

Cover Story

Opioid prescribing practices from 2010 through 2015 among dentists in the United States

What do claims data tell us?

Niodita Gupta, MD, MPH, PhD; Marko Vujcic, PhD; Andrew Blatz, MS

ABSTRACT

Background. Dentists wrote 6.4% of all opioid prescriptions in the United States in 2012. The purpose of this study was to examine opioid prescription rates, dosage of opioids prescribed, type of opioid drug prescribed, and type of dental visit at which dentists prescribe opioids.

Methods. The authors used the 2010 through 2015 Truven Health Marketscan Research databases and the Prescription Drug Monitoring Program (PDMP) Training and Technical Assistance Center conversion data set. The authors conducted descriptive analyses for days' supply, quantity prescribed, and daily morphine milligram equivalent dose.

Results. The opioid prescription rate per 1,000 dental patients increased from 130.58 in 2010 to 147.44 in 2015. Approximately 68.41% of all opioids prescribed were during surgical dental visits and approximately 31.10% during nonsurgical dental visits. During nonsurgical dental visits at which dentists prescribed an opioid, most of the procedures were restorative.

Conclusions. Among a population of dental patients with private insurance, opioid prescribing rates in the United States increased slightly from 2010 to 2015. The largest increase was among 11-through 18-year-olds. Almost one-third of opioid prescriptions written by dentists were associated with nonsurgical dental visits.

Practical Implications. Use of PDMP resources and use of nonopioid analgesics could help reduce the number of opioid prescriptions in dentistry.

Key Words. Opioids; prescriptions; dentists.

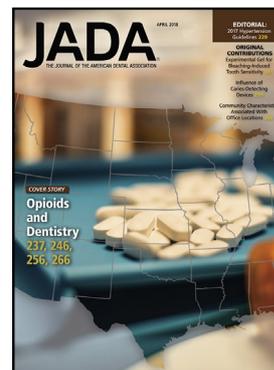
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The United States is facing a severe opioid addiction epidemic. In 2015, approximately 12.5 million people misused prescription opioids.¹ Approximately 2.1 million people misused prescription opioids for the first time, and an estimated 2 million had a prescription opioid use disorder.¹ Opioid overdoses caused 33,091 deaths in 2015 alone.¹ The amount of opioids prescribed in 2010 was 782 morphine milligram equivalents (MMEs) per capita, which decreased to 640 MME per capita in 2015.² Investigators estimated the economic burden of opioid overdose, abuse, and dependence in 2013 to be \$78.5 billion from a societal perspective.³

In 1998, dentists were the top specialty prescribers of immediate-release opioids, accounting for 15.5% of all immediate-release opioid prescriptions.⁴ However, by 2009, the amount of opioid prescriptions written by dentists decreased to 8% of all opioid prescriptions in the United States,⁵ and by 2012, this amount further decreased to 6.4%.⁶ More recent and detailed data are available in some states. For example, in South Carolina during 2012 and 2013, dentists accounted for only 8.9% of all opioid prescribers but prescribed 44.9% of the initial opioids dispensed to patients.⁷ Patients younger than 21 years received 11.2% of the total amount of opioids that dentists prescribed.⁷ Investigators conducted a study in Indiana and used 2011 data, and their results showed that access to dentists and pharmacists increased the availability of prescription opioids and that this



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increased availability was associated with higher rates of opioid drug abuse.⁸ Investigators in 1 study found that patients did not use 54% of the opioids prescribed during dental surgery.⁹

Given the high prescription rates, the potential for drug misuse, and the severe ongoing opioid addiction epidemic, it is important to understand opioid prescription practices and trends in dentistry. The purpose of this study was to describe opioid prescription rates, dosage of opioids prescribed, type of opioid drug prescribed, and type of dental visit at which dentists more frequently prescribe opioids in a large sample of people who are privately insured in the United States.

METHODS

Data source

We used integrated dental, pharmacy, and medical claims from Truven Health Marketscan Research (Truven) databases.¹⁰ These databases contain claims from people who are privately insured and are the largest convenience sample of the privately insured population. The data primarily are obtained from large employers.¹¹ The Truven databases are large enough to be nationally representative of the privately insured population.¹⁰ We also used the Prescription Drug Monitoring Program (PDMP) Training and Technical Assistance Center (TTAC) conversion data set to calculate the daily MME dose.¹² For example, Percocet (Endo Pharmaceuticals) is a combination drug of acetaminophen and oxycodone. According to the MME conversion factor, 1 milligram of oxycodone is equivalent to 1.5 mg of morphine, so a Percocet tablet with 5 mg of oxycodone is equivalent to 7.5 mg of morphine or has a dose of 7.5 MME.

Study sample

We selected patients younger than 65 years who had at least 1 prescription of opioids and at least 1 dental claim from January 1, 2010, through December 31, 2015, and who were enrolled simultaneously in a medical and dental plan. eTable 1^{13,14} (available online at the end of this article) lists the opioid drugs we considered for this study and their MME conversion factors. We compiled the list of opioid drugs on the basis of the PDMP TTAC list¹³ and the Centers for Medicare & Medicaid Services list.¹⁴ Figures 1 and 2 outline the sample selection criteria. The sample population consisted of 1,558,446 opioid prescription claims from 1,135,344 patients.

Measures

We defined an opioid prescription as dental related if it occurred within 3 days of a dental visit and there was no inpatient or outpatient claim within those same 3 days. We calculated the number of dental opioid prescriptions per 1,000 dental visits as the total number of dental opioid prescriptions divided by the total number of dental visits among patients enrolled in both a medical and dental plan, and then we multiplied it by 1,000. We further calculated the number of dental opioid prescriptions per 1,000 dental patients according to age group as the total number of dental opioid prescriptions in an age group divided by the total number of dental patients in that age group enrolled in both a medical and dental plan, and then we multiplied it by 1,000.

