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Risk of Prolonged Opioid Use Among Opioid-Naïve Patients Following Common Shoulder Arthroscopy Procedures

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Abstract

Background—Opioid-related morbidity and mortality is a major public health problem, and the risk of long-term opioid use following surgery is not well defined.

Hypothesis/Purpose—Substance dependence, pain disorders, and psychiatric conditions increase the risk for prolonged opioid use.

Study Design—Prospective Cohort

Methods—Insurance claims data from Truven MarketScan was used to identify patients who underwent shoulder arthroscopy between January 1, 2010 and March 31, 2015. We included opioid naïve patients, defined as patients who did not fill an opioid prescription within 11 months before the perioperative period. New prolonged opioid use was defined as continued opioid use between 91 and 180 days following the index procedure. We used a multivariable logistic regression model to identify patient factors associated with the risk of new prolonged opioid use. An adjusted persistent use rate was calculated by surgery type.

Results—In this cohort of 104154 opioid-naïve adult patients who underwent an arthroscopic shoulder procedure between January 1, 2010 and March 31, 2015, 8686 patients (8.3%) developed new prolonged opioid use as defined in this study. 31768 (30.5%) patients filled an opioid prescription in the 30 days prior to surgery. Patients who had a limited debridement had the highest prolonged use rate (9.0%), followed by rotator cuff repair (8.5%), anterior labrum lesion repair (8.5%), and extensive debridement (8.2%). Patients with the highest ORs of prolonged opioid use included those patients who had a total opioid dose (OME) during the perioperative period that was 743 OME or greater (i.e. at least 149 tablets of 5mg Hydrocodone) (OR, 2.0; 95% confidence interval [CI], 1.9–2.1), followed by patients with a suicide and self-harm disorder (OR, 2.0; 95% CI, 1.1–3.4), history of alcohol dependence or abuse (OR, 1.6; 95% CI, 1.3–1.9), a mood disorder (OR, 1.3; 95% CI, 1.2–1.4), patients who filled an opioid prescription in the 30 days prior to surgery (1.3; 95% CI, 1.2–1.4), female gender (1.3; 95% CI, 1.2–1.3), and patients with an anxiety disorder (OR, 1.2; 95% CI, 1.1–1.3) and history of pain diagnosis (OR, 1.2; 95% CI, 1.1–1.2) (Table 3).

Conclusion—The risk of prolonged use following arthroscopic shoulder procedures is 8.3% and higher among women and individuals with greater opioid use in the early postoperative period, mental health conditions, substance dependence and abuse, and pre-existing pain disorders.

Clinical Relevance—High risk patients warrant close surveillance following surgery for early recognition and management.

Keywords

opioid crisis; opioid dependence; opioid misuse; opioid epidemic

Introduction

The United States consumes 80% of the global opioid supply, and opioid-related deaths have increased approximately fourfold from 1998 to 2014.^{1,2} In 2008, there were 36,450 opioid related deaths accounting for a rate of 11.9 per 100, 000 individuals in the population.² Opioid medications are commonly prescribed by orthopedic surgeons.³ In 2009, orthopaedic surgeons were the fourth highest prescriber of opioids accounting for 7.7% (6.1 million) of the 80 million prescriptions dispensed in the United States.⁴ Unfortunately, long-term opioid dependence may be triggered by a period of opioid use for acute pain, and recent evidence suggests that prolonged use after surgical procedures is common, even among opioid-naïve patients.^{5–72,8,7,9–12} Therefore, understanding the risk of prolonged opioid use is critical to optimize patient perioperative safety and ensure high quality care. Given the potentially devastating sequelae of opioid dependence, it is critical to identify patient characteristics that may put them at risk of prolonged opioid use.

In 2016 the American Pain Society (APS), released new guidelines for postoperative pain medication, utilizing “multimodal therapies,” such as NSAIDs, gabapentin, acetaminophen, and other non-narcotic medications in an attempt to limit the need for opioid pain medications following surgery.¹³ Nonetheless, prescription opioids are commonly provided for outpatient pain control, and clear guidelines to direct prescribing are sparse. According to the Free-standing Outpatient Surgery Centers Database, shoulder arthroscopy is the second most commonly performed orthopaedic procedure in the United States.¹³ Despite their prevalence, there is a paucity of literature that identifies patients at risk for opioid dependence following these procedures.^{9,11,12} We performed a population-based study using the Truven Health MarketScan Research databases to assess the risk of developing prolonged opioid use in opioid-naïve patients undergoing common elective shoulder arthroscopy procedures performed in the United States. We hypothesized that patients with mental health disorders and pain disorders, and individuals undergoing more intensive surgeries such as rotator cuff tear would be at a higher risk for prolonged postoperative opioid usage.

