Prescribing patterns of opioid analgesics in a dental setting: 2013–2018

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Objective. Analgesic prescribing patterns are influenced by internal and external factors. Understanding these factors could help improve prescribing practices.

Study Design. We conducted a retrospective analysis of electronic health records with regard to analgesic prescriptions written from 2013 through 2018 at the University of Kentucky College of Dentistry. Deidentified information (age, gender, dental procedures, analgesic drug, quantity, and refills) were recorded and studied with respect to national guidelines and recent state legislation using the χ^2 test, analysis of variance, logistic regression, and multiple linear regression.

Results. Opioids comprised 74.9% of the 17,099 analgesic prescriptions written. Extractions were most commonly associated with opioid prescriptions. Multivariate analysis showed that (1) older patients were more likely to receive an opioid prescription ($P < .01$) but with fewer pills ($P < .01$); (2) surgical extractions were associated with a lower opioid prescription rate ($P < .01$) but more opioid pills per prescription compared with nonsurgical extractions ($P < .01$); and (3) the odds of receiving an opioid prescription and the number of opioid pills prescribed decreased over year after release of the national guideline ($P < .01$) and after enactment of state legislation ($P < .01$).

Conclusions. Regulations and guidelines were associated with reduction in opioid prescriptions. (Oral Surg Oral Med Oral Pathol Oral Radiol 2020;130:402–410)

Pain-relieving medications are commonly prescribed in the United States and have contributed to the opioid epidemic.[1-6] Since 1999, greater than 399,000 deaths have been attributed to this epidemic.[3,7] A major factor contributing to this public health problem is indiscriminate opioid analgesic prescriptions.[8-10] Dentists, as prescribers of opioid analgesics, serve as a source of these drugs,[11] contributing 8% of all opioid prescriptions in the United States in 2009 and 6.4% in 2012.[12,13]

Several recent studies have examined the role of the dentist and opioid prescriptions relevant to patient cohorts and after third molar extractions.[4,11,14-21] Despite accumulating evidence, Lutfiyya et al. recently noted a paucity of research that has investigated the general prescribing patterns across dentistry.[22] A better understanding of the complexities of opioid prescribing can be obtained from studies that address the characteristics of dental patients as well as the relationships between types of dental procedures, before and after the establishment of national guidelines and state legislation.

This study examined these characteristics and factors in a dental school setting, where greater than 110,000 ambulatory patient care visits are provided per year, in a state with the 4th highest drug overdose death rates in the United States.[23] The study, a 6-year retrospective analysis, examined opioid prescribing patterns with respect to 2 key events: (1) The March 2016 recommendation by the Centers for Disease Control and Prevention (CDC) to limit the duration of opioid therapy to 3 days or less for most patients with acute pain,[24] and (2) state legislation (Kentucky House Bill [HB] 333, in effect June 2017) that limits Schedule II controlled substance prescriptions for acute pain to 3 days or less.[25]

MATERIALS AND METHODS

A retrospective analysis of prescription drug data contained within the dental electronic health record (EHR; axiUm) at the University of Kentucky College of Dentistry (Lexington, KY) was performed with the approval of the University Institutional Review Board (No. 43893). Data from January 1, 2013, to December 31, 2018, were used. Analgesics were identified using generic and trade names from all prescriptions present in the EHR. Duplicates were removed (n = 3739). Also, 176 records with drug descriptions containing the words "LIQUID"/"PATCH"/"SUSP"/"SUSPENSION"/"ELIXIR"/

Statement of Clinical Relevance

Dentists should be aware that opioid prescribing patterns for pain management appears to be influenced by many factors, including, but not limited to, the type of procedure, national guidelines, and state regulations.

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"ELIXR"/"ELIXER"/"SOLN"/"SOLUTION"/"ML"/"cc," were removed.

Inclusion criteria

Data from all patients who received a nonopioid analgesic prescription (e.g., aspirin, acetaminophen, and nonsteroidal anti-inflammatory drugs [NSAIDs]) or an opioid prescription (defined as a narcotic analgesic by the Drug Enforcement Agency) prescribed alone or in combination with another analgesic between January 1, 2013, and December 31, 2018, were included. There was no age restriction.

