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New Persistent Opioid Use After Minor and Major Surgical Procedures in US Adults

Chad M. Brummett, MD; Jennifer F. Waljee, MD, MPH, MS; Jenna Goesling, PhD; Stephanie Moser, PhD; Paul Lin, MS; Michael J. Englesbe, MD; Amy S. B. Bohnert, PhD, MHS; Sachin Kheterpal, MD, MBA; Brahmajee K. Nallamothu, MD, MPH

Supplemental content

IMPORTANCE Despite increased focus on reducing opioid prescribing for long-term pain, little is known regarding the incidence and risk factors for persistent opioid use after surgery.

OBJECTIVE To determine the incidence of new persistent opioid use after minor and major surgical procedures.

DESIGN, SETTING, AND PARTICIPANTS Using a nationwide insurance claims data set from 2013 to 2014, we identified US adults aged 18 to 64 years without opioid use in the year prior to surgery (ie, no opioid prescription fulfillments from 12 months to 1 month prior to the procedure). For patients filling a perioperative opioid prescription, we calculated the incidence of persistent opioid use for more than 90 days among opioid-naive patients after both minor surgical procedures (ie, varicose vein removal, laparoscopic cholecystectomy, laparoscopic appendectomy, hemorrhoidectomy, thyroidectomy, transurethral prostate surgery, parathyroidectomy, and carpal tunnel) and major surgical procedures (ie, ventral incisional hernia repair, colectomy, reflux surgery, bariatric surgery, and hysterectomy). We then assessed data for patient-level predictors of persistent opioid use.

MAIN OUTCOMES AND MEASURES The primary outcome was defined a priori prior to data extraction. The primary outcome was new persistent opioid use, which was defined as an opioid prescription fulfillment between 90 and 180 days after the surgical procedure.

RESULTS A total of 36 177 patients met the inclusion criteria, with 29 068 (80.3%) receiving minor surgical procedures and 7109 (19.7%) receiving major procedures. The cohort had a mean (SD) age of 44.6 (11.9) years and was predominately female (23 913 [66.1%]) and white (26 091 [72.1%]). The rates of new persistent opioid use were similar between the 2 groups, ranging from 5.9% to 6.5%. By comparison, the incidence in the nonoperative control cohort was only 0.4%. Risk factors independently associated with new persistent opioid use included preoperative tobacco use (adjusted odds ratio [aOR], 1.35; 95% CI, 1.21-1.49), alcohol and substance abuse disorders (aOR, 1.34; 95% CI, 1.05-1.72), mood disorders (aOR, 1.15; 95% CI, 1.01-1.30), anxiety (aOR, 1.25; 95% CI, 1.10-1.42), and preoperative pain disorders (back pain: aOR, 1.57; 95% CI, 1.42-1.75; neck pain: aOR, 1.22; 95% CI, 1.07-1.39; arthritis: aOR, 1.56; 95% CI, 1.40-1.73; and centralized pain: aOR, 1.39; 95% CI, 1.26-1.54).

CONCLUSIONS AND RELEVANCE New persistent opioid use after surgery is common and is not significantly different between minor and major surgical procedures but rather associated with behavioral and pain disorders. This suggests its use is not due to surgical pain but addressable patient-level predictors. New persistent opioid use represents a common but previously underappreciated surgical complication that warrants increased awareness.

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Author Affiliations: Author affiliations are listed at the end of this article.

Corresponding Author: Chad M. Brummett, MD, Division of Pain Medicine, Department of Anesthesiology, University of Michigan Medical School, 1500 E Medical Center Dr, 1H247 UH, PO Box 5048, Ann Arbor, MI 48109 (cbrummet@umich.edu).

Millions of Americans undergo surgery each year, with expenditures exceeding $500 billion and accounting for approximately 40% of national health care spending.[1-6] Although 2016 guidelines from the US Centers for Disease Control (CDC) address opioid prescribing with respect to long-term pain, little attention is directed toward perioperative outpatient opioid prescribing.[7-9] Currently, postoperative opioid prescribing varies widely and frequently in excess,[10-12] even following minor surgical procedures. More broadly, nearly 530 individuals die each week in the United States due to opioid overdose, demanding comprehensive solutions for this public health crisis.[13-15]

Many patients receive their first exposure to opioids following surgery, but the incidence of new persistent opioid use after surgical care is not well defined. Specifically, the effect of surgical case mix and other preoperative risk factors remain unclear. In a population-based study of insured individuals in the United States, we examined the incidence of new persistent opioid use and associated risk factors across those receiving both minor and major surgical procedures. We hypothesized that the incidence of new persistent opioid use would be common and similar between the groups undergoing minor and major surgical procedures, thereby suggesting that persistent opioid use may be less associated with postsurgical pain than addressable patient-level factors.

