JAMA Surgery | Original Investigation

Prevalence of Preoperative Opioid Use and Characteristics Associated With Opioid Use Among Patients Presenting for Surgery

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IMPORTANCE Patterns of preoperative opioid use are not well characterized across different surgical services, and studies in this patient population have lacked important self-reported data of pain and affect.

OBJECTIVES To assess the prevalence of preoperative opioid use and the characteristics of these patients in a broadly representative surgical cohort.

DESIGN, SETTING, AND PARTICIPANTS Cross-sectional, observational study of patients undergoing surgery at a tertiary care academic medical center. Data were collected as a part of large prospective institutional research registries from March 1, 2010, through April 30, 2016.

EXPOSURES Preoperative patient and procedural characteristics, including prospectively assessed self-reported pain and functional measures.

MAIN OUTCOMES AND MEASURES Patient-reported opioid use before surgery.

RESULTS Of the total 34 186 patients recruited (54.2% women; mean [SD] age, 53.1 [16.1] years), preoperative opioid use was reported in 7894 (23.1%). The most common opioids used were hydrocodone bitartrate (4685 [59.4%]), tramadol hydrochloride (1677 [21.2%]), and oxycodone hydrochloride (1442 [18.3%]). Age of 31 to 40 years (adjusted odds ratio [aOR], 1.26; 95% CI, 1.10-1.45), tobacco use (former use aOR, 1.32 [95% CI, 1.22-1.42]; current use aOR, 1.62 [95% CI, 1.48-1.78]), illicit drug use (aOR, 1.74; 95% CI, 1.16-2.60), higher pain severity (aOR, 1.33; 95% CI, 1.31-1.35), depression (aOR, 1.22; 95% CI, 1.12-1.33), higher Fibromyalgia Survey scores (aOR, 1.06, 95% CI, 1.05-1.07), lower life satisfaction (aOR, 0.95, 95% CI, 0.93-0.96), and more medical comorbidities (American Society of Anesthesiology score aOR, 1.47 [95% CI, 1.37-1.58]; Charlson Comorbidity Index aOR, 1.29 [95% CI, 1.18-1.41]) were all independently associated with preoperative opioid use. Preoperative opioid use was most commonly reported by patients undergoing orthopedic (226 [65.1%]) and neurosurgical spinal (596 [55.1%]) procedures and least common among patients undergoing thoracic procedures (244 [15.7%]). After adjusting for patient characteristics, the patients undergoing lower extremity procedures were most likely to report preoperative opioid use (aOR, 3.61; 95% CI, 2.81-4.64), as well as those undergoing pelvic (excluding hip) (aOR, 3.09; 95% CI, 1.88-5.08), upper extremity (aOR, 3.07; 95% CI, 2.12-4.45), and spinal or spinal cord (aOR, 2.68; 95% CI, 2.15-3.32) procedures, with the group undergoing intrathoracic surgery as the reference group.

CONCLUSIONS AND RELEVANCE In this large study of preoperative opioid use that includes patient-reported outcome measures, more than 1 in 4 patients presenting for surgery reported opioid use. These data provide important insights into this complicated patient population that would appear to help guide future preoperative optimization and perioperative opioid-weaning interventions.

JAMA Surg. 2018;153(10):929-937. doi:10.1001/jamasurg.2018.2102
Published online July 11, 2018.

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In the last 25 years, the number of patients who are prescribed opioids for the treatment of pain has increased dramatically. In the United States, opioid use has escalated 4 fold without an improvement in the rates or severity of chronic pain.[1] The increase in prescription opioid sales has closely paralleled the incidence of emergency department visits and overdose of prescription and illicit opioids.[2]

Despite growing awareness of the morbidity and mortality associated with the use of opioids for chronic pain, many patients continue to be prescribed these medications.[3,4] Strong opioids are generally accepted to work for treatment of acute pain. However, once opioid treatment is initiated for acute, subacute, or chronic pain, subsequent opioid management is exceedingly challenging owing to physiologic tolerance of opioids and possible opioid-induced hyperalgesia.[5,6] In addition, patients with a history of opioid use before surgery have worse surgical outcomes,[7] greater postoperative pain,[8] pronounced perioperative morbidity,[9] and higher rates of use of health care services and costs.[7,10,11] Furthermore, opioid-tolerant patients are at risk for opioid-associated adverse events and are less likely to discontinue opioid-based therapy after their surgery.[10,12-15]

To date, the prevalence of opioid use among patients undergoing surgical care is not well understood. Nonetheless, understanding the differences in prevalence of preoperative opioid exposure among patients undergoing common elective procedures is critical to create effective strategies for optimization that are tailored to the patient and physician. In addition, studies of patients with chronic pain have shown a consistent association of pain, opioid use, anxiety, depression, and general poor health.[7,14-16] These factors are important to consider, and improved awareness around tailored prescribing in the context of certain surgical procedures should be taken into account. Certain surgical services may be more likely to encounter patients with high comorbidities for opioid use, and more targeted opioid education strategies aimed at those services may help to mitigate risk in the postoperative period. To date, however, few studies have assessed preoperative opioid use for a wide variety of surgical procedures,[17] and administrative databases lack granular patient characteristic data, such as pain severity, mood, and physical function. Using 2 large perioperative registry cohorts, we sought to define the prevalence of preoperative opioid use in a cohort of patients at a tertiary care medical center and to examine the characteristics associated with the use of preoperative opioids.