Methods

Data source and study sample

Health claims data from the Truven Health MarketScan Research Databases, including data from inpatient, outpatient, and pharmacy services, was analyzed.¹⁴ These databases include

healthcare claims data from more than 50 million employees and Medicare patients who have supplemental insurance. All patients who were included had a Current Procedural Terminology (CPT) code for a shoulder arthroscopy procedure between January 1, 2010 and March 31, 2015 (Table 1 in the appendix). These interventions were chosen because they are some of the most common arthroscopic surgeries performed by shoulder surgeons. Only the first surgical procedure for a patient was considered for analysis, and if a patient had more than one shoulder arthroscopy surgery during a single stay then the procedure assigned is based on the order of the CPT codes listed in Table 1 in the appendix.

We included only opioid naïve patients who were ages 18 or older, and patients who were discharged home from surgery. Opioid naïve patients were defined as patients did not fill an opioid prescription in the 11 months before the perioperative period (within 30 days before and 14 days after surgery) based on pharmacy claims. Patients without continuous enrollment during the 12 months prior to and 6 months after surgery were excluded to ensure complete data collection. Additionally, we excluded patients who had a length of stay > 30 days, patients who had an anesthesia code in the 6 months after discharge from the index surgical procedure, and patients without continuous pharmacy coverage. Patients who did not fill a prescription for opioids within the perioperative period or who filled a prescription with prescribed pill quantities which were outliers (greater than 3 standard deviations from the mean) were also excluded (Figure 1). Patient data included in this study was de-identified and deemed exempt by the institutional review board at our institution.

Patient factors

Demographic data collected included age, gender, geographical region, household income based on metropolitan statistical area code and type of insurance plan. The Charlson comorbidity index score was used to assess patient comorbidities.¹⁵ Mental health disorders were categorized based on the Agency for Healthcare Research and Quality Clinical Classification System (Table 2 in the appendix). Pain disorders were determined using the International Classification of Disease, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis codes (Table 3 in the appendix). To determine comorbidities, mental health disorders and pain disorders, diagnosis codes in the 12 months prior to surgery were considered. Insurance plans were classified into preferred provider organization, health maintenance organization, comprehensive insurance, point of service, and other (noncategorized) insurance plans. Each opioid prescription during the perioperative period was converted to oral morphine equivalents (OME) using standard published conversions for the morphine equivalent conversion factor per milligram.¹⁶

Outcomes

The primary outcome was prolonged opioid use, defined as one or more opioid prescription fills between 91 and 180 days after the surgical event among those patients who had filled an opioid prescription during the perioperative period.¹⁷ We examined the proportion of patients who developed prolonged opioid use after each arthroscopic surgery.

Statistical Analyses

All analyses were performed using Stata version 14.2 (StataCorp). Descriptive statistics were calculated for patient demographic variables and comorbidities. Differences between patients with prolonged opioid use and without prolonged opioid use were assessed using t tests and χ^2 tests. A multivariate logistic regression model was used to identify variables associated with prolonged opioid use, including age, gender, geographic region, household income, insurance plan, Charlson Comorbidity Index, surgical procedure, mental health disorders, pain disorders, prescription filled in the 30 days prior to surgery and total opioid dose during the perioperative period. P values were 2-tailed and statistical significance was set at $p < 0.05$.

Results

We identified 104,154 opioid-naïve adult patients who underwent an arthroscopic shoulder procedure between January 1, 2010 and March 31, 2015 and filled perioperative opioid prescriptions (Table 1). Most of our patients were male (65%) and were 50 years or older. 31,768 (30.5%) patients filled an opioid prescription in the 30 days prior to surgery. Overall, 8,686 patients (8.3%) who developed new prolonged opioid use as defined in this study. Regardless of surgery, the median dose of prescriptions during the perioperative period was 450 OME (Figure 2) and patients averaged approximately 1.5 prescriptions during this period.