Key Points

Question What is the incidence of new persistent opioid use after surgery?

Findings In this population-based study of 36 177 surgical patients, the incidence of new persistent opioid use after surgical procedures was 5.9% to 6.5% and did not differ between major and minor surgical procedures.

Meaning New persistent opioid use is more common than previously reported and can be considered one of the most common complications after elective surgery.

Methods

Data Sources and Patient Cohort

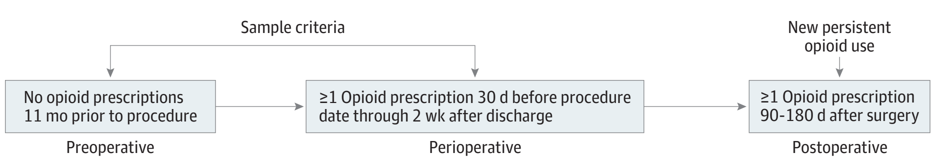
The Clinformatics Data Mart captures administrative health claims across the United States for members of a large national managed care company affiliated with OptumInsight. We examined claims from January 1, 2012, to June 30, 2015, among adults aged 18 to 64 years to capture data on surgical procedures performed between 2013 and 2014 to account for the 12-month preoperative and 6-month postoperative study period. We included only individuals with continuous medical and prescription drug coverage to evaluate the complete health care experience. We excluded patients 18 years and younger as well as patients older than 64 years owing to the incomplete capture of Medicare Part D prescriptions claims data. The study was deemed exempt from review by the University of Michigan Institutional Review Board, and informed consent was waived because the dataset was deidentified.

We selected 13 common elective surgical procedures and categorized these into minor and major groups based on prior literature. Minor surgical procedures included varicose vein removal, laparoscopic cholecystectomy, laparoscopic appendectomy, hemorrhoidectomy, thyroidectomy, transurethral prostate surgery, parathyroidectomy, and carpal tunnel. Major surgical procedures included ventral incisional hernia repair, colectomy, reflux surgery, bariatric surgery, and hysterectomy. We identified patients undergoing surgery using Current Procedural Terminology or *International Statistical Classification of Diseases and Related Health Problems* (*ICD-9*) procedure codes (eTable 1 in the Supplement).

We sought to determine new persistent opioid use after surgery and included only patients who filled an opioid prescription either in the month prior to surgery or within 2 weeks after discharge. Comparable with previous studies of opioid-naive surgical populations,[7,8] patients who had filled 1 or more prescriptions for opioids 12 months to 31 days prior to their surgical procedure were excluded from the analysis (**Figure 1**). To account for prescriptions provided preoperatively for postoperative pain control, patients filling opioids in the 30 days prior to surgery were included, and prescriptions filled in this time was included as a covariate in the analyses. Last, we excluded patients who underwent additional surgical procedures during the study period using subsequent procedural codes for anesthesia in the 6-month postoperative period.

For a comparison cohort of patients who did not undergo surgery, we identified a random 10% sample of patients aged 18 to 64 years who did not undergo surgery in the study period (n = 492 177 patients). We included only patients in the nonoperative group who did not fill an opioid prescription during a 12-month period and did not have any codes for surgical

Figure 1. Sample Criteria and Outcomes



Patients undergoing the predefined surgical procedures were included if they met the following criteria: (1) continuous insurance coverage during the 12 months before the procedure through the 6 months after; (2) no opioid prescriptions during the 11 months before the procedure; and (3) at least 1 opioid prescription fulfillment during the perioperative period, which was defined as the 30 days before the procedure to 2 weeks after discharge. The outcome of new persistent opioid use was defined as at least 1 opioid prescription fulfillment between 90 and 180 days after the procedure.

procedures or anesthesia during this period. These patients were then given a random date of surgery. No patients filled an opioid prescription in the year prior to their fictitious surgery date nor did they have any anesthesia codes in the 6 months following their fictitious surgery date.