Key Points

Question What are the prevalence of preoperative opioid use and the characteristics of these patients in a representative surgical cohort?

Findings In this cross-sectional study of 34 186 patients undergoing surgery at a large Midwestern academic medical center, 23.1% reported preoperative opioid use. Age, tobacco use, illicit drug use, higher pain severity, depression, higher Fibromyalgia Survey scores, lower life satisfaction, and more medical comorbidities were independently associated with preoperative opioid use.

Meaning Surgeons need to identify patients using opioids preoperatively and establish a safe and effective acute pain management plan, which may include preoperative reduction of opioid use, naloxone rescue strategies at discharge, and a rational plan of postoperative opioid prescribing.

Methods

Data were prospectively collected from 2 very similar ongoing research registries. Patients were excluded if they did not speak English, were unable to provide written informed consent, or were incarcerated. The institutional review board of the University of Michigan, Ann Arbor, approved this study, and all participants provided written informed consent.

The Michigan Genomics Initiative (https://www.michigangenomics.org) is an ongoing institutional biorepository data collection effort at the University of Michigan that started in 2012 and continues to recruit today. Similarly, the Analgesic Outcomes Study is a prospective, observational cohort study of acute and chronic postsurgical pain that has previously published outcomes data.[18-21] In the Michigan Genomics Initiative and Analgesic Outcomes Study, patients are recruited from the preoperative assessment clinic before surgery or in the preoperative waiting area on the day of surgery during daytime hours (approximately 5:30 AM to 5 PM). Owing to concerns of impaired cognition influencing ethical written informed consent, patients transferred to surgery from in-patient status or from the emergency department were not approached for study participation. Patients consented to the use of their health data for future unspecified research. Preoperative patient characteristic data were obtained using validated self-report measures of pain, mood, affect, and function (described below in Assessment of Pain Characteristics subsection).

Assessment of Pain Characteristics

Validated self-report measures common to the Michigan Genomics Initiative and Analgesic Outcomes Study were used in the present study and included the following:

- Pain severity was measured with the Brief Pain Inventory, which assessed overall average and worst body pain (11-point Likert-type scale, with higher scores indicating greater pain severity).[22]
- Life satisfaction was measured with a 10-point Likert-type scale (higher scores indicate greater life satisfaction).
- Characteristics of centralized pain were measured using the 2011 Fibromyalgia Survey criteria, including widespread body pain and comorbid symptoms as previously described (range, 0-31, with higher scores indicating greater centralized pain).[23,24]
- Anxiety and depression were measured using the patient-completed Hospital Anxiety and Depression Scale (score range, 0-21, with ≥8 indicating positive for anxiety and depression)[25] or the Patient Reported Outcomes Measurement Information System short-form measures of anxiety and

depression (score range, 4-16, with ≥8 indicating positive for anxiety or depression).[26]

Anesthesia Electronic Health Record Data

Preoperative opioid use was the primary variable of interest and was extracted from the preoperative anesthesia history and physical examination, which was found to be sensitive through detailed medical record review in a previous publication describing approximately 2400 patients undergoing abdominal surgery.[9] Manual review of the medical records of 25 participants categorized as nonusers of opioids was conducted, and in 24 of the 25 cases (96%), no reports of opioid use were found in the medical record. In the 1 case of potential misclassification, there was a single report of tramadol hydrochloride use 3 weeks before surgery that was not quantified. Given that many patients may not receive their primary care within the health system where they undergo surgery, we could not assess the dose or chronicity of opioid use. As such, the opioid variable was treated as a binary variable for analyses.

In addition, social history data were extracted from the anesthesia history and physical examination (Centricity; General Electric Health Care). Illicit drug use was categorized as none, any history of illicit opioid use, any history of illicit drug use other than opioids, and any history of illicit drug use of unknown type. Tobacco use was categorized as none, current, and former. Finally, alcohol consumption was classified as none, low or social, and heavy or former abuse. Sleep apnea was classified as none or present based on the anesthesia documentation without requirement of formal testing.

Additional data were extracted from the Research Data Warehouse at the University of Michigan Medical School. Specifically, the following elements were extracted: demographics; comorbidities for the calculation of the Charlson Comorbidity Index; *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9*) diagnosis codes; anesthesia *Current Procedural Terminology* (*CPT*) codes; and surgical body area *CPT* codes. Surgical body area was determined by *CPT* codes (eTable 1 in the Supplement).

Statistical Analysis

Descriptive statistics for each demographic and patient characteristic variable were computed for opioid-naive patients and those using opioids. Univariate differences between opioid-naive patients and opioid users were assessed via χ^2 test or unpaired 2-tailed *t* test as appropriate. Percentages of presurgical opioid use by procedural type were calculated, as were percentages of use by opioid type. A multivariate logistic regression model was conducted to examine the independent associations of preoperative pain characteristic variables with preoperative opioid use, controlling for procedural type. For all tests, the α level was set at 0.05.