Table 2 provides the adjusted odds ratio (OR) of filling an opioid prescription between 91 and 180 days after surgery. Patients with the highest ORs of prolonged opioid use included those patients who had a total opioid dose (OME) during the perioperative period that was 743 OME or greater (i.e. at least 149 tablets of 5mg Hydrocodone) (OR, 2.0; 95% confidence interval [CI], 1.9–2.1), followed by patients with a suicide and self-harm disorder (OR, 2.0; 95% CI, 1.1–3.4), history of alcohol dependence or abuse (OR, 1.6; 95% CI, 1.3–1.9), a mood disorder (OR, 1.3; 95% CI, 1.2–1.4), patients who filled an opioid prescription in the 30 days prior to surgery (1.3; 95% CI, 1.2–1.4), female gender (1.3; 95% CI, 1.2–1.3), an anxiety disorder (OR, 1.2; 95% CI, 1.1–1.3), and patients with a history of pain diagnosis (OR, 1.2; 95% CI, 1.1–1.2) (Table 3). Comprehensive insurance, point-of-service insurance, and higher Charlson Comorbidity Index were found to have smaller but statistically significant increased odds of prolonged opioid use. Younger age was associated with lower ORs; age between 18–29 years had an OR of 0.7 (95% CI, 0.6–0.8).

Patients who developed prolonged use had a median prescription dose of 600 OME and averaged 1.9 prescriptions during the perioperative period. Figure 3 depicts the adjusted new prolonged opioid use rate per surgical procedure. Patients who had a limited debridement had the highest prolonged use rate (9.0%), followed by rotator cuff repair (8.5%), anterior labrum lesion repair (8.5%), and extensive debridement (8.2%).

Discussion

In this cohort, we observed that 8.3% of patients who underwent shoulder arthroscopy developed new prolonged opioid use. New prolonged use was more common among

individuals with mental health conditions, substance abuse, and a history of pain disorders, and we observed that patients who went on to prolonged use were more likely to fill high doses of opioids during the perioperative period. It is important to identify these high-risk patients preoperatively, counsel them regarding this risk, and potentially arrange for an alternative pain management plan.

Going forward, it is critical for surgeons to consider the evidence regarding the consequences of using opioid-centric pain regimens, the risk factors associated with developing opioid dependence, the effect of non-musculoskeletal etiologies of pain (stress and poor coping strategies), and the value of instituting a collaborative approach for early recognition and management of opioid misuse.¹⁸ Determining the appropriate amount of opioid to prescribe after surgery is challenging to balance adequate pain control and the risk of over-prescribing. Despite our recognition of the significance of optimal perioperative pain control, up to 70% of patients report a significant degree of pain following surgery.¹⁹ Given that approximately 60% of surgical procedures in the United States takes place in the outpatient care setting, where patients are not monitored closely, it is important to prepare patients to anticipate and treat their postoperative pain appropriately.¹⁹ Despite our attempt to manage pain adequately, poorly controlled pain is one of the most commonly reported adverse effects of same day surgery, with rates as high as 25–30%.¹⁹ McGrath et al performed a survey study in 5,703 patients and found that 30% reported moderate to severe pain in the first 24 hours following surgery with 47.4% of those undergoing orthopaedic procedures reporting pain.¹⁹ Shoulder surgery was the third most painful procedure, with 54.3% patients undergoing shoulder surgery reporting pain.¹⁹ Ironically, Hill and colleagues showed that 28% of prescribed opioid pills were taken by patients after several types of outpatient general surgery procedures.²⁰ Ultimately, one of the most effective strategies for decreasing the need for pain medication is patient education. The majority of patients are unaware of what to expect post-operatively with regards to their pain and pain control. Additionally, confusing instructions such as prescribing “as-needed” can lead to incorrect self-administration of medications.¹³ Physicians should take an active role, not only in the identification of patients who are at a high risk for increased opioid usage, but also in educating patients about the proper way to manage their pain in the immediate post-operative period.