Exclusion criteria

Data were excluded if any of the following categories were incomplete or invalid: age; gender; dental procedures (as defined by the Dental Procedures and Nomenclature code or the Current Procedural Terminology code linked to the visit data); provider; date prescription provided; and name, quantity, and refills of drugs.

Data extraction

Information from valid and complete deidentified records (i.e., containing all the categorical information listed above) was entered into an Excel spreadsheet, with initial prescriptions and refill prescriptions counted separately.

Statistical analysis

The 2 primary outcome variables were the presence or absence of an opioid prescription and the number of opioid pills prescribed. Exploratory studies of potential predictors were conducted by using the χ^2 test and analysis of variance (followed by Fisher's least significant difference [LSD] if an overall significant difference was found). Multivariate analysis was performed to study prescriptions associated with extractions (i.e., the procedure most associated with opioid prescriptions). Specifically, logistic regression on the presence or absence of an opioid prescription was conducted using the following predictors: age, extraction type (surgical vs nonsurgical); sedation (provided or not); number of extractions (as a continuous variable); the CDC guidelines (before and after); Kentucky HB 333 (before and after); and year (as a categorical variable). Multiple linear regression on the number of opioid pills prescribed was performed on the basis of the same set of predictors plus drug (oxycodone combinations, hydrocodone combinations, codeine combinations, tramadol, and other). The number of pills was treated as a continuous response and subsequently log-transformed. All statistical analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC).

RESULTS

Between 2013 and 2018, there were 850,023 patient visits, with 133,891 visits in 2013 and an average increase of 2.5% visits per year. During this 6-year study period, 47,725 prescriptions were written (i.e., 5.6% visits resulted in a prescription) at the College of Dentistry. Of these prescriptions, 17,099 (35.8%) were for analgesics.

Characteristics of patients and prescriptions

The mean age of patients who received an analgesic prescription was 41 years (range 2−88 years), and the study patients were predominantly females (57.1%; Table I). Opioid prescription recipients were proportionally similar by gender as those who received a nonopioid (χ^2 test; $P = .38$). Figure 1 shows that patients 30 years or younger received 36.9% of the analgesic prescriptions, with greater than 2500 prescriptions (14.7%) written for persons under age 20 years. Of note, the percentage of opioid prescriptions increased with age by decade. The most commonly prescribed opioid was acetaminophen with hydrocodone (87%), followed by acetaminophen with oxycodone (8%), acetaminophen with codeine (2%), and tramadol (2%). The average number of pills prescribed was different across opioid categories (analysis of variance; $P < .01$). Oxycodone combinations were associated with significantly more pills compared with codeine combinations (Fisher's LSD; $P < .05$).

Characteristics of procedures associated with analgesic prescriptions

Analgesic prescriptions were associated with 83,943 procedures (i.e., 4.91 procedures per analgesic prescription, on average), with opioids prescribed to 9951

Table I. Demographic characteristics of the study population

		Nonopioid (N = 4289)	*Opioid (N = 12,810)*	*Overall (N = 17,099)*
Mean age* (minimum, median, maximum)		38 (2, 34, 88)	42 (3, 40, 88)	41 (2, 38, 88)
Gender†	Female	2489 (25.5%)	7277 (74.5%)	9766 (57.1%)
	Male	1796 (24.6%)	5514 (75.4%)	7310 (42.8%)
	Transgender	0 (0%)	5 (100%)	5 (0%)
	Unknown	4 (22.2%)	14 (77.8%)	18 (0.1%)

*Nonopioid versus opioid: $P < .01$; two-sample t-test.
†Nonopioid versus opioid: $P = .38$; χ^2 test.

