

## ANESTHESIOLOGY

# Opioid Fills for Lumbar Facet Radiofrequency Ablation Associated with New Persistent Opioid Use

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Opioid prescribing has increased significantly during the past 30 yr with significant public health consequences.<sup>1</sup> From 1990 to 2016, opioid use disorders have continued to increase as an important source of disability-adjusted life years in the United States, from eleventh to seventh place—an increase of 75%.<sup>2</sup> Increases in opioid use, opioid-related overdose mortality, and emergency room visits for nonmedical opioid use have been tightly correlated.<sup>1</sup> It has been demonstrated that opioid exposure in previously opioid-naïve patients after surgical and dental procedures is a significant and independent risk factor for chronic opioid use.<sup>3,4</sup> Despite these risks, healthcare providers continue to prescribe opioids for acute care. A recent study revealed that new persistent opioid use does not significantly differ between minor and major surgical procedures, thereby suggesting that chronic opioid use is multifactorial and not entirely due to procedural pain.<sup>3</sup> In the setting of radiofrequency ablation of the medial branch nerves for spine pain, a percutaneous procedure that can be considered analogous to minor surgery, it is worth exploring whether the risks of peri-radiofrequency ablation opioid prescribing outweigh the benefits.

Low back pain is a significant cause of pain and disability worldwide, and is the number one contributor to years lived with disability in the United States.<sup>2</sup> Lumbar zygapophyseal (facet) joint arthropathy is an established source of spine

## ABSTRACT

**Background:** Zygapophyseal (facet) joint interventions are the second most common interventional procedure in pain medicine. Opioid exposure after surgery is a significant risk factor for chronic opioid use. The aim of this study was to determine the incidence of new persistent use of opioids after lumbar facet radiofrequency ablation and to assess the effect of postprocedural opioid prescribing on the development of new persistent opioid use.

**Methods:** The authors conducted a retrospective cohort study using claims from the Clinformatics Data Mart Database (OptumInsight, USA) to identify opioid-naïve patients between 18 and 64 yr old who had lumbar radiofrequency ablation. Patients who had either subsequent radiofrequency ablation 15 to 180 days or subsequent surgery within 180 days after the primary procedure were excluded from the analysis. The primary outcome was new persistent opioid use, defined as opioid prescription fulfillment within the 8 to 90 and 91 to 180 day periods after radiofrequency ablation. The authors then assessed patient-level risk factors for new persistent opioid use.

**Results:** A total of 2,887 patients met the inclusion criteria. Of those patients, 2,277 (78.9%) had radiofrequency ablation without a perioperative opioid fill, and 610 (21.1%) patients had the procedure with a perioperative opioid fill. The unadjusted rate of new persistent opioid use was 5.6% (34 patients) in the group with a perioperative opioid fill versus 2.8% (63 patients) for those without an opioid fill. Perioperative opioid prescription fill was independently associated with increased odds of new persistent use (adjusted odds ratio, 2.35; 95% CI, 1.51 to 3.66;  $P < 0.001$ ).

**Conclusions:** Perioperative opioid use after lumbar radiofrequency ablation was associated with new persistent use in previously opioid-naïve patients, suggesting that new exposure to opioids is an independent risk factor for persistent use in patients having radiofrequency ablation for chronic back pain. Opioid prescribing after radiofrequency ablation should be reevaluated and likely discontinued in this population.

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## EDITOR'S PERSPECTIVE

### What We Already Know about This Topic

- Perioperative opioid exposure increases the risk for persistent opioid use; however, the strength of the relationship remains unclear for chronic pain patients

### What This Article Tells Us That Is New

- More than one in five opioid-naïve patients filled a prescription for opioid after minimally painful procedures
- Patients who filled opioid prescriptions had more than twice the odds of persistent opioid use

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pain.<sup>5</sup> Current data suggests that facet joint mediated pain is responsible for approximately 5 to 15% of chronic low back pain in epidemiologic studies and up to 45% of low back pain in studies based on response to facet blocks.<sup>6,7</sup> Radiofrequency ablation is the treatment modality of choice in treating facet-mediated low back pain, and is the second most common type of interventional pain management procedure performed in the United States.<sup>5,6</sup> Multiple reviews have suggested that radiofrequency ablation yields positive results in properly selected patient cohorts.<sup>5,7-9</sup> To date, chronic postintervention opioid use has largely been used as a secondary outcome and a surrogate of treatment failure.<sup>10-15</sup>

Given the frequency with which interventional procedures are utilized for facet joint-mediated pain syndromes, it is worth evaluating the impact of periprocedural opioid prescribing on the risk of chronic opioid use in the setting of lumbar radiofrequency ablation. Our primary goal was to determine the incidence of new persistent opioid use after radiofrequency ablation of the medial branches for facet-mediated low back pain. Secondary goals were to establish associated factors with persistent opioid use after radiofrequency ablation in addition to defining the impact of opioid dose filled on the risk of chronic use. We hypothesized that after adjustment for relevant patient characteristics, filling an opioid after lumbar facet radiofrequency ablation would be independently associated with new persistent opioid use.