Outcomes

Our primary outcome was new persistent opioid use, defined as an opioid prescription fulfillment between 90 and 180 days among those patients who filled opioid prescriptions perioperatively (Figure 1) and was defined a priori prior to data extraction.[8] This definition of new persistent opioid use represents a time in which normal surgical recovery would be expected for the procedures selected and is more conservative than the 3-month definition of long-term postsurgical pain by the International Association for the Study of Pain.[16] The total amount of opioids prescribed during the surgical window of 30 days before surgery to 14 days after discharge, including the dose of the medication and amount dispensed, were converted to oral morphine equivalents (OMEs).[17]

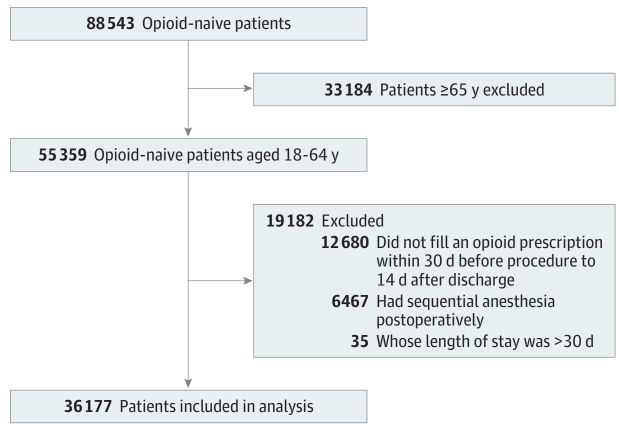
Patient Factors

We included sociodemographic and clinical covariates, including region of residence, and comorbid conditions using both a Charlson Comorbidity Index score and an indicator of current or previous tobacco use (*ICD-9* code 305.1; V15.82). In addition, the Clinical Classification System from the Agency of Healthcare Research and Quality was used to create indicators for mental health diagnoses. The subcategories of the mental health diagnoses by the Clinical Classification System were collapsed as mood disorders (ie, adjustment, anxiety, and mood disorders), suicidality (ie, suicide and intentional self-inflicted injury), disruptive behavior disorders (ie, attention deficit/hyperactivity disorder, conduct and disruptive behavior disorders, and impulse control disorders), personality disorders, schizophrenia and other psychotic disorders, substance use disorders (ie, alcohol and other substance-related disorders), and miscellaneous disorders (eTable 2 in the Supplement). In addition, preoperative pain diagnoses were obtained using *ICD-9* codes (eTable 3 in the Supplement) and categorized as back pain, neck pain, arthritis pain, and other pain disorders. The inclusion for preoperative medical comorbidities, pain diagnoses, and mental health classifications were restricted to the 1-year preoperative study period.

Statistical Analysis

All analyses were conducted using Stata version 13.1 (StataCorp). Descriptive statistics were calculated for demographic variables and comorbidities for each surgical type. Univariate differences between surgical types were assessed with *t* tests or χ^2 tests. Further, univariate differences between those with persistent opioid use and those without persistent opioid use within each surgical type were assessed with *t* tests and χ^2 tests. A multilevel, multivariate logistic regression model, with US Census Bureau geographic region included as a random intercept, was estimated to examine differences in persistent opioid use between surgical types while controlling for patient characteristics, including age, sex, race/ethnicity, education, history of tobacco use, mental health disorders, Charlson Comorbidity Index, pain disorders, and opioid prescription OME within the surgical time frame. *P* values were 2-tailed, and significance was set at $P < .05$.

Figure 2. Flow Diagram



Results

A total of 55 359 of the patients met the inclusion criteria of at least 11 months without an opioid prescription prior to the 30 days preceding a qualifying surgical procedure (**Figure 2**). After excluding patients receiving an additional anesthetic during the 180-day postoperative study period, with inpatient stays greater than 30 days, and with no opioid prescriptions during the perioperative period, the final study cohort consisted of 36 177 patients. There were 29 068 patients (80.3%) who received minor surgical procedures and 7109 (19.7%) who received major procedures.

Descriptive data are displayed in **Table 1**. There were no differences between the groups with respect to opioid prescriptions in the 30 days prior to surgery. The median total dose of all opioid prescriptions during the 30 days before surgery to 14 days after discharge was 225 mg OMEs for both groups, which equates to 45 tablets of 5-mg hydrocodone or 30 tablets of 5-mg oxycodone.

Persistent Postoperative Opioid Use in Major and Minor Surgery Groups

The incidence of new persistent opioid use was similar between the 2 groups (**Figure 3**). In the minor surgery group, 1711 patients (5.9%) filled an opioid prescription between 90 and 180 days vs 465 (6.5%) in the major surgery group (odds ratio, 1.12; 95% CI, 1.01-1.24). By comparison, only 1779 (0.4%) in the nonsurgical comparison group filled an opioid prescription between 90 to 180 days after the fictitious surgery date. We did observe a small degree of variation with respect to the incidence of new persistent opioid use across procedures, ranging from 4.5% to 9.9%. After adjusting for all of the preoperative covariates assessed, the small difference between the groups was no longer statistically significant (adjusted odds

Table 1. Preoperative Patient Characteristics and Univariate Outcomes Analyses[a]