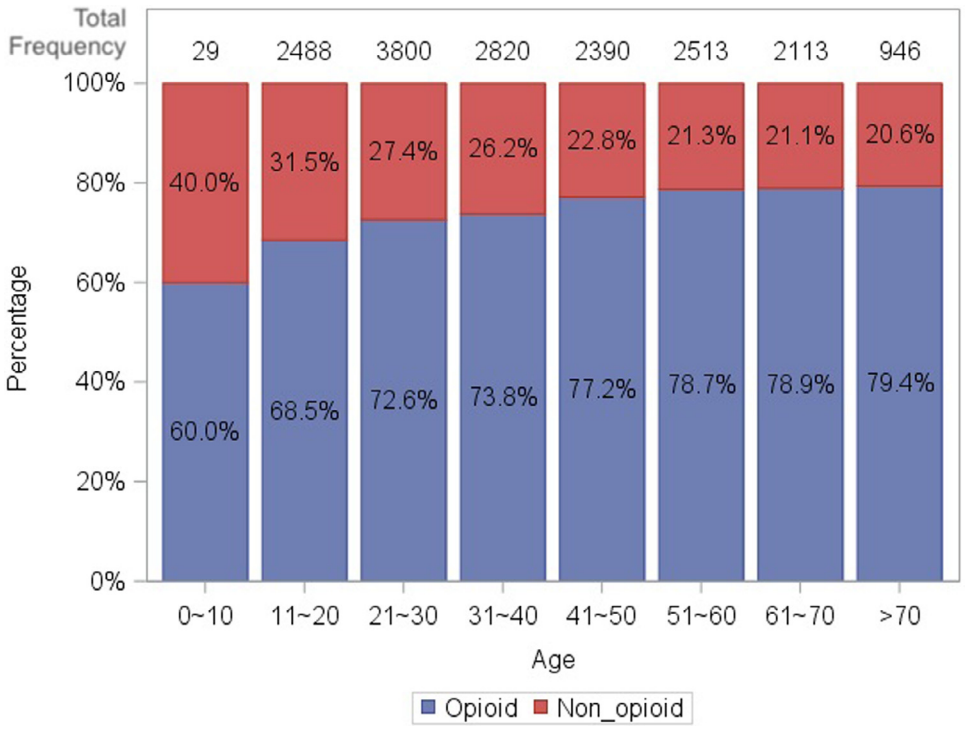

Fig. 1. Percentage and quantity of opioid and non-opioid prescriptions by age.

patients who underwent 61,754 procedures. Procedure categories associated with the 17,099 analgesic prescriptions are shown in Supplemental Table I. Here, greater than 70% of opioid prescriptions were associated with oral and maxillofacial surgery (i.e., primarily extractions) and with periodontal and implant-related procedures, with or without sedation. Dental procedures less commonly associated with opioids were endosteal implant placement (3.9%), alveoloplasty (quadrant; 3.7%), office evaluation/visit (2.9%), surgical excisions (1.1%), ridge/socket preservation (1%), denture delivery (1%), alveoloplasty (1−3 teeth; 0.7%), and a restorative procedure (0.7%).

Refills

Analgesic refills were prescribed in 6.3% of occurrences, that is, once (5.5%), twice (0.5%), and three times (0.3%). Table II shows that opioid refill medications were more frequently prescribed compared with nonopioids (χ^2 test; $P < .01$).

Table II. Refill versus nonrefill opioid and nonopioid prescriptions

	Nonrefill	*Refill*
Nonopioid	3887 (24.2%)	402 (37.9%)
Opioid	12152 (75.8%)	658 (62.1%)*

*Refill versus nonrefill: $P < .01$; χ^2 test.

Trends in analgesic prescriptions

The trend in analgesic (i.e., opioid to nonopioid) prescriptions from 2013 to 2018, separated into 3 phases according to the CDC guidelines released on March 2016 and the enactment of the Kentucky statute in June 2017, is shown in Figure 2. Here, the percentage of analgesic prescriptions written for opioids was consistently high (ranging from 81% to 84.2%) through 2016 before the CDC guidelines were released. Opioid prescriptions showed a downward trend between the 2 events and after Kentucky HB 333 went into effect, with decreases by 6.6% in 2017 before Kentucky HB 333 went into effect, another 8.9% later in 2017, and another 10.5% in 2018. A similar pattern was observed in the number of opioid pills prescribed (Figure 3).

