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Clinical Study

Relationship between initial opioid prescription size and likelihood of refill after spine surgery

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Abstract

BACKGROUND CONTEXT: Best practices in opioid prescribing after elective surgery have been developed for most surgical subspecialties, including spine. However, some percentage of patients will become chronic users.

PURPOSE: This study aimed to determine the relationship between the size of initial opioid prescription after surgery for degenerative spinal disease and the likelihood of refills.

STUDY DESIGN/SETTING: Retrospective case-control study.

PATIENT SAMPLE: Opioid-naïve patients aged 18 to 64 undergoing elective spinal procedures (anterior cervical discectomy and fusion, posterior cervical fusion, lumbar decompression, and lumbar fusion) from 2010 to 2015 filling an initial perioperative prescription using insurance claims from Truven Health MarketScan (n=25,329).

OUTCOME MEASURES: Functional measure: health-care utilization. Primary outcome was occurrence of an opioid refill within 30 postoperative days.

METHODS: We used logistic regression to examine the probability of an additional refill by initial opioid prescription strength, adjusting for patient factors.

FDA device/drug status: Not applicable.

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- Massie LW, Gunaseelan V, Zakaria HM, Waljee J, Brummett C, Schwalb JM. The National Prevalence and Characteristics of Opioid Use in Patients Undergoing Elective Spine Surgery. Spine Summit 2019, Miami Beach, FL, 3/17/19.

Portions were also included as a poster presentation:

- Massie LW, Zakaria H, Gunaseelan V, Waljee J, Brummett C, Schwalb J. National Opioid Prescribing Patterns in Elective Spine Surgery Patients. AANS National Meeting, San Diego, CA, April 2019.

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RESULTS: About 26.3% of opioid-naïve patients obtained refills of their opioid prescriptions within 30 days of surgery. The likelihood of obtaining a refill was unchanged with the size of the initial perioperative prescription across procedure categories. Patient factors associated with increased likelihood of refills included age 30 to 39 years (odds ratio [OR] 1.137, p=.007, 95% confidence interval [CI] 1.072−1.249), female gender (OR 1.137, p<.001, 95% CI 1.072−1.207), anxiety disorder (OR 1.141, p=.017, 95% CI 1.024−1.272), mood disorder (OR 1.109 p=.049, 95% CI 1.000−1.229), and history of alcohol/substance abuse (OR 1.445 p=.006, 95% CI 1.110−1.880).

CONCLUSIONS: For opioid-naïve patients, surgeons can prescribe lower amounts of opioids after elective surgery for degenerative spinal disease without concern of increased need for refills.

Keywords: Opioid; Postoperative; Spine surgery; Degenerative spine disease; Pain; Spine

Introduction

Opioids are an important component in treating postoperative pain so that patients do not suffer and do not develop complications due to immobility from their pain. However, opioid prescribing after surgery is a common cause of long-term opioid use, with about 6% of patients filling opioid prescriptions 6 months after many common surgeries [1]. After elective spine surgery, the likelihood of an opioid-naïve patient still filling opioid prescriptions at 1 year is 19% to 26% [2]. For common general surgical procedures, it has been shown that opioid use is proportional to the amount prescribed [3], suggesting that decreasing prescription size can decrease use. In addition to the risks of chronic opioid use after surgery, opioids are often not disposed of by patients after surgery [4], resulting in potential diversion and misuse by people for whom the opioids were not prescribed. The hope is that smaller prescription sizes will lead to decreased rates of chronic opioid use and misuse.

However, the issues with opioids faced by patients undergoing spine surgery are likely to be different than for patients undergoing a laparoscopic cholecystectomy. Spine surgery is often performed for pain as the primary indication and the majority of patients come to surgery on preoperative opioids [2,5]. While long-term opioid use after spine surgery in opioid naïve patients may be rare (<0.1%) in the military population [6], larger statewide analyses have supported that patients continuing to require opioids at 31 to 60 days after surgery were 4.1 times more likely to be using opioids at 1 year [7].

Therefore, it is unclear whether current guidelines on opioid prescribing that have been developed on the basis of general surgical procedures are reasonable for patients undergoing spine surgery [8]. Moreover, while prescription limits after general surgical procedures have not led to decreased patient satisfaction nor need for refills [9,10] the effects on these limits after elective spine surgery are unknown. There is concern about the increased burden on physician offices by the need for refills and of patients suffering from uncontrolled pain while waiting for refills [11].