The Truven database reports the number of days of drug therapy covered by the prescription (days' supply), the number of units of drug dispensed (quantity), and the strength of the drug (strength). We obtained the MME dose by merging the Truven data sets with the PDMP TTAC conversion data set. We calculated the daily dose as the total strength of number of drug units per day (daily dose = quantity × strength / days' supply). We calculated the daily MME dose as the MME conversion factor multiplied by the daily dose. We calculated the average number of days' supply, quantity prescribed, and daily MME dose according to age group. We also identified the opioid drugs dentists most frequently prescribed. We used the sample population from Figure 1 to calculate the measures described.

We categorized each dental visit at which a dentist prescribed opioids as surgical, nonsurgical, presurgical, or postsurgical. We identified surgical procedures on the basis of the American Dental Association Current Dental Terminology codebook¹⁵⁻¹⁹ and expert opinion from researchers at academic institutions. eTable 2 (available online at the end of this article) includes the list of all procedures that we considered surgical. If a dental visit had any of the procedure codes that we considered surgical services, we considered that dental visit as a surgical visit for this study. If a dental visit had none of the procedure codes that we considered surgical services, we considered that dental visit as a nonsurgical visit. It is possible that patients who received an opioid prescription

ABBREVIATION KEY

NDC:	National Drug Code.
NSAID:	Nonsteroidal anti-inflammatory drug.
PDMP:	Prescription Drug Monitoring Program.
Truven:	Truven Health Marketscan Research.
TTAC:	Training and Technical Assistance Center.

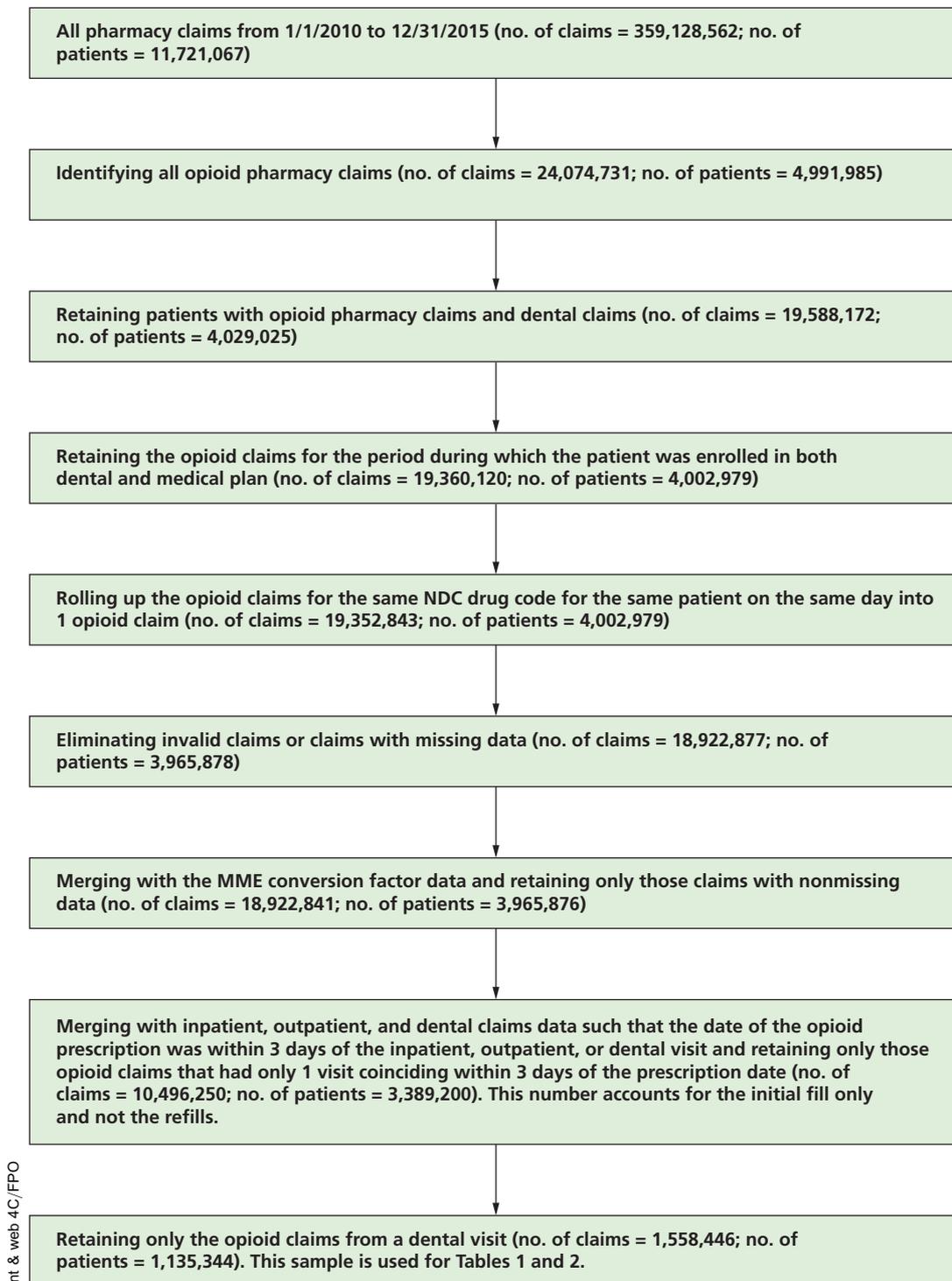
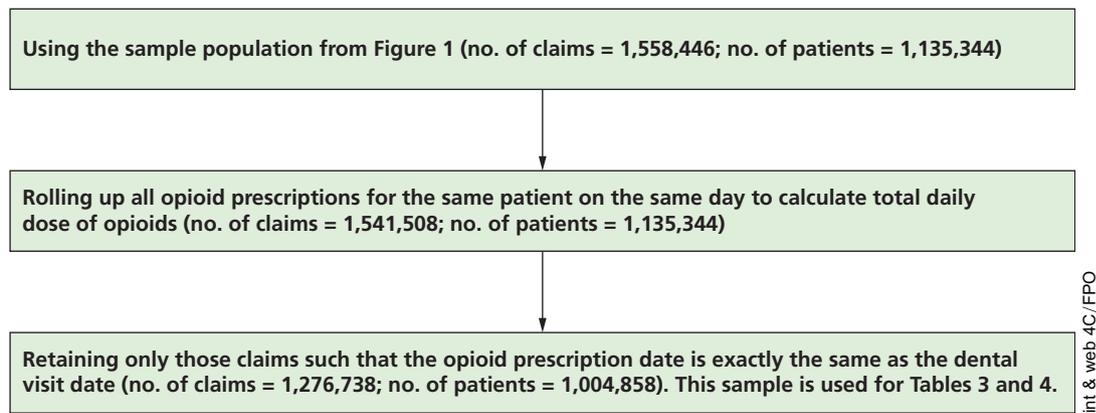