Multivariate analysis

Logistic regression and the odds ratio estimates derived from the model are shown in Table III. This analysis demonstrated that (1) the odds of receiving an opioid prescription were higher for nonsurgical extractions than for surgical extractions ($P < .01$); (2) the odds of receiving an opioid prescription decreased as the number of extractions increased ($P < .01$); (3) older patients were more likely to receive an opioid prescription ($P < .01$); and (4) there was no consistent downward change in the odds of receiving an opioid prescription before 2016 ($P > .05$). However this changed since

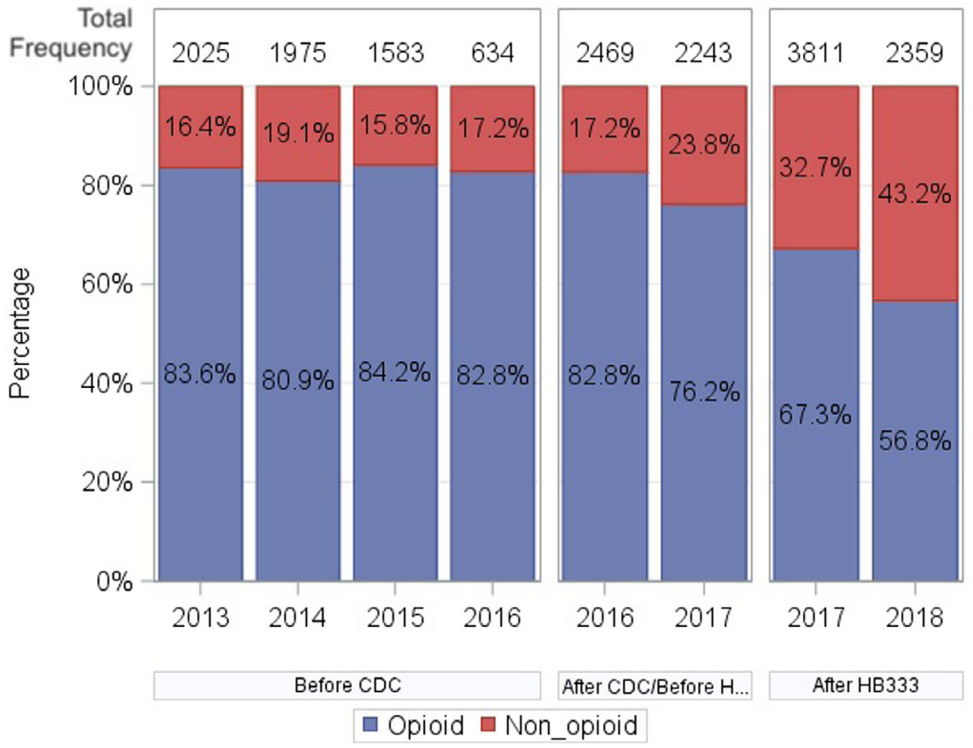

Fig. 2. Percentage and quantity of opioid and non-opioid prescriptions by year. Six years are separated into 3 periods, according to the release of CDC guidelines and Kentucky HB 333.