Results

The total cohort consisted of 34 186 participants, of whom 54.2% were women and 45.8% were men. Mean (SD) age was 53.1 (16.1) years, and 89.1% were white. Preoperative opioid use was reported in 7894 patients (23.1%).

Univariate Differences Between Preopreative Opioid Users Compared With Opioid-Naive Patients

Although opioid users did not differ from opioid-naive patients in mean age or sex, many differences between these 2 groups were significant (**Table 1**). Former (2587 [26.3%]) and current (1753 [37.8%]) tobacco users were more likely to be using opioids preoperatively than those who did not use tobacco (3531 [18.2%]) ($P < .001$ for both comparisons). Compared with patients with no alcohol consumption (4674 [24.9%]), those with heavy alcohol consumption had higher rates of preoperative opioid use (433 [34.5%]) ($P < .001$). Compared with patients with no illicit drug use in their medical records (7257 [22.4%]), patients who had indications of current or former illicit use of nonopioids (436 [40.4%]), opioids (83 [55.3%]), and unknown substances (95 [37.0%]) had higher reported rates of preoperative opioid use ($P < .001$ for all). Preoperative opioid use was also associated with higher preoperative pain severity scores (mean [SD], 5.4 [2.6]), positive findings for depression (2409 [40.7%]) and anxiety (3323 [30.7%]), lower life satisfaction scores (mean [SD], 6.0 [2.6]), and higher fibromyalgia survey scores (mean [SD], 8.3 [5.3]) ($P < .001$ for all).

Prevalence of Preoperative Opioid Use by Surgical Body Area, Surgical Service, and Drug Type

Overall, 7894 patients (23.1%) in the sample reported preoperative opioid use. Patients undergoing thoracic surgeries reported the least preoperative opioid use (244 [15.7%]), whereas those undergoing spinal or spinal cord surgery (841 [57.1%]) and pelvic surgery (53 [42.5%]) reported the most preoperative opioid use (**Table 2** and **Table 3**). By far, the most common opioid used preoperatively was hydrocodone bitartrate, with 4685 opioid users (59.4%) reporting preoperative use. Following hydrocodone, tramadol (1677 [21.2%]) and oxycodone hydrochloride (1442 [18.3%]) were the next 2 most common medications reported among opioid users.

eTable 2 in the Supplement shows the rates of opioid use by procedural specialty, with the highest rates of preoperative opioid use reported in the orthopedic spinal (226 [65.1%]), neurosurgical spinal (596 [55.1%]), orthopedic arthroplastic (667 [33.5%]), radiologic (171 [33.0%]), and hand plastic (141 [30.1%]) surgery cohorts. The lowest reported rate of preoperative opioid use was in the cardiac surgery cohort (36 [10.8%]).

Multivariate Logistic Regression Model of Preoperative Opioid Use

We observed notable differences in patient characteristics among preoperative opioid users and nonusers (**Table 4**). Compared with younger patients, patients aged 31 to 40 years were more likely to use opioids preoperatively (adjusted odds ratio [aOR], 1.26; 95% CI, 1.10-1.45; $P < .001$). Conversely, patients aged 71 to 80 years were less likely to use opioids preoperatively (aOR, 0.83; 95% CI, 0.71-0.97; $P = .02$) compared with patients younger than 31 years. Asian patients were less likely than white patients to use opioids preoperatively (aOR, 0.57; 95% CI, 0.39-0.84; $P = .005$). Former and current tobacco users were more likely than nonusers to use opioids preoperatively

Table 1. Univariate Phenotype for the Study Popuation[a]