## Materials and Methods

### Data and Patient Cohort

The Clinformatics Data Mart Database (OptumInsight, USA) captures commercial health insurance claims across the United States for 57 million members of a managed care company. The study was deemed exempt from review by the University of Michigan Institutional Review Board (Ann Arbor, Michigan), and informed consent was waived because the dataset was deemed deidentified. Strengthening the Reporting of Observational studies in Epidemiology (STROBE) guidelines were followed for the design and reporting of this study.

This study examined claims to identify patients aged 18 to 64 yr who had radiofrequency ablation of the lumbar and sacral segments between January 1, 2007 and June 30, 2016. Patients younger than 18 yr and older than 64 yr were excluded given the inability to reliably capture Medicare prescription claims data. Lumbar radiofrequency ablation procedures were identified using Current Procedural Terminology procedural codes (34635 and 64636). Only patients with continuous health care and prescription drug coverage in the 12 months before radiofrequency ablation through 12 months after radiofrequency ablation were included to ensure that all prescriptions and clinical utilization were accurately assessed. Patients with anesthesia

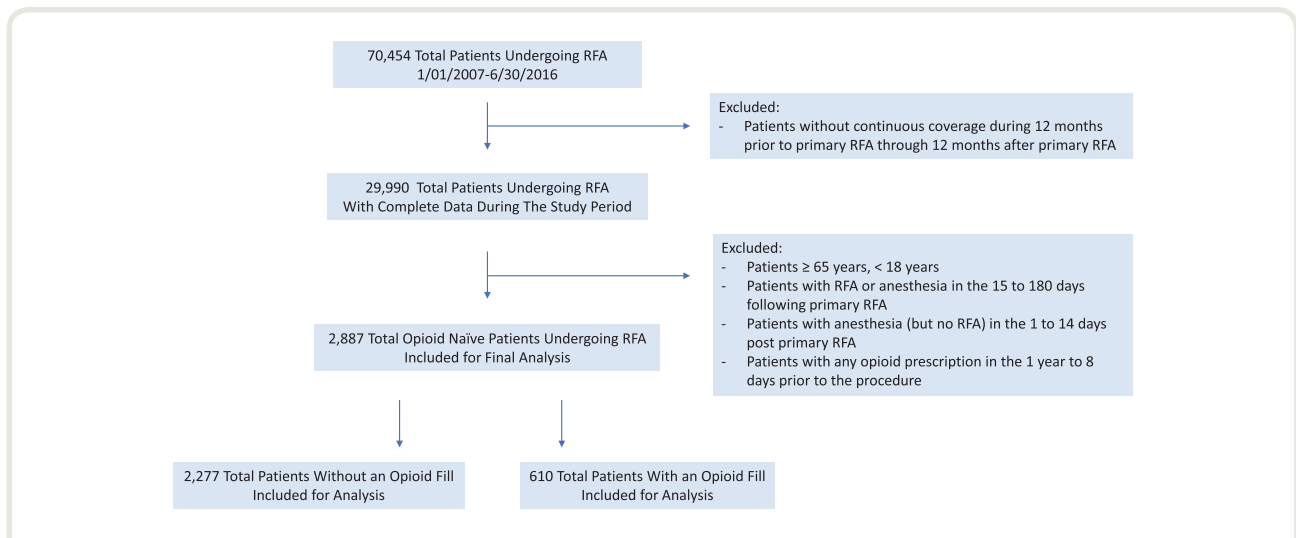
or radiofrequency ablation events in the 15 to 180 days after the primary radiofrequency ablation procedure were assumed to have undergone additional procedures and were thus excluded in order to eliminate the risk of further opioid exposure that was unrelated to the initial radiofrequency ablation. Patients with anesthesia in the 14-day period after the primary radiofrequency ablation that was not associated with another radiofrequency ablation were similarly excluded. We limited our cohort to patients who did not have any opioid prescription claims during the 12 months to 8 days before the primary radiofrequency ablation procedure, which is to comparable with previous studies of opioid-naïve surgical populations.<sup>3</sup> Figure 1 describes the study selection criteria.