Characteristic	No. (%) Overall Group	Minor Surgery Cohort	Persistent Opioid Use	No Persistent Opioid Use	*P* Value	No. (%) Major Surgery Cohort	Persistent Opioid Use	No Persistent Opioid Use	*P* Value	*P* Value for Minor vs Major
Age, y					<.001				.02	<.001
18-29	4663 (12.9)	4436 (15.3)	258 (5.8)	4178 (94.2)		227 (3.2)	17 (7.5)	210 (92.5)		
30-39	7090 (19.6)	5938 (20.4)	276 (4.7)	5662 (95.4)		1152 (16.2)	88 (7.6)	1064 (92.4)		
40-49	10 364 (28.7)	7389 (25.4)	392 (5.3)	6997 (94.7)		2975 (41.9)	159 (5.3)	2816 (94.7)		
50-59	10 207 (28.2)	8099 (27.9)	548 (6.8)	7551 (93.2)		2108 (29.7)	151 (7.2)	1957 (92.8)		
60-64	3853 (10.7)	3206 (11.0)	237 (7.4)	2969 (92.6)		647 (9.1)	50 (7.7)	597 (92.3)		
Female	23 913 (66.1)	17 860 (61.4)	1101 (64.4)	16 759 (61.3)	.01	6053 (85.2)	385 (82.8)	5668 (85.3)	.14	<.001
Race/ethnicity					<.001				.18	<.001
White	26 091 (72.1)	21 388 (73.6)	1268 (74.1)	20 120 (73.6)		4703 (66.2)	300 (64.5)	4403 (66.3)		
African American	3268 (9.0)	2161 (7.4)	151 (8.8)	2010 (7.4)		1107 (15.6)	73 (15.7)	1034 (15.6)		
Hispanic	4283 (11.8)	3467 (11.9)	183 (10.7)	3284 (12.0)		816 (11.5)	57 (12.3)	759 (11.4)		
Asian	1076 (3.0)	865 (3.0)	27 (1.6)	838 (3.1)		211 (3.0)	9 (1.9)	202 (3.0)		
Missing/unknown	1459 (4.0)	1187 (4.1)	82 (4.5)	1105 (4.0)		272 (3.8)	26 (5.6)	246 (3.7)		
Education					<.001				.17	<.001
Less than high school	184 (0.5)	149 (0.5)	8 (0.5)	141 (0.5)		35 (0.5)	3 (0.7)	32 (0.5)		
High school	9781 (27.0)	7763 (26.7)	504 (29.5)	7259 (26.5)		2018 (28.4)	147 (31.6)	1871 (28.2)		
Some college	19 781 (54.7)	15 827 (54.5)	959 (56.1)	14 868 (54.4)		3954 (55.6)	254 (54.6)	3700 (55.7)		
College degree or more	6129 (16.9)	5097 (17.5)	223 (13.0)	4874 (17.8)		1032 (14.5)	54 (11.6)	987 (14.7)		
Missing/unknown	302 (0.8)	232 (0.8)	17 (1.0)	215 (0.8)		70 (1.0)	7 (1.5)	63 (1.0)		
Region					<.001				.053	<.001
East North Central	6293 (17.4)	5245 (18.0)	320 (18.7)	4925 (18.0)		1048 (14.7)	61 (13.1)	987 (14.9)		
East South Central	1452 (4.0)	1206 (4.2)	94 (5.5)	1112 (4.1)		246 (3.5)	20 (4.3)	226 (3.4)		
Middle Atlantic	2196 (6.1)	1641 (5.7)	62 (3.6)	1579 (5.8)		555 (7.8)	21 (4.5)	534 (8.0)		
Mountain	3767 (10.4)	3101 (10.7)	175 (10.2)	2926 (10.7)		666 (9.4)	38 (8.2)	628 (9.5)		
New England	992 (2.7)	780 (2.7)	42 (2.5)	738 (2.7)		212 (3.0)	9 (1.9)	203 (3.1)		
Pacific	2252 (6.2)	1721 (5.9)	67 (3.9)	1654 (6.1)		531 (7.5)	32 (6.9)	499 (7.5)		
South Atlantic	8279 (22.9)	6583 (22.7)	389 (22.7)	6194 (22.6)		1696 (23.9)	128 (27.5)	1568 (23.6)		
West North Central	4724 (13.1)	3878 (13.3)	220 (12.9)	3658 (13.4)		846 (11.9)	60 (12.9)	786 (11.8)		
West South Central	6198 (17.1)	4896 (16.8)	340 (19.9)	4556 (16.7)		1302 (18.3)	95 (20.4)	1207 (18.2)		
Missing/unknown	24 (0.1)	17 (0.1)	2 (0.1)	15 (0.1)		7 (0.1)	1 (0.2)	6 (0.1)		
Charlson Comorbidity Index, mean (SD)	0.83 (1.5)	0.75 (1.38)	1.00 (1.58)	0.74 (1.36)	<.001	1.14 (1.9)	1.96 (2.73)	1.08 (1.80)	<.001	<.001
History of tobacco use	8449 (23.4)	6953 (23.9)	549 (32.1)	6404 (23.4)	<.001	1496 (21.0)	128 (27.5)	1368 (20.6)	<.001	<.001
Mental health disorders										
Adjustment	1626 (4.5)	1061 (3.7)	68 (4.0)	993 (3.6)	.46	565 (8.0)	39 (8.4)	526 (7.9)	.72	<.001
Anxiety	5767 (15.9)	4487 (15.4)	376 (22.0)	4111 (15.0)	<.001	1280 (18.0)	117 (25.2)	1163 (17.5)	<.001	<.001
Mood	5856 (16.2)	4393 (15.1)	362 (21.2)	4031 (14.7)	<.001	1463 (20.6)	130 (28.0)	1333 (20.1)	<.001	<.001
Suicide or self-harm	123 (0.3)	104 (0.4)	9 (0.5)	95 (0.4)	.23	19 (0.3)	4 (0.9)	15 (0.2)	.01	.24
Disruptive	993 (2.7)	831 (2.9)	62 (3.6)	769 (2.8)	.05	162 (2.3)	11 (2.4)	151 (2.3)	.90	.007
Personality	82 (0.2)	72 (0.3)	8 (0.5)	64 (0.2)	.06	10 (0.1)	0	10 (0.2)	.40	.09
Psychosis	195 (0.5)	157 (0.5)	21 (1.2)	136 (0.5)	<.001	38 (0.5)	5 (1.1)	33 (0.5)	.10	.95
Other	1309 (3.6)	749 (2.6)	58 (3.4)	691 (2.5)	.03	560 (7.9)	36 (7.7)	524 (7.9)	.91	<.001
Alcohol or substance abuse disorders	887 (2.5)	744 (2.6)	75 (4.4)	669 (2.5)	<.001	143 (2.0)	19 (4.1)	124 (1.9)	.001	.007
Pain disorders										
Arthritis	16 781 (46.4)	13 281 (45.7)	1075 (62.8)	12 206 (44.6)	<.001	3500 (49.2)	291 (62.6)	3209 (48.3)	<.001	<.001
Back	9047 (25.0)	7283 (25.1)	672 (39.3)	6611 (24.2)	<.001	1764 (24.8)	191 (41.1)	1573 (23.7)	<.001	.67
Neck	4660 (12.9)	3841 (13.2)	361 (21.1)	3480 (12.7)	<.001	819 (11.5)	95 (20.4)	724 (10.9)	<.001	<.001
Other pain conditions	14 546 (40.2)	10 813 (37.2)	874 (51.1)	9939 (36.3)	<.001	3733 (52.5)	277 (59.6)	3456 (52.02)	.002	<.001

