 (ref)		
2012	1.005 (0.986, 1.024)	0.6447
2013	1.005 (0.983, 1.026)	0.6715
2014	1.007 (0.984, 1.031)	0.5355
2015	1.015 (0.988, 1.043)	0.2882
Dental procedure groupings[b]		
Routine dental procedures unlikely to be invasive (ref)		
Mildly invasive dental procedure categories	0.990 (0.971, 1.009)	0.2888
Invasive dental procedure categories	0.997 (0.987, 1.006)	0.4765
Union classification		
Nonunion	0.991 (0.969, 1.014)	0.4484
Other	1.016 (0.982, 1.051)	0.3562
Union (ref)		
Salary category[c]		
Hourly	1.110 (1.087, 1.134)	**<0.0001**
Other	0.970 (0.938, 1.002)	0.0681
Salary (ref)		
Employment status[d]		
Employed (ref)		
Other	0.918 (0.882, 0.955)	**<0.0001**
Retired	0.900 (0.840, 0.963)	0.0024
Spouse dependent	0.990 (0.797, 1.229)	0.9245
Industry[e]		
Goods production (ref)		
Service production	0.975 (0.957, 0.993)	0.0056
Missing	1.059 (1.020, 1.100)	0.0026
Previsit conditions[f,g]		
Prosthetic joint implant	0.967 (0.821, 1.139)	0.6867
Diabetes	1.034 (0.972, 1.099)	0.2874
Immunocompromised condition	1.038 (0.937, 1.151)	0.4734
Prior substance use disorders	1.030 (0.929, 1.142)	0.5776
Preindex health service utilization[h]		
Any PCP visit	1.004 (0.988, 1.019)	0.6412
Any specialist visit	0.994 (0.979, 1.009)	0.4355
Any ER visit	0.989 (0.965, 1.015)	0.4051
Any admission	1.010 (0.955, 1.068)	0.7317

(*continued on next page*)

Table 4. Multivariable Generalized Estimating Equations Models Relating Dental Visit Characteristics With Concurrent Opioid Prescriptions Exceeding the Recommended Days' Supply (*continued*)

Characteristic	OR (95% CI)	*p*-value
Opioid prescribed[i]		
Hydrocodone (ref)		
Oxycodone	1.012 (0.991, 1.034)	0.2726
Codeine	0.941 (0.922, 0.961)	**<0.0001**
Other	1.013 (0.982, 1.045)	0.402

Note: Boldface indicates statistical significance accounting for up to 50 multiple comparisons and maintaining the family-wise Type I error rate of 0.05.
[a]A total of 222 (0.04%) observations were missing; 113 in the appropriate groups and 109 in the overprescribing group.
[b]The ADA has a standardized system to group CDT codes (dental procedure codes) into categories (shown in the table). There could be multiple procedures performed during the same visit. The ADA does not include CPT and HCPCS codes in their standard ADA dental procedure categories. The ADA CDT categories were grouped into those unlikely to be invasive (diagnostic, preventive, adjunctive, orthodontics), mildly invasive (restorative, prosthodontics) and invasive (oral and maxillofacial surgery, periodontics, endodontics, implant services), and category not available (CPT and HCPCS codes).
[c]Employee salary category is of the primary beneficiary. Salary includes nonunion, union and "other" salaried employees. Hourly includes nonunion, union, and "other" hourly employees. Other includes employees not classified as salaried or hourly or where the employee salary category is unknown.
[d]Employment status is of the primary beneficiary. Employed includes employees classified as active full-time and active part-time or seasonal. Retired includes employees classified as early retiree, Medicare eligible retiree, and retiree. Other includes Consolidated Omnibus Budget Reconciliation Act insurance continuee, long-term disability, and other/unknown.
[e]Industries of the employers were categorized according to supersectors as defined by the U.S. Bureau of Labor Statistics. Goods-producing industries include oil and gas extraction, mining, manufacturing of durable goods, manufacturing of nondurable goods, agriculture, forestry, fishing, and construction. Service-producing industries include transportation, communications, utilities, retail trade, finance, insurance, real estate, services, and wholesalers.
[f]The diabetes category includes those with Type 1 and Type 2 diabetes.
[g]Immunocompromised was defined according to previous guidelines from the ADA/AAOS.[34].
[h]Number of health service utilization assessed over the 6-month predental visit period, not accounting for enrollment in dental or medical plans. Outpatient clinic visits were defined with a provider type of nurse practitioners, physician assistant, or medical doctors. Medical doctors with a specialty of internal medicine or family medicine were included as PCP. Other types of clinical encounters were defined as a specialist visit and may include healthcare encounters without a medical provider (e.g., nurse visit or laboratory visit).
[i]Other opioids include dihydrocodeine, hydromorphone, meperidine, morphine, oxymorphone, tapentadol, and tramadol.
AAOS, American Academy of Orthopaedic Surgeons; ADA, American Dental Association; CDT, Comprehensive Dental Terminology; CPT, Current Procedural Terminology; ER, emergency room; HCPCS, Healthcare Common Procedure Coding System; PCP, primary care providers.

to Medicaid adults is optional.[49,50] As in any observational study, bias from unmeasured confounding is always possible. Pharmacy claims cannot be directly linked with the healthcare encounter or provider. To minimize misclassification and improve the specificity of prescriptions from nondentists, previously used methods were adapted to link opioids to healthcare encounters and conservatively defined a cohort where other indications for opioids are unlikely. The CDC guidelines that informed the primary definition were published in 2016, after the study period. However, the dental literature recommends prescribing opioids for no more than 2 days even for procedures thought to be associated with the severest of pain.[29]

CONCLUSIONS

Up to half of opioids received at the time of dental visits are inconsistent with guidelines on the appropriate use of opioids for acute pain. Those most impacted by overprescribing were male and young adult patients, groups at higher risk of substance use and opioid-related death. Over the study period, opioid overprescribing by dentists did not change. Evidence-based interventions tailored to dentists and oral pain are urgently needed to curtail excessive opioid prescribing by U.S. dentists.

ACKNOWLEDGMENTS

The content is solely the responsibility of the authors and does not necessarily represent the official views of the Agency for Healthcare Research or Quality (AHRQ). The sponsor had no role in the design or conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review or approval of the manuscript; or the decision to submit the manuscript for publication.

The opinions expressed are those of the authors and do not represent those of AHRQ, the Department of Veterans Affairs, or the U.S. government. This work was not presented in any public forum before publication.

Research reported in this publication was supported by the Agency for Health care Research and Quality under award number R01 HS25177 (Principal Investigator, KJS).

Given the proprietary nature of the data, the authors are unable to share the data. However, additional analyses will be completed upon request.

KJS, JZ, and GSC designed and conducted the trial. All authors were involved in one or more aspects of development

and implementation of the study design, data collection, management, analysis, and interpretation. All authors were involved in the preparation, review, or approval and submission of the manuscript.

No financial disclosures were reported by the authors of this paper.

SUPPLEMENTAL MATERIAL

Supplemental materials associated with this article can be found in the online version at https://doi.org/10.1016/j.amepre.2019.11.006.

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