Characteristic	Study Group[b] Overall (N = 34 186)	Opioid Use (n = 7894)	No Opioid Use (n = 26 292)	OR (95% CI)	*P* Value
Age, mean (SD)	53.1 (16.1)	53.3 (14.9)	53.1 (16.4)	1.00 (0.99-1.00)	.27
Sex					
Male	15 656 (45.8)	3569 (22.8)	12 087 (77.2)	0.97 (0.92-1.02)	.26
Female	18 530 (54.2)	4322 (23.3)	14 208 (76.7)	1 [Reference]	
Race					
White	30 445 (89.1)	6976 (22.9)	23 469 (77.1)	1 [Reference]	NA
African American	1780 (5.2)	529 (29.7)	1251 (70.3)	1.42 (1.28-1.58)	<.001
Asian	467 (1.4)	39 (8.4)	428 (91.6)	0.31 (0.22-0.43)	<.001
Other	1494 (4.4)	347 (23.2)	1147 (76.8)	1.02 (0.90-1.15)	.79
Tobacco use					
None	19 384 (57.2)	3531 (18.2)	15 853 (81.8)	1 [Reference]	NA
Former	9842 (29.1)	2587 (26.3)	7255 (73.7)	1.60 (1.51-1.70)	<.001
Current	4641 (13.7)	1753 (37.8)	2888 (62.2)	2.73 (2.54-2.92)	<.001
Alcohol consumption					
None	18 755 (55.4)	4674 (24.9)	14 081 (75.1)	1 [Reference]	NA
Low	13 851 (40.9)	2761 (19.9)	11 090 (80.1)	0.75 (0.71-0.79)	<.001
Heavy or former abuse	1254 (3.7)	433 (34.5)	821 (65.5)	1.59 (1.41-1.79)	<.001
Illicit drug use[c]					
None	32 382 (95.6)	7257 (22.4)	25 125 (77.6)	1 [Reference]	NA
Nonopioid	1079 (3.2)	436 (40.4)	643 (59.6)	2.35 (2.07-2.66)	<.001
Opioid	150 (0.4)	83 (55.3)	67 (44.7)	4.29 (3.10-5.92)	<.001
Unknown	257 (0.8)	95 (37.0)	162 (63.0)	2.03 (1.57-2.61)	<.001
Sleep apnea					
Absent	28 741 (84.1)	6292 (21.9)	22 449 (78.1)	1 [Reference]	NA
Present	5445 (15.9)	1599 (29.4)	3846 (70.6)	1.48 (1.39-1.58)	<.001
Overall BPI score, mean (SD)[d]	3.2 (2.9)	5.4 (2.6)	2.6 (2.6)	1.45 (1.43-1.46)	<.001
Fibromyalgia Survey score, mean (SD)[e]	5.5 (4.6)	8.3 (5.3)	4.6 (4.0)	1.18 (1.17-1.19)	<.001
Life satisfaction score, mean (SD)[f]	7.0 (2.6)	6.0 (2.6)	7.3 (2.5)	0.83 (0.82-0.83)	<.001
Depression					
Absent	24 278 (80.4)	4512 (18.6)	19 766 (81.4)	1 [Reference]	NA
Present	5920 (19.6)	2409 (40.7)	3511 (59.3)	3.00 (2.83-3.19)	<.001
Anxiety					
Absent	19 368 (64.2)	3602 (18.6)	15 766 (81.4)	1 [Reference]	NA
Present	10 822 (35.8)	3323 (30.7)	7499 (69.3)	1.94 (1.84-2.04)	<.001
ASA score					
0-2	21 895 (64.1)	4137 (18.9)	17 758 (81.1)	1 [Reference]	NA
3-4	12 291 (35.9)	3754 (30.5)	8537 (69.5)	1.89 (1.79-1.99)	<.001
Charlson Comorbidity Index					
0	239 409 (70.2)	5385 (22.5)	18 555 (77.5)	1 [Reference]	NA
1-3	3349 (9.8)	1075 (32.1)	2274 (67.9)	1.63 (1.51-1.76)	<.001
≥4	6820 (20.0)	1416 (20.8)	5402 (79.2)	0.90 (0.85-0.96)	.002

(continued)

Table 1. Univariate Phenotype for the Study Popuation[a] (continued)

Characteristic	Study Group[b] Overall (N = 34 186)	Opioid Use (n = 7894)	No Opioid Use (n = 26 292)	OR (95% CI)	*P* Value
Body area					
Intrathoracic	1552 (4.6)	245 (15.8)	1307 (84.2)	1 [Reference]	NA
Head	3715 (11.1)	745 (20.1)	2970 (80.0)	1.35 (1.14-1.57)	<.001
Neck	4151 (12.4)	804 (19.4)	3347 (80.6)	1.29 (1.10-1.50)	.001
Thorax	2170 (6.5)	364 (16.8)	1806 (83.2)	1.08 (0.90-1.28)	.40
Spine or spinal cord	1472 (4.4)	840 (57.1)	632 (42.9)	7.09 (5.98-8.41)	<.001
Abdomen					
Upper	3299 (9.8)	766 (23.2)	2533 (76.8)	1.62 (1.38-1.89)	<.001
Lower	4969 (14.8)	962 (19.4)	3999 (80.6)	1.29 (1.10-1.50)	.001
Perineum	3496 (10.4)	727 (20.8)	2769 (79.2)	1.41 (1.19-1.64)	<.001
Pelvis (except hip)	125 (0.4)	53 (42.4)	72 (57.6)	3.95 (2.69-5.74)	<.001
Upper leg (except knee)	1581 (4.7)	566 (35.8)	1015 (64.1)	2.97 (2.51-3.52)	<.001
Knee or popliteal	1933 (5.8)	401 (20.7)	1532 (79.2)	1.40 (1.17-1.66)	<.001
Lower leg	772 (2.3)	309 (40.0)	463 (60.0)	3.56 (2.92-4.34)	<.001
Shoulder or axilla	1856 (5.5)	323 (17.3)	1533 (82.8)	1.12 (0.94-1.35)	.21
Upper arm and elbow	246 (0.7)	89 (36.2)	157 (63.8)	3.02 (2.25-4.06)	<.001
Forearm, wrist, hand	1359 (4.0)	347 (25.5)	1012 (74.5)	1.83 (1.52-2.20)	<.001
Other	893 (2.7)	285 (32.2)	608 (68.4)	2.50 (2.06-3.04)	<.001

Abbreviations: ASA, American Society of Anesthesiologists; BPI, Brief Pain Inventory; NA, not applicable; OR, odds ratio.