(continued)

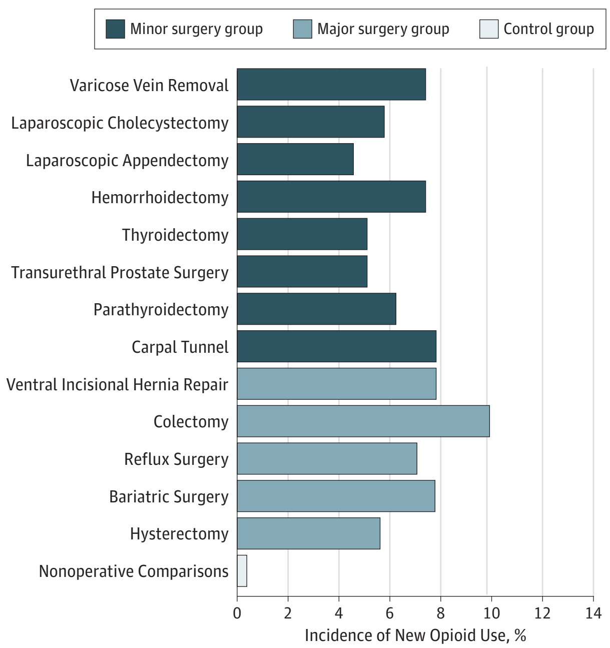
Table 1. Preoperative Patient Characteristics and Univariate Outcomes Analyses[a] (continued)