To obtain a comparison cohort of patients who did not undergo radiofrequency ablation, we identified a random 10% sample of patients aged 18 to 64 yr with chronic low back pain and who did not undergo radiofrequency ablation during the study period ( $n = 616,526$  patients). Chronic low back was determined using International Classification of Disease, Ninth and Tenth Revision—Clinical Modification (ICD-9-CM/ICD-10-CM) diagnosis codes that were most commonly documented at the University of Michigan in patients. The most common ICD-9-CM and ICD-10-CM codes for low back pain were 724.2 and M54.5, respectively. These patients were assigned a random radiofrequency ablation date and were included if they were opioid naïve and did not have any anesthesia in the 6 months after the assigned radiofrequency ablation date.

### Outcomes and Explanatory Variables

The primary outcome was new persistent opioid use defined as the combination of the following: fulfillments in 8 to 90-day and 91 to 180-day periods after the procedure. The explanatory variable of interest included periprocedural opioid fill. Opioids were considered periprocedural if filled within a 7-day period before and 7-day period after the index radiofrequency ablation procedure. This definition was established before data extraction and represents expected recovery time after radiofrequency ablation, at which point continued opioid use would not be expected.<sup>3,4,16</sup> Data on opioid fills were obtained from pharmacy claims and were determined based on American Hospital Formulary Service Pharmacologic-Therapeutic Classification and generic name (see Supplemental Digital Content 1, <http://links.lww.com/ALN/C231> for included opioids). Persistent use was also calculated for the comparison cohort to determine the rate of becoming a new persistent opioid user without pain management interventions.

We included patient sociodemographic characteristics that were available in the database as covariates, including age, sex, race, education level, geographic region of residence, and year of radiofrequency ablation procedure. Missing sociodemographic information for patients was coded as unknown. We categorized age into four categories. We also



**Fig. 1.** Strengthening the Reporting of Observational studies in Epidemiology (STROBE) flow diagram of inclusion and exclusion criteria in the construction of the final cohort. RFA, radiofrequency ablation of lumbar facet joints.

included Charlson Comorbidity Index Score and current or previous tobacco use to assess comorbidity burden.<sup>17</sup> We further categorized the calculated Charlson Comorbidity Index Score into categories (0, 1 or 2, 3 or more) to differentiate highly comorbid patients. Tobacco use was determined using ICD-9-CM (305.1; V15.82) and ICD-10-CM (Z72.0; F17.2; Z87.891) diagnosis codes as well as smoking status in OptumInsight Health Risk Assessment dataset. The Agency of Healthcare Research and Quality Clinical Classification System was used to assess mental health disorders and pain disorders.<sup>18</sup> Mental health disorders were classified as anxiety disorder, alcohol and substance abuse disorder, and other mental health disorders (adjustment disorders, attention deficit disorders, impulse control disorders, mood disorders including depression, personality disorders, psychosis, suicide, and self-harm, and other miscellaneous health disorders; Supplemental Digital Content 2, <http://links.lww.com/ALN/C232>). Pain disorders were: headache including migraine, rheumatoid arthritis and related conditions, osteoarthritis, abdominal pain, and other nontraumatic joint disorders (Supplemental Digital Content 3, <http://links.lww.com/ALN/C233>). We used the claims from the 12 months before the radiofrequency ablation procedure determine the clinical covariates previously mentioned.

## Statistical Analysis

All statistical analyses were performed using Stata 14.2 (StataCorp, USA). Complete cases analysis was used for all models. Descriptive statistics were calculated for demographic variables and comorbidities. Differences between those with and without persistent opioid use for patients with and without an opioid exposure were assessed with chi-square tests. A multivariable logistic regression model

was used to examine differences in persistent opioid use by opioid exposure around time of radiofrequency ablation while controlling for patient characteristics. These patient characteristics were included in the logistic regression model due to their clinical relevance. The *P* values were two-tailed and significance was set at *P* < 0.05. We did not conduct an *a priori* statistical power calculation and sample size was based on the number of patients who met the inclusion criteria. There were no outliers in the study population. The outcome and sensitivity analyses (discussed in the Sensitivity Analyses section) were defined *a priori*, and were consistent with the previous studies of our team and other similar research on this topic<sup>3,16,19,20</sup>; however, the study and planned analyses were not registered.