[a] Intrathoracic body area was chosen as the reference category because it had the lowest incidence of opioid use. Univariate logistic models were conducted to obtain odds ratios and *P* values.

[b] Numbers in each characteristic may not total numbers in column headings owing to missing data. Unless otherwise indictated for continuous data, data are presented as number percentage of patients. Percentages have been rounded and may not total 100.

[c] Categories include former or current use.

[d] Scores range from 0 to 10, with higher scores indicating greater pain severity.

[e] Scores range from 0 to 31, with higher scores indicating greater centralized pain.

[f] Scores range from 0 to 10, with higher scores indicating greater life satisifaction.

Table 2. Patients Who Used Opioids Before Surgery by Surgical Upper Body Area and Type of Opioid

Preoperative Opioid Used	Overall (N = 34 186)	Surgical Body Area, No. (%)[a] Head (n = 3714)	Neck (n = 4150)	Thorax (n = 2167)	Intrathoracic (n = 1553)	Spine or Spinal (n = 1472)	Shoulder or Axilla (n = 1854)	Upper Arm and Elbow (n = 245)	Forearm, Wrist, and Hand (n = 1359)
Any, No. (%)	7894 (23.1)	745 (20.1)	806 (19.4)	363 (16.8)	244 (15.7)	841 (57.1)	321 (17.3)	88 (35.9)	348 (25.6)
Type of opioid used, No. (%)									
Hydrocodone bitartrate	4685 (59.4)	449 (60.3)	488 (60.5)	220 (60.6)	149 (61.1)	493 (58.6)	190 (59.2)	50 (56.8)	203 (58.3)
Tramadol hydrochloride	1677 (21.2)	153 (20.5)	162 (20.1)	67 (18.5)	46 (18.9)	157 (18.7)	70 (21.8)	17 (19.3)	70 (20.1)
Oxycodone hydrochloride[b]	1442 (18.3)	130 (17.5)	151 (18.7)	75 (20.7)	32 (13.1)	177 (21.0)	50 (15.6)	18 (20.5)	68 (19.5)
Morphine sulfate	457 (5.8)	30 (4.0)	49 (6.1)	14 (3.9)	15 (6.1)	89 (10.6)	11 (3.4)	3 (3.4)	11 (3.2)
Codeine phosphate	333 (4.2)	31 (4.2)	40 (5.0)	20 (5.5)	16 (6.6)	22 (2.6)	18 (5.6)	4 (4.5)	12 (3.4)
Fentanyl patch	150 (1.9)	16 (2.1)	17 (2.1)	7 (1.9)	8 (3.3)	28 (3.3)	2 (0.6)	0	3 (0.9)
Methadone hydrochloride	146 (1.9)	21 (2.8)	14 (1.7)	5 (1.4)	3 (1.2)	26 (3.1)	3 (0.9)	3 (3.4)	5 (1.4)
Buprenorphine (patch, tablet, or film)	73 (0.9)	4 (0.5)	5 (0.6)	2 (0.6)	2 (0.8)	6 (0.7)	3 (0.9)	2 (2.3)	11 (3.2)
Tapentadol hydrochloride	14 (0.2)	2 (0.3)	0	1 (0.3)	0	6 (0.7)	1 (0.3)	0	0
Other[c]	17 (0.7)	3 (0.4)	0	0	1 (0.4)	2 (0.2)	1 (0.3)	0	1 (0.3)

[a] Percentages are calculated from those with any opioid use.

[b] Indicates oral formulation.

[c] Includes fentanyl lozenge, opium, butorphanol, hydromorphone, and oxymorphone.

(aORs, 1.32 [95% CI, 1.22-1.42] and 1.62 [95% CI, 1.48-1.78], respectively; $P < .001$ for both). Patients with low alcohol consumption were less likely than those with none to be using opioids preoperatively (aOR, 0.92; 95% CI, 0.86-0.99; $P = .02$).

Table 3. Patients Who Used Opioids Before Surgery by Surgical Lower Body Area and Type of Opioid