It is critical to understand the relationship of initial prescription size to probability of refill to guide best practices in prescribing. Therefore, we sought to determine if there is an optimal prescription dosage in the initial perioperative period that would minimize the need for refills. We chose to focus on opioid-naïve patients, since this patient population is the focus of other postoperative prescribing efforts [12] and because of the complexity and heterogeneity of tolerance in patients with preoperative opioid use. We also examined factors associated with refills in opioid naïve patients after spine surgery. We hypothesized that there is an optimal prescription size that would minimize the need for refills.

Methods

Data source and study cohort

We utilized inpatient, outpatient, and prescription drug insurance claims from the IBM MarketScan Commercial Claims Database to obtain eligible patients. These databases contain data for 130 million individuals, encompassing employees, their spouses and dependents who are covered by employer-sponsored private health insurance in the United States.

We evaluated data from patients undergoing common elective spinal procedures, identified using Current Procedural Terminology codes, between January 1, 2010 and December 31, 2015 (Supplemental Table 1). The spinal procedures included anterior cervical discectomy and fusion (ACDF), posterior cervical fusion (PCF), lumbar decompression (LD), and posterior lumbar fusion (PLF). Patients with diagnoses of scoliosis, trauma, tumors, and infections, identified using *International Classification of Disease, Ninth and Tenth Revision, Clinical Modification* diagnosis codes (ICD-9/ICD-10) codes, were excluded (Supplemental Table 2). Only opioid-naïve patients between the ages of 18 to 64 were included. Opioid-naïve patients were defined as those who did not have an ICD-9 or ICD-10 code for opioid dependence, had not filled a prescription for opioids, buprenorphine or naltrexone in the 365 days to 8 days before admission to surgery, and did not have a Current Procedural Terminology code (4306F) associated with counseling for opioid addiction. The ICD-9 codes used for opioid dependence were 304.00, 304.01, 304.02, 304.70, 304.71, 304.72, 305.50, 305.51, and 305.52. ICD-10 codes used were F11.10, F11.12, F11.14, F11.15, F11.18, F11.19, F11.20, F11.22, F11.23, F11.24, F11.25, F11.28, and F11.29. Opioids considered for analysis were codeine, dihydrocodeine, fentanyl, hydrocodone, hydromorphone, levorphanol, meperidine, methadone, morphine, nalbuphine, oxycodone, oxymorphone, pentazocine, tapentadol, and tramadol. Opioid, buprenorphine, and naltrexone prescriptions were identified using therapeutic drug class and generic name.

Patients were excluded if they lacked continuous insurance coverage in the year before and after their surgery, had subsequent surgery in the year after their surgery, were not discharged home, had a hospital length of stay longer than 30 days, or if they had a combination 360-degree procedure. Patients were also excluded if they did not fill an initial perioperative prescription. To make sure that we did not exclude patients given an opioid prescription before surgery for use afterward, an initial perioperative prescription was defined as filling an opioid prescription in the 7 days before admission to surgery or in the 7 days after discharge, as has been previously described [13].

Outcomes

The primary outcome was refill of an opioid prescription. Refill was defined as one or more opioid prescriptions filled after the initial perioperative prescription and within 30 days of discharge from spine surgery.

Explanatory variable

The primary explanatory variable was the size of the initial perioperative prescription, which was measured in oral morphine equivalents (OMEs). Using the type of opioid, strength and quantity, each initial perioperative prescription was converted to OMEs with standard published conversions for the morphine equivalent conversion factor. If the patient received a prescription in the 7 days before surgery as well as within 7 days of discharge, only the latter was used to calculate OMEs.

Patient factors

Patient sociodemographic variables included age, gender, census region of residence, household income based on metropolitan statistical area code and insurance type. We included the following comorbidities: (1) Charlson comorbidity index score; (2) mental health disorders based on the clinical classification system from the Agency of Healthcare Research and Quality, categorized as adjustment disorders, anxiety, disruptive disorders, mood disorders, personality disorders, psychosis, alcohol and substance abuse disorders, suicide and self-harm, and other mental health disorders (Supplemental Table 3); and (3) pain conditions categorized as arthritis and joint pain, back pain, neck pain, and other pain using ICD-9 and ICD-10 codes (Supplemental Table 4). To determine comorbidities, we considered all claims in the year before admission to spine surgery. We also included the type of spine procedure.