Figure 1. Sample selection criteria. MME: Morphine milligram equivalent. NDC: National Drug Code.

during a nonsurgical dental visit received opioids because they had planned surgical treatment that was not initiated during that particular visit. The opioids may have been a way to manage pain until definitive surgical treatment could be started. To adjust for this possibility, we classified nonsurgical visits with opioid prescriptions that preceded a surgical visit within 15 days as presurgical visits. Similarly, a patient may have prolonged pain after a surgical visit. We adjusted for this possibility by categorizing those nonsurgical visits with opioid prescriptions that succeeded a surgical visit within 15 days as postsurgical visits. We used a subset of the sample population to categorize dental visits into these 4 distinct categories as [Figure 2](#) shows. The subsample population in our study consists of 1,276,738 opioid prescription claims from 1,004,858 patients.



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Figure 2. Criteria for selecting the subset of the sample.

We then calculated the rate of opioid prescriptions according to age group for surgical, presurgical, and nonsurgical dental visits. We also calculated the number of days' supply, quantity prescribed, and daily MME dose for surgical, presurgical, postsurgical, and nonsurgical dental visits. Furthermore, we calculated the rate of opioid prescriptions for each category of dental procedures (that is, restorative; endodontic; periodontic; prosthodontic: removable; maxillofacial prosthetics; implant services; prosthodontic: fixed; oral and maxillofacial surgery; orthodontic; and adjunctive general services) separately for both surgical and nonsurgical dental visits. We counted each procedure performed during a visit. For example, if the dentist performed an endodontic procedure and an adjunctive general service procedure during a nonsurgical dental visit associated with an opioid prescription, we counted both the endodontic and adjunctive general service procedures in their respective categories as procedures during a nonsurgical dental visit at which the dentist prescribed opioids. Each dental visit is likely to have a diagnostic or preventive procedure associated with it. Hence, we excluded the diagnostic and preventive procedures from the pool of procedures performed during surgical and nonsurgical dental visits.

Data analyses

We used statistical software (SAS 9.4, SAS Institute) for data analysis. We calculated descriptive statistics for days' supply, quantity prescribed, and daily MME dose. The data for days' supply, quantity prescribed, and daily MME dose were skewed, so we provided the median and interquartile range along with the mean and standard deviation.

RESULTS

In our sample of people who were privately insured, the number of opioid prescriptions written by dentists per 1,000 dental visits was 50.37 (95% confidence interval [CI], 50.17 to 50.58) in 2010, and it increased to 58.70 (95% CI, 58.48 to 58.92) in 2015. The number of opioid prescriptions written by dentists per 1,000 dental patients also increased from 130.58 (95% CI, 130.04 to 131.12) in 2010 to 147.44 (95% CI, 146.88 to 148.00) in 2015. There was a sharp increase in the number of opioid prescriptions per 1,000 dental patients for the group aged 11 through 18 years from 99.71 in 2010 to 165.94 in 2015. [Table 1](#) presents the results for the number of opioid prescriptions per 1,000 dental patients according to age group.

The median number of days' supply of opioids dentists prescribed was 3 days for all age groups. The median quantity of opioids prescribed was highest (approximately 80) for the group younger than 11 years, but the median MME dose for patients younger than 11 years was only 10.80. The median quantity of opioids dentists prescribed was 20 for all age groups. The median daily MME dose dentists prescribed was 33.33 for all age groups; however, the median daily MME doses for groups aged 11 through 18 years and 19 through 25 years were 36.00 and 37.50, respectively. [Table 2](#) summarizes the mean and median days' supply, quantity of opioids, and daily MME dose that dentists prescribed according to patient age group.

The 5 opioid drugs dentists most frequently prescribed were acetaminophen with hydrocodone bitartrate, acetaminophen with oxycodone hydrochloride, acetaminophen with codeine, hydrocodone bitartrate with ibuprofen, and tramadol hydrochloride. Acetaminophen with hydrocodone

Table 1. Number of opioid prescriptions written by dentist per 1,000 dental patients according to patient age group in the United States for 2010 through 2015.*

AGE GROUP, Y	2010, NO. (95% CI) [†]	2011, NO. (95% CI)	2012, NO. (95% CI)	2013, NO. (95% CI)	2014, NO. (95% CI)	2015, NO. (95% CI)
< 11	23.78 (22.78 to 24.78)	22.45 (21.49 to 23.40)	22.42 (21.48 to 23.35)	23.38 (22.34 to 24.41)	24.72 (23.62 to 25.82)	29.49 (28.09 to 30.88)
11-18	99.71 (98.44 to 100.97)	100.32 (99.08 to 101.56)	99.69 (98.49 to 100.89)	107.99 (106.66 to 109.32)	124.91 (123.43 to 126.40)	165.94 (163.98 to 167.91)
19-25	214.18 (211.42 to 216.94)	206.19 (203.87 to 208.51)	182.88 (180.94 to 184.83)	171.68 (169.79 to 173.57)	171.79 (169.98 to 173.60)	185.06 (183.05 to 187.07)
26-40	153.31 (152.04 to 154.58)	150.97 (149.78 to 152.16)	145.90 (144.81 to 146.99)	142.71 (141.59 to 143.84)	150.44 (149.30 to 151.58)	169.41 (168.06 to 170.76)
41-55	131.99 (131.08 to 132.91)	131.79 (130.91 to 132.66)	126.38 (125.58 to 127.18)	125.47 (124.65 to 126.29)	127.38 (126.56 to 128.20)	140.20 (139.26 to 141.13)
56-64	127.24 (125.98 to 128.49)	119.25 (118.14 to 120.36)	115.73 (114.73 to 116.72)	115.74 (114.74 to 116.75)	116.13 (115.16 to 117.10)	132.84 (131.75 to 133.94)
All Age Groups Under 65 Y	130.58 (130.04 to 131.12)	129.70 (129.19 to 130.20)	125.28 (124.82 to 125.74)	125.04 (124.56 to 125.52)	129.81 (129.33 to 130.29)	147.44 (146.88 to 148.00)