Preoperative Opioid Used	Overall (N = 34 186)	Body Surgical Area, No. (%)[a]							
		Upper Abdomen (n = 3298)	Lower Abdomen (n = 4963)	Perineum (n = 3497)	Pelvic (n = 125)[b]	Upper Leg (n = 1582)[c]	Knee or Poplietal (n = 1933)	Lower Leg (n = 772)	Other (n = 896)
Any, No. (%)	7894 (23.1)	765 (23.2)	962 (19.4)	728 (20.8)	53 (42.4)	567 (35.8)	401 (20.7)	309 (40.0)	287 (32.0)
Type of opioid used, No. (%)									
Hydrocodone bitartrate	4685 (59.4)	416 (54.4)	625 (65.0)	464 (63.7)	35 (66.0)	317 (55.9)	210 (52.4)	179 (57.9)	158 (55.1)
Tramadol hydrochloride	1677 (21.2)	195 (25.5)	186 (19.3)	136 (18.7)	4 (7.5)	186 (32.8)	115 (28.7)	44 (14.2)	53 (18.5)
Oxycodone hydrochloride[d]	1442 (18.3)	137 (17.9)	151 (15.7)	118 (16.2)	13 (24.5)	67 (11.8)	72 (18.0)	111 (35.9)	62 (21.6)
Morphine sulfate	457 (5.8)	68 (8.9)	46 (4.8)	44 (6.0)	6 (11.3)	21 (3.7)	18 (4.5)	8 (2.6)	21 (7.3)
Codeine phosphate	333 (4.2)	24 (3.1)	40 (4.2)	25 (3.4)	2 (3.8)	25 (4.4)	24 (6.0)	9 (2.9)	19 (6.6)
Fentanyl patch	150 (1.9)	11 (1.4)	15 (1.6)	14 (1.9)	1 (1.9)	9 (1.6)	8 (2.0)	4 (1.3)	7 (2.4)
Methadone hydrochloride	146 (1.9)	13 (1.7)	11 (1.1)	13 (1.8)	2 (3.8)	6 (1.1)	7 (1.8)	2 (0.7)	9 (3.1)
Buprenorphine (patch, tablet, or film)	73 (0.9)	6 (0.8)	8 (0.8)	9 (1.2)	0	7 (1.2)	3 (0.7)	0	5 (1.7)
Tapentadol hydrochloride	14 (0.2)	1 (0.1)	0	1 (0.1)	0	2 (0.4)	0	0	0
Other[e]	17 (0.7)	3 (0.4)	1 (0.1)	0	0	4 (0.7)	0	0	1 (0.4)

[a] Percentages are calculated from those with any opioid use.

[b] Excludes hip.

[c] Excludes knee.

[d] Indicates oral formulation.

[e] Includes fentanyl lozenge, opium, butorphanol, hydromorphone, and oxymorphone.

Compared with no reported illicit drug use, those with reported illicit opioid use (aOR, 1.74; 95% CI, 1.16-2.60; $P = .007$) and illicit nonopioid drug use (aOR, 1.24; 95% CI, 1.05-1.47; $P = .01$) were more likely to take opioids preoperatively.

Higher pain severity (aOR, 1.33; 95% CI, 1.31-1.35), depression (aOR, 1.22; 95% CI, 1.12-1.33), high Fibromyalgia Survey scores (aOR, 1.06; 95% CI, 1.05-1.07), and lower life satisfaction (aOR, 0.95; 95% CI, 0.93-0.96) ($P < .001$ for all) were independently associated with preoperative opioid use. Furthermore, higher numbers of comorbidities, as measured by the American Society of Anesthesiology score (aOR, 1.47; 95% CI, 1.37-1.58) and a Charlson Comorbidity Index of 4 or greater (aOR, 1.29; 95% CI, 1.18-1.41), were independently associated with preoperative opioid use ($P < .001$ for both).

Preoperative Opioid Use by Surgical Procedure

Compared with intrathoracic surgery (244 [15.7%]), nearly all other surgical groups had significantly higher odds of preoperative opioid use. Preoperative use of opioids was particularly high in patients undergoing surgery of the spine or spinal cord (aOR, 2.68; 95% CI, 2.15-3.32), pelvis (aOR, 3.09; 95% CI, 1.88-5.08), lower leg (aOR, 3.61; 95% CI, 2.81-4.64), and upper extremity (aOR, 3.07; 95% CI, 2.12-4.45) ($P < .001$ for all).

Discussion

This cross-sectional study using data from a large prospective clinical registry demonstrates that nearly 1 of every 4 patients (23.1%) presenting for surgery at a large academic medical center are receiving an opioid before surgery. Preoperative opioid use was associated with a greater burden of comorbid disease and multiple risk factors for poor recovery (Tables 1 and 4), suggesting that identification of individuals with these risk factors could be useful in guiding perioperative optimization and postoperative management. Previous studies demonstrated that preoperative opioid use was independently associated with increased costs, morbidity, and use of health care resources in multiple studies of specific surgical populations.[27] These data suggest that the implications of opioid use may not be limited to abdominal and spinal surgery, and addressing preoperative opioid use may be an underexplored opportunity for improving quality of surgical outcomes and reducing cost. According to an October 2015 report from the Michigan Prescription Drug and Opioid Abuse Task Force,[28] prescribing in Michigan slightly exceeds the national average, with more than 21 million prescriptions for controlled substances written in 2014. This number is roughly 4 million more than were written in 2007, and during that time, the population of Michigan actually declined.[28] The United States consumed approximately 99% of the world hydrocodone supply in 2007[29]; hence, it is not surprising that hydrocodone was by far the most common preoperative opioid reported in this study.