Statistical analysis

All analyses were conducted using SAS version 9.4 (SAS Institute, Inc., Cary, NC, USA) and Stata version 15.1 (StataCorp, College Station, TX, USA). We used descriptive statistics to describe the demographic and clinical characteristics of the study cohort. We calculated the incidence of refill within 30 days of surgery. We then used a multivariable logistic regression model to determine the likelihood of refill based on initial perioperative prescription size (in OME) while controlling for age, gender, census region of residence, median income, insurance type, Charlson comorbidity score, type of surgical procedure, mental health disorders, and pain conditions. Complete cases analysis was used for the regression model. The p values were two-tailed, and significance was set at $p<.05$.

Ethical considerations

The study was deemed exempt from review by our Institutional Review Board. Informed consent was waived because the dataset was deemed de-identified.

This manuscript was prepared in accordance with STROBE guidelines.

Results

Twenty-three percent (25,329/104,407, Supplemental Table 5) of patients undergoing common degenerative spinal surgery from 2010 to 2015 in the Truvien database were opioid-naïve. Of patients in this time period undergoing the most common spine surgeries, 68.4% to 78.4% were prescribed opioids for their back or neck pain before surgery, with the vast majority for 1 to 3 months, in line with prior estimates [2,6]. About 20% of patients undergoing ACDF, LD, and PCF in our cohort had been using opioids chronically or carried a diagnosis of opioid dependency, in line with prior findings [2,14].

A total of 25,329 patients met the cohort's full inclusion and exclusion criteria. Patient characteristics of the cohort are displayed in Table 1. Within the cohort, 43.7% underwent LD (n=11,060), 39.9% underwent ACDF (n=10,096), 11.7% underwent PLF (n=2,975), and 4.7% underwent PCF (n=1,198). Mean age of patients was 49±10 years and most (57%) patients were male (n=14,600). Patients from the South census region comprised 39.1% of our cohort followed by patients from North Central (26.3%), Northeast (18.3%), and West (15.8%). 7.6% (n=1,930) of patients had a history of anxiety disorders and 8.8% (n=2,229) of patients had a history of mood disorders. Diagnostic codes for arthritis pain, back pain and neck pain were found in 68.9% (n=17,448), 76.1% (n=19,275), and 51.9% (n=13,138) of patients, respectively.

Table 2 details the multivariable analysis examining the factors associated with the likelihood of postoperative refill. This was initially performed separately for each procedure subtype (Supplemental Tables 1−4), but then consolidated

Table 1
Patient characteristics

	N	%
Total number of opioid-naïve patients	25329	
Patients with postoperative refill	6669	26.3
Age (in years), mean (SD)	49 (10)	
Gender		
Male	14600	57.6
Female	10729	42.4
Region		
Northeast	4622	18.3
North Central	6652	26.3
South	9903	39.1
West	3996	15.8
Unknown	156	0.6
Median income		
<50K	453	1.8
50K−59K	4162	16.4
60K−69K	8302	32.8
70K−79K	4313	17.0
80K−89K	1758	6.9
>=90K	6341	25.0
Insurance		
PPO	15667	61.9
Comprehensive	915	3.6
HMO	2505	9.9
Point of service	2145	8.5
Other	3007	11.9
Unknown	1090	4.3
Charlson comorbidity score, mean (SD)	0.4 (0.96)	
Surgical procedure		
Anterior cervical surgery	10096	39.9
Lumbar decompression	11060	43.7
Posterior cervical surgery	1198	4.7
Posterior lumbar fusion	2975	11.8
Mental health disorders		
Adjustment disorder	610	2.4
Anxiety disorder	1930	7.6
Disruptive disorder	374	1.5
Mood disorder	2229	8.8
Personality disorder	19	0.1
Psychosis	53	0.2
Alcohol and substance abuse disorder	267	1.1
Suicide and self-harm disorder	31	0.1
Other mental health disorder	459	1.8
Pain disorders		
Arthritis	17448	68.9
Back	19275	76.1
Neck	13138	51.9
Other pain conditions	6142	24.3
Median initial OME (IQR)	450 (375)	

when the findings were found to be consistent across LD, ACDF, PCF, and PLF. Patient factors associated with increased likelihood of an opioid naïve patient requiring postoperative refills included age 30 to 39 years (odds ratio [OR] 1.137, p=.007, 95% confidence interval [CI] 1.072−1.249) and female gender (OR 1.137, p<.001, 95% CI 1.072−1.207). History of anxiety disorders (OR 1.141, p=.017, 95% CI 1.024−1.272), mood disorders (OR 1.109, p=0.049, 95% CI 1.000−1.229), and alcohol or substance abuse (OR 1.445, p=.006, 95% CI 1.110−1.880) were all significantly correlated with increased likelihood of refills.