Characteristic	No. (%) Overall Group	Minor Surgery Cohort	Persistent Opioid Use	No Persistent Opioid Use	*P* Value	No. (%) Major Surgery Cohort	Persistent Opioid Use	No Persistent Opioid Use	*P* Value	*P* Value for Minor vs Major
Opioid prescription fulfillments										
30 d before procedure	6539 (18.1)	5222 (18.0)	435 (25.4)	4787 (17.5)	<.001	1317 (18.5)	108 (23.2)	1209 (18.2)	.007	.27
Total opioid dose of prescriptions within surgical window, median (IQR), OME	225 (150)	225 (150)	225 (187.5)	225 (150)	<.001	225 (187.5)	300 (262.5)	225 (187.5)	<.001	<.001

Abbreviations: IQR, interquartile range; OME, oral morphine equivalency.

[a] Univariate analyses were performed within each of the surgical groups as well as between groups for the outcome of new persistent opioid use.

Figure 3. Incidence of New Persistent Opioid Use by Surgical Condition



The incidence of new persistent opioid use was similar between the 2 groups (minor surgery, 5.9% vs major surgery, 6.5%; odds ratio, 1.12; SE, 0.06; 95% CI, 1.01-1.24). By comparison, the incidence in the nonoperative control group was only 0.4%.

ratio, 1.04; 95% CI, 0.93-1.18; *P* = .48) (**Table 2**). The mean (SD) number of prescriptions was 1.4 (0.9), with a mean (SD) of 53 (105.3) pills. Of those filling an opioid prescription between 90 and 180 days after surgery, the mean (SD) number of opioid prescriptions in the study period was 3.3 (2.0) with a mean (SD) of 125 (200.4) pills.

Risk Factors for New Persistent Opioid Use

In this cohort, tobacco use, alcohol and substance abuse disorders, and comorbid conditions increased the risk of new persistent opioid use among opioid-naive patients, regardless of surgical procedure (Table 2). In addition, anxiety, depression, and other preoperative pain disorders (ie, back pain, neck pain, arthritis, and centralized pain conditions) were independently associated with continued postoperative opioid use. Patients receiving an opioid prescription in the 30 days before surgery had almost 2-fold higher odds of persistent opioid use after surgery, even after adjustment for other covariates. While there was a significant association between those patients receiving the most opioids in the perioperative period (300 mg OME or higher) and new persistent use, the effect size was fairly small (adjusted OR, 1.14; 95% CI, 1.03-1.27).

In the mixed-effects model of the US Census Bureau regions (Table 2), the West South Central (incidence = 7.02%) and East South Central (incidence = 7.85%) regions were independently associated with higher rates of new persistent opioid use, while the Middle Atlantic region (incidence = 3.78%) was independently associated with a lower incidence of new persistent opioid use.

Discussion

In this study of a large cohort of privately insured patients in the United States, 6% of patients undergoing both minor and major surgical procedures continued to use opioids after 90 days after surgery. Rates of prolonged use were similar between those who underwent minor and major procedures, and patients with a greater number of comorbidities, including pain conditions, substance abuse, and mental health disorders, were particularly vulnerable to prolonged opioid use (Table 2). Given the declining rates of morbidity and mortality following common elective surgical procedures, new persistent opioid use represents an important, common, and underrecognized complication of perioperative care.[2,4-6]

Approximately 50 million ambulatory surgical procedures were performed in the United States in 2010[18]; thus, our findings suggest that more than 2 million individuals may transition to persistent opioid use following elective, ambulatory surgery each year. When including inpatient surgical procedures and considering the growth in surgical care in the United States, the number may be much higher. As such, our findings suggest that more than 2 million individuals may transition to persistent opioid use following elective surgery each year. These results are aligned with reports published by Clarke et al[8] and Alam et al[7] describing prolonged postoperative opioid use among a population-based sample of Canadians 65