* Source: Analysis of Truven Health MarketScan Research databases.¹⁰ The sample population consists of 1,558,446 opioid prescription claims from 1,135,344 patients.
[†] CI: Confidence interval.

bitartrate accounted for 70.21% of all opioid drugs dentists prescribed in 2010. This amount decreased to 69.16% in 2014 and further to 63.36% in 2015. Acetaminophen with oxycodone hydrochloride accounted for 10.90% of all opioid drugs dentists prescribed in 2010 and increased to 11.62% in 2015. Acetaminophen with codeine accounted for 10.56% of all opioid drugs dentists prescribed in 2010 and increased to 14.28% in 2015. Hydrocodone bitartrate with ibuprofen accounted for 3.09% of all opioid drugs dentists prescribed in 2010 and decreased to 1.89% in 2015. Tramadol hydrochloride accounted for 1.78% of all opioid prescriptions written by dentists in 2010 and increased to 4.60% in 2015 (eTable 3, available online at the end of this article).

For all age groups, most dental visits at which dentists prescribed opioids were surgical dental visits (68.41%). The groups aged 11 through 18 years and 19 through 25 years had lower percentages of opioid prescriptions for nonsurgical dental visits than did the other age groups. Table 3 summarizes the percentages of opioid prescriptions according to age group and according to dental visit type (that is, surgical, presurgical, postsurgical, and nonsurgical dental visits).

For all age groups, the median days' supply dentists prescribed was 3 days for all 4 types of dental visits. The median quantity of opioids dentists prescribed was 18 for nonsurgical visits, 20 for surgical visits, 16 for presurgical visits, and 16 for postsurgical visits. The median daily MME dose dentists prescribed was 30.00 for nonsurgical visits, 33.33 for surgical dental visits, 37.50 for presurgical dental visits, and 33.33 for postsurgical dental visits.

After exclusion of diagnostic and preventive categories of procedures, restorative procedures constituted 55.57% of all procedures performed during a nonsurgical dental visit at which dentists prescribed opioids, and oral and maxillofacial surgery accounted for 59.11% of all procedures performed during a surgical dental visit at which dentists prescribed opioids. Table 4 summarizes the breakdown of dental procedures performed during nonsurgical and surgical dental visits at which dentists prescribed opioids.

DISCUSSION

The results of this study show that for people who were privately insured in the United States from 2010 through 2015, the rate of opioid prescriptions per 1,000 dental patients has increased, especially for the group aged 11 through 18 years. This age group also received a higher median daily MME dose compared to the median daily MME dose for all age groups, and approximately 89% of the opioids prescribed for this age group were associated with a surgical dental visit. Denisco and colleagues²¹ estimated that 3.5 million people with an average age of 20 years may have been exposed to opioids through dentistry. Volkow and colleagues⁵ reported that in 2009 dentists were the main prescribers of opioids for adolescents and young adults aged 10 through 19 years and prescribed 31% of all the opioid prescriptions for this age group. In a study of high school seniors, 36.9% of nonmedical users of prescription opioids used the drugs from their own previous prescriptions, and 27% of these

Table 2. Mean and median days' supply, quantity prescribed, and daily MME* dose dentists prescribed according to patient age group in the United States for 2010 through 2015 combined.[†]

AGE GROUP, Y	DAYS' SUPPLY		QUANTITY PRESCRIBED		DAILY MME DOSE	
	Mean (Standard Deviation [SD])	Median (Interquartile Range [IQR])	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)
< 11	4.21 (3.66)	3 (3)	87.90 (63.88)	80 (70)	13.50 (12.79)	10.80 (10.08)
11-18	3.60 (1.96)	3 (1)	28.80 (39.40)	20 (9)	42.54 (42.06)	36.00 (23.00)
19-25	3.67 (2.75)	3 (2)	23.07 (27.44)	20 (6)	44.80 (56.46)	37.50 (22.00)
26-40	4.23 (4.71)	3 (2)	23.01 (27.36)	18 (5)	42.44 (53.70)	33.33 (20.00)
41-55	5.32 (6.80)	3 (3)	26.84 (34.05)	18 (6)	43.17 (77.44)	33.33 (20.00)
56-64	6.04 (7.84)	3 (3)	30.21 (39.02)	20 (9)	43.98 (86.04)	33.33 (20.00)
All Age Groups Under 65 Y	4.82 (5.92)	3 (3)	26.78 (34.35)	20 (7)	43.05 (68.71)	33.33 (20.00)

* MME: Morphine milligram equivalent. † Source: Analysis of Truven Health Marketscan Research databases¹⁰ and Prescription Drug Monitoring Program Training and Technical Assistance Center conversion data set.¹² The sample population consists of 1,558,446 opioid prescription claims from 1,135,344 patients.