Patients in the Northeast were significantly less likely to refill (OR 0.886, p=.008, 95% CI 0.810−0.969) but patients in the Midwest (OR 1.221, p<.001, 95% CI 1.134−1.315) and West (OR 1.113, p=.019, 95% CI 1.018−1.216) were significantly more likely to refill when compared with patients in the South.

Overall, 26.3% of patients refilled their opioid prescriptions within 30 days of discharge from spinal surgery. Patients who underwent PLF (46.3%) were most likely to refill followed by patients who underwent posterior cervical surgery (PCS; 35.1%), ACDF (26.5%), and LD (19.9%). The median initial perioperative prescription size (IQR) was 450 OME (375) for ACDF and PCS. The median initial perioperative prescription size (IQR) was 450 OME (300) for LD. The median initial perioperative prescription size (IQR) for PLF was larger at 600 (525) OME. The likelihood of refilling a prescription did not change significantly with an increase in the size of initial perioperative opioid prescription. There were differences in the probability of refilling a prescription when stratified by procedure type (Fig. 1) that persisted (Fig. 2) when risk adjusted by the preoperative characteristics delineated in Table 2. Patients who underwent a PLF were more likely to refill at a rate of 42% across OMEs. LD patients were least likely to refill across OMEs. Although there was a decrease in the likelihood of refill in patients undergoing LD (25% vs 23%) and PCS (30% vs 34%) and receiving <=100 OMEs and 101 to 200 OMEs, these differences were not statistically significant.

In terms of surgical procedure, when compared with LD, all other procedures are at increased likelihood of requesting refills: ACDF (OR 1.525, p<.001, 95% CI 1.367−1.702), PCF (OR 2.386, p<.001, 95% CI 2.041−2.789), and PLF (OR 3.505, p<.001, 95% CI 3.211−3.827).

The presence of concurrent diagnosis for arthritic pain, back pain, and neck pain was not a significant risk factor, however, a diagnosis of other pain conditions was associated with increased likelihood of refills (OR 1.126, p=.001, 95% CI 1.052−1.206). The size of the initial perioperative prescription was not significantly associated with the likelihood of refilling a postoperative opioid prescription.

Discussion

Our data from 2010 to 2015 demonstrated significant heterogeneity in opioid prescribing after spinal surgery (mean 913, SD=10,440). We did not find an association between the initial perioperative prescription size and the likelihood of obtaining refills after the most common spine procedures in opioid-naïve patients. This suggests one of two possibilities: (1) very low amounts of opioids can be prescribed after spine surgery for opioid naïve patients without fear of increasing frequency of calls for refill prescriptions, even as low as 19 Oxycodone 5 mg tablets (100 OME); and (2) providers are good at predicting what patients will need and prescribe the appropriate amount for a 20% to 45% refill rate. The latter seems unlikely since there was still a high rate of refills, some