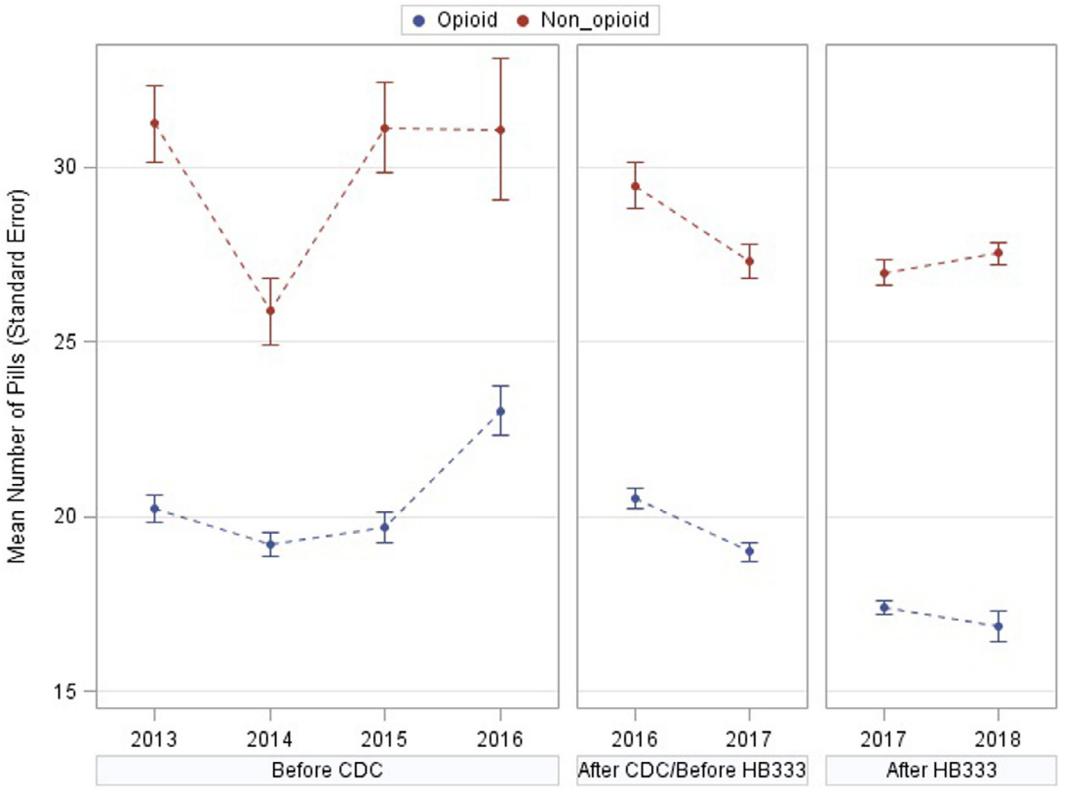

Fig. 3. Mean number of analgesic pills prescribed by year. Blue points and dashed line represent opioid pills prescribed; red points and dashed line represent nonopioid pills prescribed; bars represent standard errors. Six years are separated into three periods, according to the release of CDC guidelines and Kentucky HB 333.

Table III. Odds ratio estimates of factors associated with opioid prescribing based on logistic regression

Effect	*Odds ratio estimate*	*95% confidence interval*
Nonsurgical versus surgical	1.264	(1.085−1.473)
Number of extractions (per 1-extraction increase)	0.954	(0.931−0.978)
Sedation versus no sedation	1.008	(0.860−1.180)
Age (per 1-year increase)	1.013	(1.008−1.018)
Year 2014 versus 2013	0.806	(0.584−1.113)
Year 2015 versus 2014	2.135	(1.414−3.224)
Year 2016 before CDC guidelines versus 2015	0.730	(0.424−1.255)
Year 2016 after versus before CDC guidelines	0.966	(0.612−1.527)
Year 2017 before KY statute versus 2016 after CDC guidelines	0.533	(0.415−0.684)
Year 2017 after versus before KY statute	0.599	(0.494−0.727)
Year 2018 versus 2017 after KY statute	0.647	(0.537−0.780)

Table IV. Estimated effects on the number of opioid pills prescribed based on linear regression

Effect	*estimate*	*95% CI*
Nonsurgical versus surgical	−0.275	(−0.297 to −0.252)
Number of extractions (per 1-extraction increase)	0.045	(0.041 to 0.049)
Sedation versus no Sedation	0.059	(0.035 to 0.082)
Age (per 1-year increase)	−0.004	(−0.004 to −0.003)
Oxycodone versus hydrocodone combinations	0.024	(−0.022 to 0.070)
Codeine versus hydrocodone combinations	−0.026	(−0.117 to 0.064)
Tramadol versus hydrocodone combinations	0.161	(0.015 to 0.308)
Other versus hydrocodone combinations	−0.058	(−0.222 to 0.106)
Year 2014 versus 2013	−0.031	(−0.073 to 0.012)
Year 2015 versus 2014	0.033	(−0.012 to 0.079)
Year 2016 before CDC guidelines versus 2015	0.162	(0.101 to 0.223)
Year 2016 after versus before CDC guidelines	−0.200	(−0.255 to −0.145)
Year 2017 before KY statute versus 2016 after CDC guidelines	−0.068	(−0.102 to −0.034)
Year 2017 after versus before KY statute	−0.125	(−0.158 to −0.093)
Year 2018 versus 2017 after KY statute	−0.075	(−0.113 to −0.037)

2017 (both $P < .01$ in 2017 before and after Kentucky HB 333 went into effect; $P < .01$ in 2018).