Table 3. Percentage of opioid prescriptions by dentist according to type of dental visits, according to patient age group, in the United States for 2010 through 2015 combined.*

AGE GROUP, Y	NONSURGICAL DENTAL VISIT, NO. (%)	SURGICAL DENTAL VISIT, NO. (%)	PRESURGICAL DENTAL VISIT, NO. (%)	POSTSURGICAL DENTAL VISIT, NO. (%)
< 11	3,261 (30.42)	7,452 (69.51)	— [†]	— [†]
11-18	15,470 (11.12)	123,489 (88.78)	— [†]	123 (0.09)
19-25	38,737 (23.98)	122,072 (75.56)	169 (0.10)	575 (0.36)
26-40	109,791 (35.16)	200,263 (64.13)	471 (0.15)	1,739 (0.56)
41-55	153,924 (36.48)	265,733 (62.98)	499 (0.12)	1,779 (0.42)
56-64	75,882 (32.83)	154,449 (66.81)	160 (0.07)	674 (0.29)
All Age Groups Under 65 Y	397,065 (31.10)	873,458 (68.41)	1,318 (0.10)	4,897 (0.38)

* Source: Analysis of Truven Health Marketscan Research databases.¹⁰ The sample population consists of 1,276,738 opioid prescription claims from 1,004,858 patients. Percentages may not add up to 100% because of rounding. † Data are not presented because the cell size is less than 30.

prescriptions came from a dentist.²² Results of our analysis help confirm the need for cautious opioid prescribing for this subpopulation to reduce the exposure and misuse of opioids at a younger age.

Our study results show that approximately 31% of the opioids prescribed for all age groups were associated with nonsurgical dental visits. This finding suggests there might be opportunities to reduce opioid prescription rates by targeting nonsurgical dental visit prescribing practices. Study results have shown that nonsteroidal anti-inflammatory drugs (NSAIDs) are effective for pain with few adverse effects,²³ whereas opioids are associated with more adverse effects.²⁴ Patients can manage pain by using optimal doses of NSAIDs at regular time intervals and by preoperative administration of NSAIDs in cases in which pain is anticipated.²⁵ Opioids can be considered if the pain persists after the optimal dose of NSAIDs has been reached. Investigators in 1 study noted that a combination of ibuprofen and acetaminophen can be more effective than opioids, with fewer adverse effects, in providing analgesia after third-molar extractions.²⁶ The National Academy of Medicine also recommends that dentists use nonopioid analgesics for pain management along with precautionary measures such as use of PDMPs, counseling patients about risks and benefits, and monitoring patients.²⁷ According to PDMP TTAC,²⁸

PDMPs collect, monitor, and analyze electronically transmitted prescribing and dispensing data submitted by pharmacies and dispensing practitioners. The data are used to support states' efforts in education, research, enforcement and abuse prevention. PDMPs are managed under the auspices of a state, district, commonwealth, or territory of the United States.

PDMPs allow practitioners and pharmacists to obtain reports about opioid drug use for their patients, which they can use to prevent concurrent prescriptions and identify patients at risk of experiencing opioid drug abuse. However, investigators in 1 study reported that only 38% of dentists ever had accessed a PDMP.²⁹ Investigators in another study noted that mandatory use of a PDMP

Table 4. Breakdown of dental procedures performed during dental visits at which dentists prescribed opioids in the United States for 2010 through 2015 combined.*

PROCEDURE CATEGORY	NO. (%)
Nonsurgical Dental Visit	
Restorative	118,471 (55.57)
Adjunctive general	43,554 (20.43)
Periodontics	24,091 (11.30)
Endodontics	13,529 (6.35)
Prosthodontics fixed	7,588 (3.56)
Prosthodontics removable	3,292 (1.54)
Implants	1,590 (0.75)
Orthodontics	1,024 (0.48)
Maxillofacial prosthetics	43 (0.02)
Oral and maxillofacial surgery	0 (0.00)
Total	213,182 (100.00)
Surgical Dental Visit	
Oral and maxillofacial surgery	1,459,256 (59.11)
Adjunctive general	493,959 (20.01)
Endodontics	169,415 (6.86)
Restorative	158,794 (6.43)
Periodontics	98,695 (4.00)
Implants	49,045 (1.99)
Prosthodontics removable	21,493 (0.87)
Prosthodontics fixed	16,891 (0.68)
Orthodontics	595 (0.02)
Maxillofacial prosthetics	444 (0.02)
Total	2,468,587 (99.99) [†]

* Source: Analysis of Truven Health MarketScan Research databases.¹⁰ We excluded diagnostic and preventive procedures from this analysis. The sample population consists of 1,276,738 opioid prescription claims from 1,004,858 patients. † The percentages in this column are rounded and, hence, add up to 99.99%.

caused a 78% decrease in the quantity of opioids prescribed and an increase in the use of nonopioid analgesics.³⁰ Increased use of PDMPs among dentists and other health care providers can help identify patients at risk of experiencing opioid misuse or abuse, prevent concurrent prescriptions, and discourage drug shoppers.

In our sample, the use of hydrocodone decreased from 2014 through 2015, and the use of other drugs such as codeine and tramadol increased during the same time frame, which could be a possible effect of the reclassification of drugs. In October 2014, the US Drug Enforcement Administration reclassified hydrocodone as a schedule II drug from a schedule III drug.³¹ Oxycodone is a schedule II drug, codeine is a schedule III drug, and tramadol is a schedule IV drug.³² Schedule II drugs require a written prescription, whereas schedule III and IV drugs can be telephoned in to pharmacies. Because schedule II drugs are controlled more strongly and schedule III and IV drugs are easier and more convenient to prescribe, it is possible that the reclassification of hydrocodone helped reduce hydrocodone prescriptions while increasing the number of codeine and tramadol prescriptions; however, our study results do not establish causality. Nonetheless, hydrocodone still accounted for almost 63% of all opioid prescriptions written by dentists in 2015.

Limitations

There are several limitations to this study. This study is based on claims data for people who are privately insured. Hence, we cannot generalize the results of this study to the entire US population. However, given that the opioid addiction epidemic affects all income groups,²⁰ our sample may not

exhibit selection bias. The analysis is based on a large convenience sample of people who are privately insured but may not necessarily be nationally representative.