Table 2. Multivariate Logistic Regression Model of New Persistent Opioid Use

Characteristic	Adjusted Odds Ratio (95% CI)	SE	*P* Value
Minor (0) vs major (1) surgery cohort	1.09 (0.96-1.23)	0.07	.18
Age, y			
18-29	1 [Reference]	NA	NA
30-39	0.76 (0.64-0.90)	0.07	.002
40-49	0.72 (0.61-0.84)	0.06	<.001
50-59	0.88 (0.75-1.04)	0.07	.13
60-64	0.90 (0.74-1.10)	0.09	.30
Female	0.99 (0.89-1.10)	0.05	.90
Race/ethnicity			
White	1 [Reference]	NA	NA
African American	1.13 (0.97-1.33)	0.09	.12
Asian	0.73 (0.51-1.04)	0.13	.08
Hispanic	0.98 (0.84-1.15)	0.08	.83
Education			
College degree or more	1 [Reference]	NA	NA
Some college	1.19 (1.03-1.38)	0.09	.02
High school	1.22 (1.04-1.43)	0.10	.01
Less than high school	1.08 (0.53-2.18)	0.39	.84
History of tobacco use	1.35 (1.21-1.49)	0.07	<.001
Charlson Comorbidity Index	1.10 (1.08-1.13)	0.01	<.001
Disorders			
Adjustment	0.86 (0.68-1.07)	0.10	.18
Anxiety	1.25 (1.10-1.42)	0.08	<.001
Mood	1.15 (1.01-1.30)	0.07	.04
Disruptive	1.03 (0.78-1.34)	0.14	.98
Other psychiatric	0.85 (0.67-1.08)	0.10	.17
Alcohol or substance abuse	1.34 (1.05-1.72)	0.17	.02
Other pain	1.39 (1.26-1.54)	0.07	<.001
Pain			
Back	1.57 (1.42-1.75)	0.09	<.001
Neck	1.22 (1.07-1.39)	0.08	.002
Arthritis	1.56 (1.40-1.73)	0.08	<.001
Opioid prescription in 30 d before procedure	1.93 (1.71-2.19)	0.12	<.001
Total opioid dose (OME) during surgical window of 300 mg or greater (75% percentile or greater)	1.14 (1.03-1.27)	0.06	.02
Random effects parameter			
Region variance, estimate; SE (95% CI)	0.03	0.02 (0.007-0.10)	NA

Abbreviations: NA, not applicable; OME, oral morphine equivalency.

years and older. Clarke et al[8] examined opioid use among all patients who filled an opioid prescription within 90 days after surgery, and Alam et al[7] did not require an opioid prescription after surgery for inclusion. In contrast, we specifically included patients who only filled prescriptions during the immediate perioperative procedure and excluded patients who received additional anesthesia (and presumably additional procedures) after the index procedure. Our cohort represents the direct transition from postoperative use to persistent use more than 3 months after surgery among patients who are opioid naive. Our results are also comparable with the 5% incidence of new long-term opioids use after the first opioid exposure using data from the Oregon prescription drug monitoring program, which includes nonoperative opioid prescriptions.[19]

More recently, Sun et al[20] described a lower incidence (0.119%-1.41%) following a variety of surgical conditions using a definition of more than 10 opioid prescription fulfillments or more than 120 days supplied between 3 and 12 months after surgery. While this definition identifies those patients filling large amounts of opioids, it may underestimate the incidence of new persistent opioid use and captures only the far extreme of opioid consumption. Surgical recovery would be expected well before the 90-day to 180-day outcome period used in the study, and any opioid use in this period is considered a long-term issue and inappropriate in a previously opioid-free cohort.

Persistent Use May Not Be Related to Surgical Pain

Our findings also highlight that prolonged opioid use following surgery may not simply be a consequence of poorly controlled pain. The pain experienced after major procedures would be expected to be greater than for minor procedures, which could be more likely to result in continued opioid use for long periods. However, we observed that new persistent opioid use did not differ between major and minor procedures. Aligned with our previous work, patients likely continue opioids for reasons other than intensity of surgical pain. For example, approximately 4% of patients undergoing total hip replacement and 8% undergoing knee arthroplasty who were not taking opioids before surgery continued to use opioids 6 months after surgery.[9] More interestingly, the change in the surgical knee or hip pain intensity from prior to surgery to 6 months after surgery was unrelated to new persistent opioid use.

Long-term postsurgical pain has received considerable attention in recent years,[21] but the reasons for which patients continue to use opioids after surgery are complex and not simply due to surgical pain. Unfortunately, opioids have been termed *painkillers* despite the fact that their long-term benefit with respect to pain relief has not been demonstrated.[9,22-25] Moreover, because opioids are prescribed medications, patients may overestimate their safety and use opioids intended for postsurgical pain for other symptoms, such as back and neck pain, headaches, osteoarthritis, and insomnia, for which opioids are not effective.[22-24] Previous studies have also demonstrated that psychiatric conditions, such as depression, are associated with long-term opioid use, and patients may continue to use their postoperative opioids to treat emotional pain and affective distress.[26-31] Regional variation was also found, with higher rates of new persistent opioid use in the East and West South Central United States.