Table 2
Multivariable logistic regression for refill

	Odds ratio	p value	95% confidence interval	
Initial postop prescription OME	1.000	.723	1.000	1.000
Age (ref group: 50−59)				
18−29	1.089	.243	0.944	1.257
30−39	1.137	.007	1.035	1.249
40−49	1.000	.989	0.930	1.075
60−64	0.950	.234	0.873	1.034
Gender (ref group: male)				
Female	1.137	<.001	1.072	1.207
Region (ref group: South)				
Northeast	0.886	.008	0.810	0.969
North Central	1.221	<.001	1.134	1.315
West	1.113	.019	1.018	1.216
Unknown	0.528	.004	0.340	0.820
Median income (ref group: 60K−69K)				
<50K	0.899	.355	0.718	1.126
50K−59K	1.033	.468	0.947	1.127
70K−79K	0.980	.642	0.898	1.069
80K−89K	1.040	.535	0.919	1.180
>=90K	1.024	.552	0.948	1.106
Insurance (ref group: PPO)				
Comprehensive	1.065	.416	0.914	1.241
HMO	0.902	.041	0.816	0.996
Point of service	0.974	.625	0.876	1.083
Other	0.832	<.001	0.757	0.914
Unknown	1.107	.179	0.955	1.284
Charlson comorbidity score	1.018	.241	0.988	1.049
Surgical procedure (ref group: Lumbar de compression)				
Anterior cervical surgery	1.525	<.001	1.367	1.702
Posterior cervical surgery	2.386	<.001	2.041	2.789
Posterior lumbar fusion	3.505	<.001	3.211	3.827
Mental health disorders				
Adjustment disorder	0.992	.928	0.823	1.194
Anxiety disorder	1.141	.017	1.024	1.272
Disruptive disorder	1.191	.133	0.948	1.496
Mood disorder	1.109	.049	1.000	1.229
Personality disorder	0.570	.346	0.177	1.836
Psychosis	0.558	.097	0.280	1.111
Alcohol and substance abuse disorder	1.445	.006	1.110	1.880
Suicide and self-harm disorder	1.057	.895	0.468	2.386
Other mental health disorder	1.219	.057	0.994	1.494
Pain disorders				
Arthritis	0.981	.551	0.920	1.046
Back	0.990	.813	0.914	1.073
Neck	0.911	.065	0.826	1.006
Other pain conditions	1.126	.001	1.052	1.206

prescription sizes for naïve patients are several standard deviations from the mean and there was so much geographic heterogeneity in refill rate.

Our patient cohort demonstrated similar associations between increased likelihood of opioid refills and medical comorbidities as have been widely reported [15]: opioid-naïve patients in our cohort were at increased likelihood of requesting opioid refills when they had a concurrent anxiety (OR=1.141, p=.017), mood (OR=1.109, p=.049), or substance disorder (OR 1.445, p=.006). These data suggest that such patients are either more prone to pain or that they are treating other conditions with opioids [1,16].

We were unable to determine an optimal postoperative dose for opioid-naïve patients being sent home after spine surgery to minimize refills. However, these data suggest that opioid prescribing for opioid-naïve patients can be significantly decreased without adversely affecting refill rates, as has been seen for other procedures [9].

Limitations

As noted above, this study only considered opioid naïve patients undergoing surgery for degenerative spinal disease, representing a minority of patients undergoing this type of

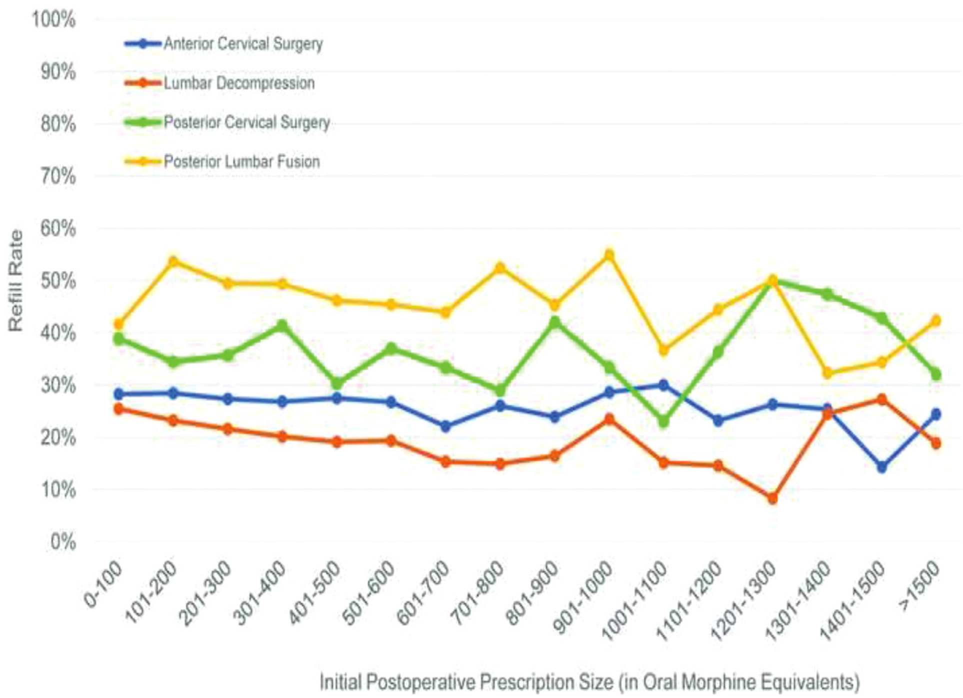

Fig. 1. The probability of refill by initial perioperative prescription size and type of spinal procedure.