To obtain a prescriber source, we restricted our opioid claims data set to initial prescription fills only and did not account for refills. Usually, prescriptions from dentists are short term, designed to last a maximum of 5 days. Although it is possible that patients obtained refills, our data set does not account for those opioid claims. Therefore, our analyses could lead to underestimation of the rate of opioid use among dental patients.

In our study, we assumed that if a dentist prescribed an opioid, the level of pain was high enough to warrant filling that prescription within 3 days. It is possible that patients filled their prescriptions later than our assumption of 3 days and that we excluded these patients from our analyses. Because we did not have a definite prescriber source and had to rely on visit date and prescription fill date, our assumption best identified the prescriber while excluding other potential overlaps and refills. We acknowledge this as a limitation of our study.

CONCLUSIONS

Within a large population of people who were privately insured in the United States, the number of opioid prescriptions per 1,000 dental patients increased from 2010 to 2015, especially for the group aged 11 through 18 years. The number of days' supply prescribed was the same for all age groups. The quantity of opioids prescribed was 20. The groups aged 11 through 18 years and 19 through 25 years received higher daily MME doses than did the other age groups. Most opioids prescribed were associated with surgical dental visits. Although dentistry is accounting for less of the total volume of opioid prescriptions in the United States, results of our analysis suggest important areas of focus for further managing opioid prescribing among dentists. ■

SUPPLEMENTAL DATA

Supplemental data related to this article can be found at: <https://doi.org/10.1016/j.adaj.2018.01.005>.

Dr. Gupta is a health services researcher, Health Policy Institute, American Dental Association, 211 E. Chicago Ave. Chicago, IL 60611, e-mail guptani@ada.org. Address correspondence to Dr. Gupta.

Dr. Vujicic is the chief economist and the vice president, Health Policy Institute, American Dental Association, Chicago, IL.

Mr. Blatz is a research analyst, Health Policy Institute, American Dental Association, Chicago, IL.

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eTable 1. List of opioid drugs and their morphine milligram equivalent conversion factor.

OPIOID DRUG*	MORPHINE MILLIGRAM EQUIVALENT CONVERSION FACTOR
Buprenorphine [†]	30.00
Butorphanol	7.00
Codeine	0.15
Dihydrocodeine	0.25
Fentanyl [†]	0.13
Hydrocodone	1.00
Hydromorphone	4.00
Levomethadyl	8.00
Levorphanol	11.00
Meperidine	0.10
Methadone	3.00
Morphine	1.00
Nalbuphine	1.00
Opium	1.00
Oxycodone	1.50
Oxymorphone	3.00
Pentazocine	0.37
Tapentadol	0.40
Tramadol	0.10

* Strength in milligrams unless noted otherwise. Sources: National Center for Injury Prevention and Control¹³ and Centers for Medicare & Medicaid Services.¹⁴ † The conversion factor in the table for buprenorphine and fentanyl is for tablet form. The conversion factor for buprenorphine transdermal patch (micrograms per hour) is 12.6 and buprenorphine film (micrograms) is 0.03. The conversion factor for fentanyl film or oral spray (micrograms) is 0.18, for fentanyl nasal spray (micrograms) is 0.16, and for fentanyl transdermal patch (micrograms per hour) is 7.2.

eTable 2. Current Dental Terminology codes (CDT) considered as surgical procedures.*

CDT CODE	DESCRIPTION
D3220	Therapeutic pulpotomy (excluding final restoration) - removal of pulp coronal to the dentinocemental junction and application of medicament
D3221	Pulpal debridement, primary and permanent teeth
D3222	Partial pulpotomy for apexogenesis - permanent tooth with incomplete root development
D3230	Pulpal therapy (resorbable filling) — anterior, primary tooth (excluding final restoration)
D3240	Pulpal therapy (resorbable filling) — posterior, primary tooth (excluding final restoration)
D3310	Endodontic therapy, anterior tooth (excluding final restoration)
D3320	Endodontic therapy, bicuspid tooth (excluding final restoration)
D3330	Endodontic therapy, molar (excluding final restoration)
D3410	Apicoectomy - anterior
D3421	Apicoectomy - premolar (first root)
D3425	Apicoectomy - molar (first root)
D3426	Apicoectomy (each additional root)
D3427	Periradicular surgery without apicoectomy
D3428	Bone graft in conjunction with periradicular surgery — per tooth, single site

* Source: The American Dental Association Current Dental Terminology (CDT) code book,¹⁵⁻¹⁹ and expert opinion from researchers at academic institutions. The description of the CDT codes is based on the American Dental Association Current Dental Terminology (CDT) code book 2018.³³