## Sensitivity Analyses

Sensitivity analyses were conducted to test other previously defined and published outcomes for new persistent or chronic opioid use. All definitions for new persistent opioid use rely on a 12-month opioid-naïve period before radiofrequency ablation. Both Alam *et al.*<sup>20</sup> and Daoust *et al.*<sup>21</sup> defined “persistent use” as any additional claim from days 305 to 425 in an investigation of use after the initial event (surgery or trauma). Data for our cohort were available up to 365 days after the procedure, thus any opioid fill from day 305 to 365 was used as a proxy for this definition of new persistent use. Sun *et al.*<sup>22</sup> defines persistent use as greater than or equal to 10 prescriptions or 120 days’ supply within the 91 to 365 day postprocedural period. Brummett *et al.*<sup>3</sup> previously studied new persistent opioid use after major and minor surgery, and used any opioid prescription from days 90 to 180 as a marker of chronic use. We also applied a conservative definition requiring one or

more opioid fills in four consecutive quarters (excluding the primary prescription) as part of our analysis. The same explanatory variables previously mentioned were included in the logistic regression models for the sensitivity analyses.

## Results

A total of 2,887 patients met the inclusion criteria. A total of 2,277 patients who were opioid naïve and had radiofrequency ablation did not receive a periprocedural opioid fill and 610 patients did fill an opioid. The majority of the patients in the periprocedural opioid fill group filled the opioid between the 7 days before and 3 days after the radiofrequency ablation (greater than 95%), with the highest rates of fill on the day of the procedure (51.8%) and the day before the procedure (20.8%). The rate of new persistent opioid use was 5.6% ( $n = 34$ ) in the group that filled a periprocedural opioid *versus* 2.8% ( $n = 63$ ) in the group that did not. The control cohort comprised of patients with a diagnosis of chronic back pain who did not undergo any procedure had a new persistent opioid use rate of 0.7% (fig. 2). Descriptive data are displayed in table 1.

### New Persistent Opioid Use More Common among Patients Who Filled an Opioid in the Periprocedural Radiofrequency Ablation Period

There was a significant difference in the rate of new persistent opioid use between patients who filled a periprocedural opioid prescription and those who did not (5.6% [ $n = 34$ ] *vs.* 2.8% [ $n = 63$ ];  $P < 0.001$ ). The adjusted odds ratio of persistent opioid use when comparing periprocedural opioid

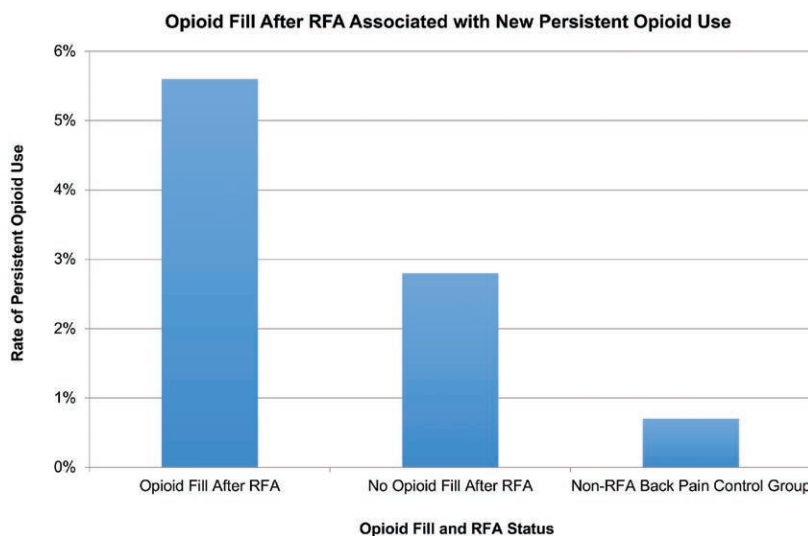
fills was 2.35 (95% CI, 1.51 to 3.66) when compared to patients who did not fill opioids after radiofrequency ablation ( $P \leq 0.001$ ). The only other covariate independently associated with new persistent use was advanced education. Table 2 includes the results of logistic regression model.

### New Persistent Opioid Use Related to Periprocedural Radiofrequency Ablation Fills Was Consistent Using a Number of Previous Chronic Opioid Use Definitions

The results of a sensitivity analysis using variable definitions of chronic opioid use are reported in table 3. New persistent opioid use in the setting of radiofrequency ablation is higher in patients who filled a peri-radiofrequency ablation opioid across an array of previously used definitions of persistent opioid use from the literature.

Previous work by Brummett *et al.*<sup>3</sup> defined a new persistent opioid user as having filled a prescription in the 91 to 180 days after the index procedure. Using this definition, 196 (8.6%) of patients who did not fill an opioid, and 75 (12.3%) who did fill an opioid, were determined to be new persistent opioid users. The adjusted odds ratio for new persistent opioid use under this definition was found to be significant, albeit lower than the definition used in our primary outcome, at 1.61 ( $P = 0.001$ ; 95% CI, 1.20 to 2.15).