One of the strongest indicators of long-term postoperative opioid use is preoperative opioid use,[21] and preoperative opioid use has been associated with worse surgical outcomes.[27] Today, most patients undergoing surgery receive an opioid prescription for postoperative pain control.[30] Current evidence suggests that most patients are prescribed more opioids than necessary to achieve appropriate pain control, and treating physicians are often tempted to provide more opioid than is actually required for a given surgical condition.[31] Overprescrib-

Table 4. Multivariate Logistic Regression Model Showing Unique Contribution of Presurgical Phenotypic Variables[a]

Phenotypic Variable	Adjusted OR (95% CI)	*P* Value
Age, y		
18-30	1 [Reference]	NA
31-40	1.26 (1.10-1.45)	.001
41-50	1.11 (0.98-1.26)	.10
51-60	1.10 (0.97-1.24)	.13
61-70	0.95 (0.84-1.08)	.44
71-80	0.83 (0.71-0.97)	.02
≥81	0.84 (0.66-1.07)	.15
Male	1.13 (1.06-1.21)	<.001
Race		
White	1 [Reference]	NA
African American	0.98 (0.85-1.13)	.75
Asian	0.57 (0.39-0.84)	.005
Other	0.95 (0.81-1.11)	.50
Tobacco use		
None	1 [Reference]	NA
Former	1.32 (1.22-1.42)	<.001
Current	1.62 (1.48-1.78)	<.001
Alcohol consumption		
None	1 [Reference]	NA
Low	0.92 (0.86-0.99)	.02
Heavy or former abuse	1.00 (0.85-1.18)	.97
Illicit drug use[b]		
None	1 [Reference]	NA
Nonopioid	1.24 (1.05-1.47)	.01
Opioid	1.74 (1.16-2.60)	.007
Unknown	1.12 (0.80-1.58)	.50
Sleep apnea	1.03 (0.95-1.13)	.45
Overall BPI score	1.33 (1.31-1.35)	<.001
Fibromyalgia Survey score	1.06 (1.05-1.07)	<.001
Life satisfaction	0.95 (0.93-0.96)	<.001
Depression	1.22 (1.12-1.33)	<.001
Anxiety	0.94 (0.87-1.02)	.13
ASA score of 3 or 4	1.47 (1.37-1.58)	<.001
Charlson Comorbidity Index		
0	1 [Reference]	NA
1-3	1.03 (0.92-1.14)	.62
≥4	1.29 (1.18-1.41)	<.001
Surgical body area		
Intrathoracic	1 [Reference]	NA
Head	1.22 (0.99-1.49)	.06
Neck	1.27 (1.04-1.55)	.02
Thorax	1.38 (1.10-1.73)	.005
Spine or spinal cord	2.68 (2.15-3.32)	<.001
Upper abdomen	1.34 (1.09-1.64)	.005
Lower abdomen	1.24 (1.02-1.51)	.03
Perineum	1.40 (1.14-1.72)	.001
Pelvis (except hip)	3.09 (1.88-5.08)	<.001
Upper leg (except knee)	1.60 (1.29-2.00)	<.001
Knee or popliteal	1.30 (1.04-1.63)	.02
Lower leg	3.61 (2.81-4.64)	<.001
Shoulder or axilla	1.09 (0.86-1.38)	.48
Upper arm and Elbow	3.07 (2.12-4.45)	<.001
Forearm, wrist, and hand	1.63 (1.29-2.07)	<.001
Other	2.03 (1.58-2.61)	<.001

Abbreviations: ASA, American Society of Anesthesiologists; BPI; Brief Pain Inventory; NA, not applicable; OR, odds ratio.

[a] Intrathoracic body area was chosen as the reference category because it had the lowest incidence of opioid use. A multivariate logistic models was conducted to obtain the adjusted ORs and *P* values.

[b] Includes former and current use.

ing can be especially problematic in patients who are already taking an opioid before surgery and may create challenges for the surgical care team in the postoperative period, when preoperative opioid exposure may lead to increased opioid use after surgery. Patients receiving higher doses of opioids are more prone to overdose, and physicians providing acute care should consider naloxone hydrochloride prescribing in patients receiving high doses and those with risk factors for overdose.

Association of Preoperative Opioid Use With a More Medically Challenging Patient Characteristic

Opioid users had higher rates of heavy alcohol consumption, tobacco use, and illicit drug use, as well as more medical comorbidities, increased pain severity, more widespread body pain, and higher rates of negative affect (Table 1). This finding is consistent with previous work[14,32,33] showing that patients with more physical and mental illness tend to be given opioids. Previous studies[14] have demonstrated that patients with chronic pain who are currently taking opioids have a greater burden of comorbid conditions, affective disorders, and substance abuse, compared with patients who do not use opioids for chronic pain. A careful evaluation of medical comorbidities, affective distress, and current alcohol and illicit substance use as well as the physicians' motivation for providing an opioid should be weighed and carefully considered in the context of the above data. Ideally, these potential problems would be identified in the preoperative period when a thoughtful discussion around postoperative pain and reasonable expectations can take place.