CDC Guidelines Fail to Address Postoperative Prescribing

Despite the sharp focus on the opioid epidemic following the release of the CDC Guidelines for Prescribing Opioids for Chronic Pain,[15,25,32,33] there has been little attention placed on postoperative prescribing. The omission of postoperative prescribing guidelines was appropriate in many ways, as the data presented in the present study, to our knowledge, are among the first to quantify the very serious scope of the problem, and little is known regarding the variation in opioid consumption following surgery. However, even with these data, the reasons for which patients continue to use their opioids remain unclear. Moreover, this study does not address the millions of patients each year who receive excess opioids that often remain stored in an unsecure manner, thereby leading to potential diversion and abuse.[34] While the CDC guidelines and an increased attention on long-term outpatient management of opioids has and will continue to decrease opioid prescribing,[35] the effect of postoperative use on the opioid overdose epidemic has been less recognized. To our knowledge, there are currently no normative data for postoperative opioid prescribing to guide practice, and as such, it has become an issue of convenience and little attention has been placed on the potential morbidity to follow.

Clinical Implications

Although opioids remain an integral part of acute postoperative pain management, the data do not support long-term efficacy. In fact, many experts believe that the risks of opioids far outweigh the potential benefits.[22,24,25] As such, new persistent opioid use after surgery represents a poor long-term outcome and could be termed an adverse event. Given that our cohort is largely made up of individuals covered by employer-based plans and their dependents, our findings further underscore the importance of prolonged postoperative opioid use among young individuals during their prime years with respect to career and family demands.

Although we noted that some procedures appeared to have greater issues with persistent opioid use (eg, colectomy), we believe that new persistent opioid use is inappropriate in most cases. We acknowledge that the interventions may need to be tailored to the condition in some cases, but there are certainly some aspects of patient and health care professional interventions that are more generalizable.

Limitations

Despite the many strengths of this study, there are some limitations. First, we did not capture actual opioid consumption; however, the repeated opioid prescription fulfillments (with an average of 3.3 prescription fills between 90 and 180 days) suggest that patients were continuing to use opioids. Despite the fact that the cohort had not filled an opioid prescription in the year prior to their procedures, it is possible that the postoperative opioid prescriptions were related to another procedure or diagnosis. To mitigate this risk, we eliminated all patients with claims related to additional anesthesia during the postoperative period. As was noted above, the use of claims data does not allow for a granular assessment of other painful conditions and mood disorders (eg, degree of impairment or symptoms) that may be driving persistent use. Prospective data are needed to better understand the patient-level factors associated with new persistent postoperative opioid use. In addition, our categorization of major vs minor surgical conditions may be subject to critique, but the categories were created a priori and with guidance from previous studies on this topic. Reclassifying some of the procedures (eg, moving all laparoscopic procedures to the minor surgery category) did not significantly change the results (data not shown). Finally, our cohort was drawn from a large, population-based cohort of insured adults and their dependents, and our findings may not be generalizable to the uninsured, underinsured, and individuals 65 years and older.

Conclusions

In a cohort of previously opioid-naive patients, approximately 6% continued to use opioids more than 3 months after their surgery, and as such, prolonged opioid use can be deemed the most common postsurgical complication. New persistent opioid use is not different among patients who underwent minor and major surgical procedures, thereby suggesting that prolonged opioid use is not entirely due to surgical pain.

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Author Affiliations: Division of Pain Medicine, Department of Anesthesiology, University of Michigan Medical School, Ann Arbor (Brummett, Goesling, Moser, Kheterpal); Institute for Healthcare Policy and Innovation, University of Michigan, Ann Arbor (Brummett, Waljee, Lin, Englesbe, Bohnert, Kheterpal, Nallamothu); Department of Surgery, University of Michigan Medical School, Ann Arbor (Waljee, Englesbe); Department of Psychiatry, University of Michigan Medical School, Ann Arbor (Bohnert); Injury Research Center, University of Michigan Medical School, Ann Arbor (Bohnert); Veterans' Affairs Center for Clinical Management Research, Ann Arbor, Michigan (Bohnert, Nallamothu); Michigan Center for Health Analytics and Medical Prediction, Department of Internal Medicine, University of Michigan Medical School, Ann Arbor (Nallamothu).

Author Contributions: Drs Brummett and Moser had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.
Study concept and design: Brummett, Waljee, Goesling, Englesbe, Bohnert, Kheterpal, Nallamothu.
Acquisition, analysis, or interpretation of data: Brummett, Waljee, Moser, Lin, Englesbe, Bohnert, Nallamothu.
Drafting of the manuscript: Brummett, Waljee, Goesling, Moser, Englesbe.
Critical revision of the manuscript for important intellectual content: Brummett, Waljee, Lin, Englesbe, Bohnert, Kheterpal, Nallamothu.
Statistical analysis: Waljee, Moser.
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Supervision: Brummett, Waljee, Englesbe.

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