The linear regression, focusing on the number of opioid pills prescribed, and the resulting fitted model are summarized in Table IV. This analysis showed that (1) more opioid pills were prescribed, on average, for surgical extractions than for nonsurgical extractions ($P < .01$); (2) more extractions were associated with more opioid pills prescribed ($P < .01$); (3) older patients received fewer opioid pills ($P < .01$); (4) extractions involving sedation were associated with more opioid pills prescribed ($P < 0.01$); and (5) there was a successive decrease in the number of opioid pills prescribed after the release of the CDC guidelines ($P < .01$ in 2016; $P < 0.01$ in 2017) and after enactment of Kentucky HB 333 ($P < .01$ in 2017; $P < .01$ in 2018).

DISCUSSION

This 6-year retrospective study that involved review of thousands of analgesic prescriptions demonstrates several important findings. First, 36.9% of all opioids prescribed were to persons 30 years of age or younger, and 14.7% were to those 20 years of age or younger. Second, oral and maxillofacial surgical procedures, specifically extractions, were most associated with an opioid prescription. Third, most patients who received an opioid prescription received, on average, 16 to 21 opioid pills across age decades. Fourth, the pill count increased with increasing potency of opioid prescribed. Fifth, more extractions and sedation procedures contributed to more opioid pills prescribed. Finally, after the release of the CDC guidelines and the Kentucky statute, patients were less likely to receive opioid prescriptions and were prescribed fewer opioid pills.

Dentists are recognized providers of opioids, contributing to the use of millions of opioid pills by patients annually.[11-13,26] Moreover, nearly all opioids prescribed by dentists are immediate-release opioid medications,[16] a frequently abused class of opioids. Dentists can play a role in minimizing opioid abuse by limiting opioid prescriptions to young patients.[14] This is important because the adolescent brain is more vulnerable to the effects of opioids than the adult brain,[27] and exposure to an opioid prescription increases the risk of subsequent opioid use.[28] In the present study, children, adolescents, and young adults under age 20 years received 14.7% of dentist-prescribed opioids. This frequency is similar to that reported in the prescription drug monitoring program data for South Carolina[17] and lower than that reported for the prior decade.[29]