Risk factors for prolonged opioid usage for common hand surgery procedures have been investigated.¹² Waljee and colleagues examined opioid usage in 296,452 patients who underwent upper extremity procedures including: carpal tunnel release, trigger finger release, cubital tunnel release, and carpometacarpal arthroplasty/arthrodesis.²¹ The authors reported that 59% of patients filled narcotics prescriptions post operatively, with a declining rate of opioid usage with advancing age.²¹ Overall, prescriptions were filled for a mean 7.3 days, 4.5% of the total patients required a prescription refill. Filling a prescription preoperatively was predictive of the need to fill a prescription, as well as the need for a longer duration of opioid usage (24 versus 5 days in opioid naïve).²¹ Recognizing risk factors that predispose patients to prolonged opioid use may help providers identify patients who warrant close surveillance following surgery for early recognition or opioid misuse and provide these patients with direction to appropriate resources and opioid alternatives.

Stiglitz and colleagues quantified the duration and effect of post-operative pain following shoulder arthroscopy.²² The authors used the Visual Analog Pain scale and tracked pain from postoperative day 0 to 30, with final follow up at one year. They reported a pain level of 2.9 preoperatively; with less pain immediately postoperatively (2.5 on day 0, 2.2 on day 1) with an increase in pain from day 2–30. Pain never exceeded a 4, and at 1 year follow up averaged a 2.2.²² The authors also examined total opioid requirement. Total morphine usage averaged 8.2 mg, with more than 50% of the total morphine being administered on the day of surgery.²² Rotator cuff tear was found to be the most painful procedure, followed by instability surgery, and decompression.²² Considering the opioid usage rate in the prior study, combined with the findings of our study, it may be appropriate to limit narcotic supply to less than a week, even for more painful procedures such as rotator cuff surgery.

Our analysis revealed that limited debridement had the highest overall percentage of patients who developed prolonged opioid usage. In our group, the is not a “diagnosis” that warrants arthroscopy in isolation, and usually are performed in conjunction with some other primary procedure. It is possible that these procedures had a suboptimal outcome due to a poor indication, which in turn was contributory to continued pain and a need for medication. Furthermore, we demonstrated that there was no statistically significant difference in pain as measured by opioid usage between “minor” and “major” arthroscopic procedures, which may indicate that the magnitude of pain experienced by these patients goes beyond the physiologic pain associated with shoulder disability. George and colleagues examined the biopsychosocial elements associated with pain following arthroscopic shoulder surgery and found that fear of pain, or catastrophizing pain were predictive of heightened shoulder pain.²³ William and colleagues investigated the relationship between pain, mood, and anxiety disorders with respect to pain at various parts of the body.²⁴ Patients with current mood disorders were 2.2 times more likely to have shoulder pain, and those with anxiety disorders were 1.9 times more likely.²⁴ Similarly, our study also found an association between prolonged opioid use and mood, anxiety and pain disorders.

Increased attention is being placed on multimodal pain management as potential solution in minimization of perioperative narcotic consumption. Surgeons utilize local anesthesia or regional blocks where possible, particularly for shoulder procedures.²⁵ Hadzic and colleagues found that interscalene brachial plexus block combined with general anesthesia was superior to general anesthesia alone when used in a same day surgery setting.²⁶ The authors found that patients who received a regional block had less unplanned admissions, and a faster discharge time than those without a block.²⁶ Regional blocks may help with the acute pain patients experience in the immediate postoperative period and have been evaluated in multimodal pain management strategies for pain control after shoulder surgery.²⁶ Alternative medications can also be used to manage pain after shoulder surgery. Tippi and colleagues performed a systematic review, which reported that a single dose of gabapentin (ranging from 300–1200 mg) reduced opioid consumption by an equivalent of 30 mg of morphine during the first 24 hours after surgery.²⁷ While less potent opioid medications such as tramadol can be effective in managing post-operative pain, these prescriptions are less commonly filled than stronger opioids following outpatient hand surgery.²¹

Our study has several limitations. First, this study is an analysis of administrative claims data, which lacks sufficient specificity to determine the extent of pain that patients experience following surgery or other patient factors that could be influencing opioid consumption. Therefore, we cannot know if the prescription rates are overly high or inappropriately low compared with patient-reported pain scores. Additionally, we were not able to tell what exactly was done during each surgical procedure. For example, we cannot determine the type of rotator cuff repair performed, or the amount of acromion that was resected; and, operative time was not reported. Additionally, we did not include the use of non-opioid alternative prescriptions as these are readily available, and patients may have purchased these medications over the counter without insurance coverage, making them difficult to track. Therefore, the extent to which these alternatives influence the utilization of opioids following common shoulder surgery procedures cannot be discerned from this data. Second, there is no standard definition for prolonged or persistent opioid use. Our definition of prolonged or persistent use is based on previous population-based studies examining opioid use in patients undergoing surgical procedures.^{28,17} Third, we assume that opioid prescriptions filled between 91 and 180 days after surgery are filled for pain associated with a condition that required the index surgical intervention.