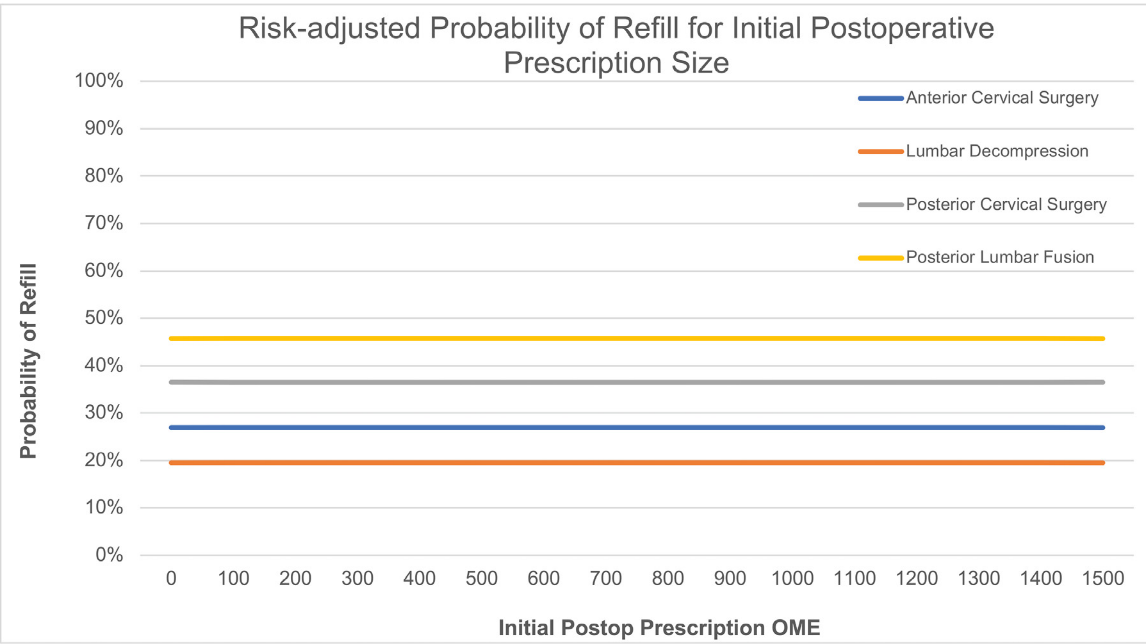

Fig. 2. Risk-adjusted probability of refill for initial postoperative prescription size.

surgery. In addition, our patient population was limited to those who had insurance through their employer, and we only included patients with data 1 year before and after surgery, suggesting continued employment. Therefore, the results in this patient population may be better than if it included patients with poor outcomes who lost their insurance.

Our data were limited to information about prescribed dosages of opioids, not actual patient consumption. In patients requesting refills, we presume that their initial perioperative prescription was completely utilized; however, we are unable to quantify actual patient usage from these data and would presume that patients not requesting refills are likely not using all of their available OMEs. Similarly, since our data are derived from insurance company data of prescriptions filled at pharmacies, if patients are obtaining medications from other insurers, obtaining illicit opioids, or during a readmission, we would not capture those data. Additionally, these data are based on prescribing from 2010 to 2015, before the majority of the legislative restrictions on opioid prescribing.

Since we were unable to capture data about prescription use in a rehabilitative setting, we limited our cohort to patients discharged to home. Additionally, the cohort lacks granular data regarding number of levels treated and surgical technique. We are unable to correlate the amount of opioid use and degree of reported pain.

Due to the administrative nature of the database, we do not have information about patient satisfaction with their postoperative pain control and other outcomes, or whether these patients had ever had prior surgeries.

However, despite these limitations, our study is likely generalizable to the subset of patients undergoing surgery for degenerative spine disease who are opioid naive, as it includes a broad cross-section of employed patients and their dependents undergoing the most common elective spinal surgeries.

Conclusions

We were unable to define an optimal postoperative prescription opioid dosage that would be associated with t''''he lowest likelihood of requiring a refill or developing future opioid dependence in previously naïve patients. Therefore, we recommend minimal prescriptions for opioid-naïve patients.

Supplementary materials

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.spinee.2021.01.016.

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