Table SI. Frequency of Procedures and Opioid Prescriptions by Category

	Procedures	*Frequency (%)*	*Opioid Frequency (%)*
Oral Surgery with Sedation	Surgical extractions >3 teeth + Anesthesia/ Sedation + Diagnostics	1508 (8.8%)	1044 (69.2%)
	Extraction, erupted tooth or exposed root + Surgical extractions + Anesthesia/ Sedation + Diagnostics	1143 (6.7%)	775 (67.8%)
	Other combinations of Oral and Maxillofacial Surgery Procedures + Anesthesia/ Sedation + Diagnostics	772 (4.5%)	541 (70.1%)
	Surgical extractions <=3 teeth + Anesthesia/ Sedation + Diagnostics	684 (4.0%)	486 (71.1%)
	Extraction, erupted tooth or exposed root <=3 teeth + Anesthesia/Sedation + Diagnostics	404 (2.4%)	343 (84.9%)
	Oral and Maxillofacial Surgery Procedures + Anesthesia/ Sedation + Removable Prosthodontics + Diagnostics	371 (2.2%)	300 (80.9%)
	Extraction, erupted tooth or exposed root >3 teeth + Anesthesia/Sedation + Diagnostics	286 (1.7%)	200(69.9%)
	Oral and Maxillofacial Surgery Procedures + Surgical Procedures on the Digestive System + Anesthesia/ Sedation + Diagnostics	195 (1.1%)	145 (74.4%)
	Oral and Maxillofacial Surgery Procedures + Surgical Procedures on the Musculoskeletal System + Anesthesia/ Sedation + Diagnostics	78 (0.5%)	59 (75.6%)
Oral Surgery with Periodontal and/or Implant-Related	Oral and Maxillofacial Surgery Procedures + Periodontics + Anesthesia/ Sedation + Diagnostics	368 (2.2%)	291 (79.1%)
	Oral and Maxillofacial Surgery Procedures + Implant Services +Anesthesia/ Sedation + Diagnostics	335 (2.0%)	253 (75.5%)
Oral Surgery without Sedation	Extraction, erupted tooth or exposed root <= 3 teeth + Diagnostics	1450 (8.5%)	1197 (82.6%)
	Other combinations of Oral and Maxillofacial Surgery Procedures + Diagnostics	936 (5.5%)	735 (78.5%)
	Surgical extractions <=3 teeth + Diagnostics	916 (5.4%)	746 (81.4%)
	Extraction, erupted tooth or exposed root + Surgical extractions + Diagnostics	678 (4.0%)	530 (78.2%)
	Extraction, erupted tooth or exposed root >3 teeth + Diagnostics	435 (2.5%)	336 (77.2%)
	Surgical extractions >3 teeth + Diagnostic	409 (2.4%)	320 (78.2%)
	Oral and Maxillofacial Surgery Procedures + other categories (combinations involving surgical procedures not counted in above)	364 (2.1%)	279 (76.6%)
	Oral and Maxillofacial Surgery Procedures involving Surgical Procedures on the Musculoskeletal System + Diagnostics	226 (1.3%)	172 (76.1%)
	Surgical Procedures on the Digestive System + Diagnostics	204 (1.2%)	168 (82.4%)
	Oral and Maxillofacial Surgery Procedures + other categories except for Extractions, Surgical Procedures on the Digestive System and Implant Services + Diagnostics	137 (0.8%)	91 (66.4%)
	Surgical Procedures on the Digestive System + other categories except for Removable Prosthodontics, Implant Services and Extractions + Diagnostics	31 (0.2%)	23 (74.2%)
Periodontal	Periodontics + Diagnostics	921 (5.4%)	700 (76.0%)

(*continued*)

Table SI. Continued

	Procedures	*Frequency (%)*	*Opioid Frequency (%)*
	Periodontics + other categories except for Oral and Maxillofacial Surgery Procedures + Diagnostics	217 (1.3%)	163 (75.1%)
Implant Related	Implant Services + Diagnostics	832 (4.9%)	657 (79.0%)
	Implant Services + other categories except for Oral and Maxillofacial Surgery Procedures, Periodontics, and Diagnostics	131 (0.8%)	96 (73.3%)
Diagnostic	Removable Prosthodontics alone + Diagnostics	18 (0.1%)	17(94.4%)
	Diagnostics alone	2533 (14.8%)	1744 (68.9%)
	Diagnostics + Anesthesia/Sedation	71 (0.4%)	64 (90.1%)
Other	Anesthesia/Sedation alone	59 (0.3%)	33(55.9%)
	Other cases that were not counted in above	387 (2.3%)	302 (78%)
	Total	17,099	12,810

CDT codes by (frequency) per categories listed above:
Anesthesia/Sedation: D9223 (3325), D9243 (2054), D9240 (1165), D9220 (516), D9230 (414), D9222 (349), D9239 (134), D9221 (8)
Diagnostic: D0140 (1701), D0150 (422), D0220 (349), D0330 (340), D0330 (173), D0120 (26), D0381 (28), D0160 (22), D0180 (21), D0382 (13)
Implant Related: D6010, D6104, D6056, D6051, D6100, D6199, D6011, D6066, D6101, D6085
Oral Surgery: D7140, D7210, D7240, D7310, D7230, D7220, D7953, D7250, D7311, D7320
Periodontal: D4266 (207), D4263 (197), D4273 (198), D4277 (175), D4241 (161), D4267 (156), D4249 (151), D4341/D4342 (109), D4261 (87), D4275 (73)