Conclusion

Understanding patient characteristics that predispose them to developing prolonged opioid use can help identify patients who are at higher risk for transitioning to long-term opioid use. Our study found that 8.3% of patients who underwent shoulder arthroscopy developed new prolonged opioid use and that patients with the highest odds ratio of prolonged opioid use included those patients who had a total opioid dose (OME) during the perioperative period that was 743 or greater, followed by patients with a suicide and self-harm disorder, alcohol dependence or abuse, a mood disorder, female gender, and patients with a history of pain diagnosis. Younger age was associated with a lower OR for developing prolonged opioid use. These high-risk patients should be provided with appropriate education regarding their risk preoperatively. Additionally, patients who are recognized to be at high risk may require close surveillance, and treatment with alternative pain medications during the postoperative period.

Appendix

Table 1:

Shoulder arthroscopy procedures with Current Procedural Terminology (CPT) codes

Surgery Description	CPT Code
Major Procedures	
Rotator cuff repair	29827
Superior labrum anterior and posterior lesion repair	29807
Capsulorrhaphy	29806
Biceps tenodesis	29828
Minor Procedures	

Surgery Description	CPT Code
Subacromial decompression with acromioplasty	29826
Extensive debridement	29823
Limited debridement	29822

Table 2:**Mental health disorders**

Mental Health Condition	Clinical Classification System Code
Adjustment disorder	650
Anxiety disorder	651
Attention deficit, conduct disorders	652
Impulse control disorders	656
Mood disorders	657
Personality disorders	658
Schizophrenia	659
Alcohol related disorders	660
Substance related disorders	661
Suicide and self-harm	662
Miscellaneous disorders	670

Table 3:**Pain diagnoses**

Pain Disorder Category	ICD-9 Code
Back	722.30, 722.32, 722.33, 722.70, 722.72, 722.73, 722.80, 722.82, 722.83, 722.90, 722.92, 722.93, 737.1, 737.3, 738.4, 738.5, 739.2, 739.3, 739.4, 756.10, 756.11, 756.12, 756.19, 805.4, 805.8, 839.2, 839.42, 846, 846.0, 847.1, 847.2, 847.3, 847.9, 721.3x – 721.9x, 722.2x, 724.xx, 756.13
Neck	721.0X, 721.1X, 722.0X, 722.31, 722.71, 722.81, 722.91, 723.XX, 839.0, 839.1, 847.0
Arthritis	711.XX, 712.XX, 713.X, 714.XX, 715.XX, 716.XX, 717.XX, 718.XX, 719.XX, 725, 726.XX, 727.XX, 728.XX, 729.3X, 729.7X, 729.8X, 729.9X, 730.XX, 731.X, 732.X, 733.XX, 734, 735.X, 736.XX, 737.2X, 737.4X, 738.1X, 710, 710.1, 710.3, 710.4, 710.5, 710.8, 710.9, 729, 729.2, 729.4, 729.5, 729.6, 737, 737.8, 737.9, 738, 738.2, 738.3, 738.6, 738.7, 738.8, 738.9, 739, 739.1, 739.5, 739.6, 739.7, 739.8, 739.9
Other pain disorders	
Temporomandibular joint disorder	524.60, 524.61, 524.62, 524.63, 524.64, 524.69
Tension headache	307.81
Headache/head pain/suboccipital headache	784.0
Occipital neuralgia/headache	723.8
Tear film insufficiency, unspecified (dry eyes)	375.15
Myalgia and myositis, unspecified (Fibromyalgia)	729.1

Pain Disorder Category	ICD-9 Code
Noncardiac or musculoskeletal chest pain	786.59
Dyskinesia of the esophagus	530.5
Functional bowel (includes IBS)	564.xx
Interstitial cystitis	595.1
Vulvodynia	625.7x
Endometriosis	617.x
Dyspepsia	536.8
Sicca syndrome	710.2
Tinnitus	388.3
Chronic fatigue syndrome	780.71
Migraine	346.00, 346.01, 346.02, 346.03, 346.10, 346.11, 346.12, 346.13, 346.20, 346.21, 346.22, 346.23, 346.30, 346.31, 346.32, 346.33, 346.40, 346.41, 346.42, 346.43, 346.50, 346.51, 346.52, 346.53, 346.60, 346.61, 346.62, 346.63, 346.70, 346.71, 346.72, 346.73, 346.80, 346.81, 346.82, 346.83, 346.90, 346.91, 346.92, 346.93
Insomnia	780.52

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What is known about this subject

Shoulder arthroscopy is commonly performed by orthopedic surgeons, and prescription opioids continue to be a key element of postoperative pain management.