eTable 2. Continued

CDT CODE	DESCRIPTION
D3429	Bone graft in conjunction with periradicular surgery – each additional contiguous tooth in the same surgical site
D3430	Retrograde filling - per root
D3431	Biologic materials to aid in soft and osseous tissue regeneration in conjunction with periradicular surgery
D3432	Guided tissue regeneration, resorbable barrier, per site, in conjunction with periradicular surgery
D3450	Root amputation - per root
D3460	Endodontic endosseous implant
D3470	Intentional reimplantation (including necessary splinting)
D3910	Surgical procedure for isolation of tooth with rubber dam
D3920	Hemisection (including any root removal), not including root canal therapy
D4210	Gingivectomy or gingivoplasty - four or more contiguous teeth or tooth bounded spaces per quadrant
D4211	Gingivectomy or gingivoplasty - one to three contiguous teeth or tooth bounded spaces per quadrant
D4212	Gingivectomy or gingivoplasty to allow access for restorative procedure, per tooth
D4230	Anatomical crown exposure - four or more contiguous teeth or bounded tooth spaces per quadrant
D4231	Anatomical crown exposure - one to three teeth or bounded tooth spaces per quadrant
D4240	Gingival flap procedure, including root planing - four or more contiguous teeth or tooth bounded spaces per quadrant
D4241	Gingival flap procedure, including root planing - one to three contiguous teeth or tooth bounded spaces per quadrant
D4245	Apically positioned flap
D4249	Clinical crown lengthening – hard tissue
D4260	Osseous surgery (including elevation of a full thickness flap and closure) – four or more contiguous teeth or tooth bounded spaces per quadrant
D4261	Osseous surgery (including elevation of a full thickness flap and closure) – one to three contiguous teeth or tooth bounded spaces per quadrant
D4263	Bone replacement graft – retained natural tooth – first site in quadrant
D4264	Bone replacement graft – retained natural tooth – each additional site in quadrant
D4265	Biologic materials to aid in soft and osseous tissue regeneration
D4266	Guided tissue regeneration - resorbable barrier, per site
D4267	Guided tissue regeneration - nonresorbable barrier, per site (includes membrane removal)
D4268	Surgical revision procedure, per tooth
D4270	Pedicle soft tissue graft procedure
D4271	Free soft tissue graft procedure (including donor site surgery)
D4273	Autogenous connective tissue graft procedure (including donor and recipient surgical sites) first tooth, implant, or edentulous tooth position in graft
D4274	Mesial/distal wedge procedure, single tooth (when not performed in conjunction with surgical procedures in the same anatomical area)
D4275	Non-autogenous connective tissue graft (including recipient site and donor material) first tooth, implant, or edentulous tooth position in graft
D4276	Combined connective tissue and double pedicle graft, per tooth
D4277	Free soft tissue graft procedure (including recipient and donor surgical sites) first tooth, implant or edentulous tooth position in graft
D4278	Free soft tissue graft procedure (including recipient and donor surgical sites) each additional contiguous tooth, implant or edentulous tooth position in same graft site
D6010	Surgical placement of implant body: endosteal implant
D6011	Second stage implant surgery
D6012	Surgical placement of interim implant body for transitional prosthesis: endosteal implant
D6013	Surgical placement of mini implant
D6040	Surgical placement: eposteal implant

(continued)

eTable 2. Continued

CDT CODE	DESCRIPTION
D6050	Surgical placement: transosteal implant
D6100	Implant removal, by report
D6101	Debridement of a peri-implant defect or defects surrounding a single implant, and surface cleaning of the exposed implant surfaces, including flap entry and closure
D6102	Debridement and osseous contouring of a peri-implant defect or defects surrounding a single implant and includes surface cleaning of the exposed implant surfaces, including flap entry and closure
D6103	Bone graft for repair of peri-implant defect – does not include flap entry and closure
D6104	Bone graft at time of implant placement
D7111	Extraction, coronal remnants – primary tooth
D7140	Extraction, erupted tooth or exposed root (elevation and/or forceps removal)
D7210	Extraction, erupted tooth requiring removal of bone and/or sectioning of tooth, and including elevation of mucoperiosteal flap if indicated
D7220	Removal of impacted tooth - soft tissue
D7230	Removal of impacted tooth - partially bony
D7240	Removal of impacted tooth - completely bony
D7241	Removal of impacted tooth - completely bony, with unusual surgical complications
D7250	Removal of residual tooth roots (cutting procedure)
D7251	Coronectomy – intentional partial tooth removal
D7260	Oroantral fistula closure
D7261	Primary closure of a sinus perforation
D7270	Tooth reimplantation and/or stabilization of accidentally evulsed or displaced tooth
D7272	Tooth transplantation (includes reimplantation from one site to another and splinting and/or stabilization)
D7280	Exposure of an unerupted tooth
D7282	Mobilization of erupted or malpositioned tooth to aid eruption
D7283	Placement of device to facilitate eruption of impacted tooth
D7285	Incisional biopsy of oral tissue-hard (bone, tooth)
D7286	Incisional biopsy of oral tissue-soft
D7287	Exfoliative cytological sample collection
D7288	Brush biopsy - transepithelial sample collection
D7290	Surgical repositioning of teeth
D7291	Transseptal fiberotomy/supra crestal fiberotomy, by report
D7292	Placement of temporary anchorage device [screw retained plate] requiring flap; includes device removal
D7293	Placement of temporary anchorage device requiring flap; includes device removal
D7294	Placement of temporary anchorage device without flap; includes device removal
D7295	Harvest of bone for use in autogenous grafting procedure
D7310	Alveoplasty in conjunction with extractions - four or more teeth or tooth spaces, per quadrant
D7311	Alveoplasty in conjunction with extractions - one to three teeth or tooth spaces, per quadrant
D7320	Alveoplasty not in conjunction with extractions - four or more teeth or tooth spaces, per quadrant
D7321	Alveoplasty not in conjunction with extractions - one to three teeth or tooth spaces, per quadrant
D7340	Vestibuloplasty - ridge extension (secondary epithelialization)
D7350	Vestibuloplasty - ridge extension (including soft tissue grafts, muscle reattachment, revision of soft tissue attachment and management of hypertrophied and hyperplastic tissue)
D7410	Excision of benign lesion up to 1.25 cm
D7411	Excision of benign lesion greater than 1.25 cm
D7412	Excision of benign lesion, complicated