The type of opioid and the number of pills prescribed are interesting points of discussion. Acetaminophen plus hydrocodone represented 87% of the opioid prescriptions after surgical extractions, and acetaminophen with oxycodone represented 8%—a finding that is similar to those of other studies[17,29] and a survey of oral surgeons,[16] but is in contrast to the 70% and 24% of patients who underwent third molar extraction, as reported in the Truven Health Market Scan Commercial and Dental database.[8] In the present study, when oxycodone was prescribed, more pills were prescribed, on average, than were codeine combinations. Thus, increased opioid potency was associated with more pills being prescribed. This finding is surprising because if drug selection is matched properly with the pain level anticipated, then it could be expected that providers would prescribe the same number of pills and just adjust the prescription by selecting a more potent drug—not by increasing the number of pills as well. This observation may suggest that cognitive bias is occurring; that is, when the provider selects the more potent drug he or she also adds a few more pills to the prescription. Consistent with this theory, surgical extractions and an increasing number of teeth extracted were associated with more opioid pills being prescribed. However, increasing the number of pills for more extractions and for surgical extractions is a practice that should be questioned and addressed because studies have shown that most patients consume only about one-third of the opioid pills prescribed after general surgery[30,31] and that only a limited number of opioid pills are required after extraction of asymptomatic third molars.[32]

The best practice recommendation is to use NSAIDs as the first-choice analgesic for acute pain because the number needed to treat to achieve pain relief is lower for ibuprofen plus acetaminophen than for oxycodone plus acetaminophen.[33-35] If an opioid is to be prescribed, we recommend that providers consider targeting 10 or fewer pills for most oral surgical procedures. This approach to treat acute pain provides 3 to 4 pills of an opioid per day for no more than 3 days, as recommended by the CDC.[24] Patients should take clock-regulated NSAIDs during the intervals between opioid doses to enhance analgesia, if severe pain is expected.

Reports indicate that opioid prescribing rates are on the decline.[13,21,36,37] The Drug Enforcement Agency's prescribing mandates,[9,38,39] state drug monitoring programs that allow screening of patients before an opioid prescription, and CDC guidelines on acute pain management have all contributed to this reduction.[24,40] Fortunately, it has been possible to translate these approaches to the management of acute dental pain. Our data and the data from South Carolina[17] indicate that fewer persons younger than 30 years of age are receiving opioid prescriptions compared with a large cohort of similarly aged Medicaid patients who underwent surgical extractions a decade ago.[29] Additional reductions would be expected with the enactment of state regulations that limit the number of days an opioid shall be prescribed for acute pain. Our analysis regarding the release of the CDC guidelines and the Kentucky regulation showed that patients were less likely to receive opioid medication after the CDC guidelines were released, and the likelihood further decreased after the Kentucky statute went into effect. The CDC guidelines and the Kentucky statute also coincided with fewer opioid pills being

prescribed. Thus, the release of national guidelines followed by state regulations are associated with and may serve as effective methods in reducing opioid prescribing and the number of pills prescribed by dentists.

As to be expected, this study has some limitations. First, a retrospective analysis is limited by the entry of complete and accurate information into EHRs. Thus, EHRs may not have captured all the patients who received analgesic prescriptions or recommendations for over-the-counter medications. Second, the data were not analyzed by race, other health conditions, comorbidities, previous opioid prescriptions, or surgery sites (e.g., third molars). Caution is advised in making direct comparisons of our findings with other studies on third molar extractions because our surgical procedures were more heterogeneous. Third, because of the nature of the analysis, direct links cannot be made among opioid prescription patterns, the CDC guidelines, and state regulations; only associations can be made. Accordingly, other factors that could account for the results should be considered, and these include prescribing culture,[41] guidelines published by the American Dental Association and other professional organizations, increasing awareness and changing attitude nationally of opioid risks of addiction, prescription drug monitoring programs, recognition of the efficacy of alternative therapies, turnover of providers, and department/school oversight.

CONCLUSIONS

Dentists frequently prescribe analgesics to patients, and these prescribing practices appear to be influenced by the procedure performed, the potency of the opioid selected, and other external influences (e.g., national guidelines and legal statutes). This suggests that reducing the frequency and amount of prescriptions of opioids could be achieved by using a variety of approaches that create awareness and knowledge and by following guidelines and policies. The profession should explore these strategies to further limit opioid prescribing by dentists.

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