Management of Preoperative Opioids

Our findings indicate that patients undergoing orthopedic and neurosurgical procedures have a high incidence of prescription opioid use at the time of surgery, whereas patients undergoing cancer-related procedures and thoracic surgery have a much lower prevalence of current opioid use (eTable 2 in the Supplement). Previous studies have evaluated preoperative opioid use for a particular surgical service, with estimates ranging from 0% to 15% in breast and gynecological surgery,[16] approximately 40% to 44% in hip surgery and knee arthroplasty,[12] and approximately 56% in spinal surgery.[34] As a result of patients given maintenance dosages of opioids for chronic con-

ditions, many will present as long-term opioid users when they undergo surgical interventions.

Given the associations between preoperative opioid use and increased costs, morbidity, and use of health care services,[27] many experts suggest preoperative weaning or cessation of opioid use. However whether these associations are reversible through preoperative opioid weaning or cessation remains unclear, our data lend support for an interdisciplinary biopsychosocial preoperative program to reduce opioid use that has been piloted by others.[35] Reduction of opioid use is not a simple task and requires input from counselors and psychologists with training to address the negative affect and increased comorbidities in this challenging cohort. Studies in this area have been largely confined to retrospective data and opinion, but some emerging data suggest that preoperative weaning from opioid use can improve outcomes.[36] Reduction of opioid use in the immediate preoperative period may not be practical, depending on the urgency of the surgery. However, surgeons must recognize that current opioid use on the day of surgery is associated with concerning risk factors for poor outcomes. At a minimum, this association should prompt further conversation among surgeons and patients before surgery regarding postoperative pain management and transition of care and early involvement of primary care physicians and pain specialists when appropriate to facilitate the transition of care. In addition, surgeons should consider referral for perioperative optimization of these patients in the setting of elective surgery.

Strengths and Limitations

To our knowledge, this study is one of few to assess preoperative opioid use across a wide range of surgical conditions and the first, to our knowledge, to incorporate validated patient-reported outcome measures together with the more typically described health data from the medical record. However, some limitations apply. First, this single-center study from a large academic hospital may not be generalizable to other settings. Second, although the study was large enough to detect some racial differences in preoperative opioid use, the population was predominantly white. In addition, given the way in which opioid use is documented in the electronic health record, we could not reliably assess dose or duration of use. Previous studies have shown differences in surgical outcomes using similar methods for categorizing opioid use. Regulatory restrictions at the time of this study precluded us from using the state's prescription drug monitoring program; however, future studies would benefit from such data access. Last, a history of substance abuse was taken from the anesthesia history and physical examination. Although history of tobacco and alcohol use and substance abuse is part of a standard preoperative history, the sensitivity of this assessment is not known.

Conclusions

Overall, 23.1% of patients presenting for surgery at a large academic tertiary referral center were taking an opioid at the time of surgery, and the use of opioids was associated with a more negative medical and pain profile. Current opioid use has significant implications in pain management, and surgeons must be able to identify these patients and establish a safe and effective acute pain management plan that may include preoperative reduction of opioid use, naloxone rescue strategies at discharge, and a rational plan of postoperative opioid prescribing.

ARTICLE INFORMATION

Accepted for Publication: April 15, 2018.

Published Online: July 11, 2018. doi:10.1001/jamasurg.2018.2102

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Obtained funding: Brummett.
Administrative, technical, or material support: Hilliard, Waljee, Metz, Clauw, Englesbe, Abecasis, Brummett.
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Conflict of Interest Disclosures: Dr Waljee reported serving as an unpaid consultant for 3M Health Information Systems. Dr Clauw reported receiving research funding from Cerephex Corporation, Forest Pharmaceuticals, Inc, Merck & Co, and Pfizer, Inc, and serving as a consultant for Tonix Pharmaceuticals, Pfizer, Inc, Depomed, Inc, Sammumed, LLC, Aptinyx, Inc, and Zynerba Pharmaceuticals, Inc. Dr Brummett reported holding a patent for peripheral perineural dexmedetomidine licensed to University of Michigan; consulting for Recro Pharma, Inc, and Heron Therapeutics, Inc, which was not related to the present work; and receiving research funding from Neuros Medical, Inc. No other disclosures were reported.

Funding/Support: This study was supported by grants R01 DA038261 (co-principal investigators [PIs] Drs Clauw and Brummett), R01 DA042859 (co-PIs Drs Waljee and Brummett), and K23 DA038718 (PI Dr Goesling) from the National Institute on Drug Abuse, National Institutes of Health; grant P50 AR070600 from the National Institute of Arthritis and Musculoskeletal and Skin Diseases (co-PIs Drs Clauw and Brummett); and grant K08HS023313 from the Agency for Healthcare Research and Quality (PI Dr Waljee); the University of Michigan School Dean's Office, Michigan Genomics Initiative and Precision Health Initiative; research funding from the American College of Surgeons and the American Foundation for Surgery of the Hand (Dr Waljee); and the Michigan Department of Health and Human Services (Drs Waljee, Englesbe, and Brummett).

Role of the Funder/Sponsor: The funding sources had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Disclaimer: The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health or the Michigan Department of Health and Human Services.

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