What this study adds to knowledge

Describes the incidence of and risk factors for developing prolonged opioid use after shoulder arthroscopy.

Figure 1.
Inclusion and exclusion criteria.

Figure 2.
Oral morphine equivalent (OME) distribution during the perioperative period.

Figure 3.

Adjusted new prolonged opioid use rate by surgical procedure. Error bars indicate 95% CI.

Table 1

Patient Characteristics

	Overall (N=104,154)	Persistent Opioid Use (N=8686)	No Persistent Opioid Use (N=95,468)	P value
Age, y				
18–29	9787 (9.4)	511 (5.9)	9276 (9.7)	<0.001
30–39	9322 (9)	721 (8.3)	8601 (9)	
40–49	22331 (21.4)	1820 (21)	20511 (21.5)	
50–59	34325 (33)	3069 (35.3)	31256 (32.7)	
60–69	21852 (21)	1991 (22.9)	19861 (20.8)	
≥70	6537 (6.3)	574 (6.6)	5963 (6.3)	
Gender				
Male	67186 (64.5)	5013 (57.7)	62173 (65.1)	<0.001
Female	36968 (35.5)	3673 (42.3)	33295 (34.9)	
Geographic Region				
Northeast	20710 (19.9)	1310 (15.1)	19400 (20.3)	<0.001
North Central	27074 (26)	2281 (26.3)	24793 (26)	
South	36281 (34.8)	3478 (40)	32803 (34.4)	
West	19148 (18.4)	1527 (17.6)	17621 (18.5)	
Unknown	941 (0.9)	90 (1)	851 (0.9)	
Median Income				
<40K	94 (0.1)	6 (0.1)	88 (0.1)	<0.001
40K–49K	1323 (1.3)	120 (1.4)	1203 (1.3)	
50K–59K	16000 (15.4)	1520 (17.5)	14480 (15.2)	
60K–69K	34236 (32.9)	2924 (33.7)	31312 (32.8)	
≥70K	52501 (50.4)	4116 (47.4)	48385 (50.7)	
Insurance				
PPO	61185 (58.7)	5099 (58.7)	56086 (58.8)	<0.001
Comprehensive	7334 (7)	714 (8.2)	6620 (6.9)	
HMO	12398 (11.9)	1026 (11.8)	11372 (11.9)	
Point of Service	8231 (7.9)	734 (8.5)	7497 (7.9)	
Other	10339 (9.9)	734 (8.5)	9605 (10.1)	
Unknown	4667 (4.5)	379 (4.4)	4288 (4.5)	
Charlson Comorbidity Index, mean (SD)	0.44 (0.929)	0.56 (1.047)	0.43 (0.917)	<0.001
Surgical Procedures				
Anterior and Posterior Lesion Repair	11386 (10.9)	839 (9.7)	10547 (11.1)	<0.001
Biceps Tenodesis	2525 (2.4)	199 (2.3)	2326 (2.4)	
Capsulorrhaphy	6907 (6.6)	414 (4.8)	6493 (6.8)	
Extensive Debridement	3948 (3.8)	315 (3.6)	3633 (3.8)	