(continued)

eTable 2. Continued

CDT CODE	DESCRIPTION
D7413	Excision of malignant lesion up to 1.25 cm
D7414	Excision of malignant lesion greater than 1.25 cm
D7415	Excision of malignant lesion, complicated
D7440	Excision of malignant tumor - lesion diameter up to 1.25 cm
D7441	Excision of malignant tumor - lesion diameter greater than 1.25 cm
D7450	Removal of benign odontogenic cyst or tumor - lesion diameter up to 1.25 cm
D7451	Removal of benign odontogenic cyst or tumor - lesion diameter greater than 1.25 cm
D7460	Removal of benign nonodontogenic cyst or tumor - lesion diameter up to 1.25 cm
D7461	Removal of benign nonodontogenic cyst or tumor - lesion diameter greater than 1.25 cm
D7465	Destruction of lesion(s) by physical or chemical method, by report
D7471	Removal of lateral exostosis (maxilla or mandible)
D7472	Removal of torus palatinus
D7473	Removal of torus mandibularis
D7485	Reduction of osseous tuberosity
D7490	Radical resection of maxilla or mandible
D7510	Incision and drainage of abscess - intraoral soft tissue
D7511	Incision and drainage of abscess - intraoral soft tissue - complicated (includes drainage of multiple fascial spaces)
D7520	Incision and drainage of abscess - extraoral soft tissue
D7521	Incision and drainage of abscess - extraoral soft tissue - complicated (includes drainage of multiple fascial spaces)
D7530	Removal of foreign body from mucosa, skin, or subcutaneous alveolar tissue
D7540	Removal of reaction producing foreign bodies, musculoskeletal system
D7550	Partial ostectomy/sequestrectomy for removal of non-vital bone
D7560	Maxillary sinusotomy for removal of tooth fragment or foreign body
D7610	Maxilla - open reduction (teeth immobilized, if present)
D7620	Maxilla - closed reduction (teeth immobilized, if present)
D7630	Mandible - open reduction (teeth immobilized, if present)
D7640	Mandible - closed reduction (teeth immobilized, if present)
D7650	Malar and/or zygomatic arch - open reduction
D7660	Malar and/or zygomatic arch - closed reduction
D7670	Alveolus - closed reduction, may include stabilization of teeth
D7671	Alveolus - open reduction, may include stabilization of teeth
D7680	Facial bones - complicated reduction with fixation and multiple surgical approaches
D7710	Maxilla - open reduction
D7720	Maxilla - closed reduction
D7730	Mandible - open reduction
D7740	Mandible - closed reduction
D7750	Malar and/or zygomatic arch - open reduction
D7760	Malar and/or zygomatic arch - closed reduction
D7770	Alveolus - open reduction stabilization of teeth
D7771	Alveolus, closed reduction stabilization of teeth
D7780	Facial bones - complicated reduction with fixation and multiple approaches
D7810	Open reduction of dislocation
D7820	Closed reduction of dislocation

(continued)

eTable 2. Continued

CDT CODE	DESCRIPTION
D7830	Manipulation under anesthesia
D7840	Condylectomy
D7850	Surgical discectomy, with/without implant
D7852	Disc repair
D7854	Synovectomy
D7856	Myotomy
D7858	Joint reconstruction
D7860	Arthrotomy
D7865	Arthroplasty
D7870	Arthrocentesis
D7871	Non-arthroscopic lysis and lavage
D7872	Arthroscopy - diagnosis, with or without biopsy
D7873	Arthroscopy: lavage and lysis of adhesions
D7874	Arthroscopy: disc repositioning and stabilization
D7875	Arthroscopy: synovectomy
D7876	Arthroscopy: discectomy
D7877	Arthroscopy: debridement
D7880	Occlusal orthotic device, by report
D7899	Unspecified TMD therapy, by report
D7910	Suture of recent small wounds up to 5 cm
D7911	Complicated suture - up to 5 cm
D7912	Complicated suture - greater than 5 cm
D7920	Skin graft (identify defect covered, location and type of graft)
D7921	Collection and application of autologous blood concentrate product
D7940	Osteoplasty - for orthognathic deformities
D7941	Osteotomy - mandibular rami
D7943	Osteotomy - mandibular rami with bone graft; includes obtaining the graft
D7944	Osteotomy - segmented or subapical
D7945	Osteotomy - body of mandible
D7946	Lefort I (maxilla - total)
D7947	Lefort I (maxilla - segmented)
D7948	Lefort II or lefort III (osteoplasty of facial bones for midface hypoplasia or retrusion) - without bone graft
D7949	Lefort II or lefort III - with bone graft
D7950	Osseous, osteoperiosteal, or cartilage graft of the mandible or maxilla - autogenous or nonautogenous, by report
D7951	Sinus augmentation with bone or bone substitutes via a lateral open approach
D7952	Sinus augmentation via a vertical approach
D7953	Bone replacement graft for ridge preservation - per site
D7955	Repair of maxillofacial soft and/or hard tissue defect
D7960	Frenulectomy - also known as frenectomy or frenotomy - separate procedure not incidental to another procedure
D7963	Frenuloplasty
D7970	Excision of hyperplastic tissue - per arch
D7971	Excision of pericoronal gingiva
D7972	Surgical reduction of fibrous tuberosity

(continued)

eTable 2. Continued

CDT CODE	DESCRIPTION
D7980	Surgical sialolithotomy
D7981	Excision of salivary gland, by report
D7982	Sialodochoplasty
D7983	Closure of salivary fistula
D7990	Emergency tracheotomy
D7991	Coronoidectomy
D7995	Synthetic graft - mandible or facial bones, by report
D7996	Implant-mandible for augmentation purposes (excluding alveolar ridge), by report
D7997	Appliance removal (not by dentist who placed appliance), includes removal of archbar
D7998	Intraoral placement of a fixation device not in conjunction with a fracture
D7999	Unspecified oral surgery procedure, by report

eTable 3. Percentages of opioids most frequently prescribed by dentists in the United States, 2010 through 2015.*

GENERIC DRUG NAME	2010, %	2011, %	2012, %	2013, %	2014, %	2015, %
Acetaminophen With Hydrocodone Bitartrate	70.21	70.66	70.69	70.18	69.16	63.36
Acetaminophen With Oxycodone Hydrochloride	10.90	10.30	10.25	10.43	10.53	11.62
Acetaminophen With Codeine	10.56	9.94	9.91	10.12	10.81	14.28
Hydrocodone Bitartrate With Ibuprofen	3.09	2.85	2.90	2.96	2.68	1.89
Tramadol Hydrochloride	1.78	2.61	2.79	2.96	3.48	4.60

* Source: Analysis of Truven Health Marketscan Research databases.¹⁰