	Overall (N=104,154)	Persistent Opioid Use (N=8686)	No Persistent Opioid Use (N=95,468)	P value
Limited Debridement	3403 (3.3)	300 (3.5)	3103 (3.3)	
Rotator Cuff Repair	44107 (42.4)	4041 (46.5)	40066 (42)	
Subacromial Decompression with Acromioplasty	31878 (30.6)	2578 (29.7)	29300 (30.7)	
Mental Health Disorders				
Adjustment disorder	2397 (2.3)	207 (2.4)	2190 (2.3)	0.596
Anxiety disorder	5517 (5.3)	634 (7.3)	4883 (5.1)	<0.001
Disruptive disorder	1481 (1.4)	118 (1.4)	1363 (1.4)	0.602
Mood disorder	6912 (6.6)	836 (9.6)	6076 (6.4)	<0.001
Personality disorder	100 (0.1)	17 (0.2)	83 (0.1)	0.002
Psychosis	199 (0.2)	17 (0.3)	172 (0.2)	0.008
Alcohol and substance abuse disorder	1001 (1.0)	142 (1.6)	859 (0.9)	<0.001
Suicide and self-harm disorder	76 (0.1)	19 (0.2)	57 (0.1)	<0.001
Other mental health disorder	1410 (1.4)	161 (1.9)	1249 (1.3)	<0.001
Pain disorder				
Arthritis	102122 (98.1)	8504 (97.9)	93618 (98.1)	0.310
Back	21050 (20.2)	1987 (22.9)	19063 (20.0)	<0.001
Neck	15416 (14.8)	1537 (17.7)	13879 (14.5)	<0.001
Other pain conditions	16075 (15.4)	1679 (19.3)	14396 (15.1)	<0.001
Opioid prescription filled in the 30 days prior to procedure	31768 (30.5)	3294 (37.9)	28474 (29.8)	<0.001
Total opioid dose of prescription within perioperative period, median (IQR), OME	450 (442.5)	600 (525)	450 (390)	<0.001

Abbreviations: SD, standard deviation; IQR, interquartile range; OME, oral morphine equivalency

Table 2

Association of Patient Characteristics, Surgery Procedure and Perioperative OME on the Likelihood of New Persistent Opioid Use

	Odds Ratio	P-value	95% Confidence Interval	
Age (ref group: 50–59)				
18–29	0.678	<0.001*	0.605	0.759
30–39	0.929	0.108	0.849	1.016
40–49	0.946	0.079	0.889	1.007
60–69	0.984	0.605	0.925	1.046
>=70	0.895	0.035*	0.807	0.992
Gender (ref group: Male)				
Female	1.258	<0.001*	1.200	1.318
Geographic Region (ref group: South)				
Northeast	0.643	<0.001*	0.599	0.691
North Central	0.902	<0.001*	0.851	0.956
West	0.777	<0.001*	0.727	0.830
Unknown	1.064	0.589	0.849	1.333
Median Income (ref group: >=70K)				
<40K	0.724	0.448	0.314	1.669
40K – 49K	1.056	0.580	0.870	1.282
50K – 59K	1.098	0.005*	1.029	1.172
60K – 69K	1.032	0.223	0.981	1.087
Insurance (ref group: PPO)				
Comprehensive	1.144	0.004*	1.044	1.254
HMO	1.007	0.849	0.937	1.082
Point of Service	1.100	0.023*	1.013	1.195
Other	0.887	0.004*	0.818	0.962
Unknown	1.153	0.015*	1.028	1.294
Charlson Comorbidity Index	1.109	<0.001*	1.085	1.133
Surgical Procedure (ref group: Subacromial Decompression)				
Anterior and Labrum Lesion Repair	1.043	0.344	0.956	1.138
Biceps Tenodesis	0.940	0.424	0.808	1.094
Capsulorrhaphy	0.943	0.338	0.836	1.063
Extensive Debridement	1.008	0.902	0.891	1.140
Limited Debridement	1.108	0.113	0.976	1.258
Rotator Cuff Repair	1.045	0.105	0.991	1.102
Mental Health Disorders				
Anxiety	1.171	0.001*	1.068	1.284
Mood	1.290	<0.001*	1.189	1.400

	Odds Ratio	P-value	95% Confidence Interval	
Personality	1.520	0.129	0.885	2.610
Psychosis	1.105	0.648	0.721	1.692
Alcohol and substance abuse disorder	1.567	<0.001*	1.297	1.893
Suicide and self-harm disorder	1.965	0.017*	1.129	3.420
Other mental health disorder	1.202	0.034*	1.014	1.424
Pain Disorders				
Back pain	1.087	0.003*	1.028	1.150
Neck pain	1.116	0.001*	1.049	1.188
Other pain conditions	1.162	<0.001*	1.095	1.232
Opioid prescription filled in the 30 days prior to procedure	1.305	<0.001*	1.245	1.368
Total opioid dose (OME) during surgical window of 742.5 OME or greater (75% or greater)	2.001	<0.001*	1.910	2.097