Our sensitivity analyses also take into account new persistent opioid use from a broader time horizon than our primary definition. Previous studies have made use of definitions that explore new persistent use in the year after surgery, in contrast to the 6-month period chosen as our



**Fig. 2.** Unadjusted rates of new persistent opioid use for patients who filled a periprocedural opioid prescription, those who did not fill a periprocedural opioid prescription, and those who did not undergo radiofrequency ablation of the lumbar facet joints but have a diagnosis of chronic back pain. The adjusted odds ratio for new persistent opioid use was 2.35 (95% CI, 1.51 to 3.66;  $P < 0.001$ ) for patients with an opioid fill after radiofrequency ablation (RFA).

**Table 1.** Descriptive Statistics Reporting Differences between Patients Who Did and Did Not Fill an Opioid Prescription in the Periprocedural Period

	RFA Without Periprocedural Opioid, n (%) (n = 2,277)	RFA with Periprocedural Opioid, n (%) (n = 610)	P Value
Age, yr			
18–39	353 (16)	107 (18)	0.054
40–49	618 (27)	191 (31)	
50–59	925 (41)	218 (36)	
60–64	381 (17)	94 (15)	
Male	1,031 (45)	280 (46)	0.784
Race			
White	373 (16)	80 (13)	0.013
Nonwhite	1,781 (78)	509 (83)	
Unknown	123 (5)	21 (3)	
Education			
High school diploma or less	494 (22)	116 (19)	0.107
Less than bachelor's degree	1266 (56)	369 (61)	
Bachelor's degree plus	476 (21)	119 (20)	
Unknown	41 (2)	6 (1)	
Procedure yr			
2007	171 (8)	49 (8)	0.001
2008	214 (9)	53 (9)	
2009	220 (10)	64 (11)	
2010	218 (10)	90 (15)	
2011	219 (10)	49 (8)	
2012	239 (11)	68 (11)	
2013	215 (9)	65 (11)	
2014	275 (12)	69 (11)	
2015	309 (14)	76 (13)	
2016	197 (9)	27 (4)	
Charlson comorbidity index categories			
0	1,586 (70)	454 (74)	0.029
1 to 2	627 (28)	147 (24)	
3 or More	64 (3)	9 (2)	
Tobacco use	371 (16)	101 (17)	0.876
Geographical region			
East North Central	293 (13)	79 (13)	< 0.001
East South Central	55 (2)	16 (3)	
Middle Atlantic	119 (5)	24 (4)	
Mountain	297 (13)	90 (15)	
New England	47 (2)	18 (3)	
Pacific	203 (9)	30 (5)	
South Atlantic	636 (28)	170 (28)	
West North Central	250 (11)	122 (20)	
West South Central	373 (16)	61 (10)	
Unknown	4 (0)	0 (0)	
Anxiety disorder	325 (14)	69 (11)	0.058
Alcohol and substance abuse disorder	58 (3)	9 (2)	0.118
Other mental health disorders	468 (20)	138 (23)	0.265
Pain diagnoses (other than low back pain)*	1,407 (62)	372 (61)	0.715

\*Pain diagnoses included other pain diagnoses, not low back pain. Pain diagnoses included were headache including migraine, rheumatoid arthritis and related conditions, osteoarthritis, abdominal pain, and other nontraumatic joint disorders (Supplemental Digital Content 3, <http://links.lww.com/ALN/C233>).

RFA, radiofrequency ablation of the lumbar facet joints.

primary outcome.<sup>20–22</sup> New persistent use rates in patients with and without an opioid fill in the periprocedural period were 10.3 and 17% (235 and 104 patients), respectively, when assessing opioid use in the 305- to 365-day post-radiofrequency ablation period, comparable to the study by Alam *et al.*<sup>20</sup> The adjusted odds ratio with a persistent use definition of at least one opioid prescription in the 305- to

365-day postprocedural period was 1.84 ( $P < 0.001$ , 95% CI 1.42 to 2.39).

Sun *et al.*<sup>22</sup> used a persistent use definition of greater than 10 opioid prescriptions or 120 days supplied in the 91- to 365-day post-radiofrequency ablation period. Using this definition, 54 patients (2.4%) who did not fill a periprocedural prescription became new persistent users compared to

**Table 2.** Multivariable Logistic Regression Analysis Demonstrating Factors Associated with New Persistent Opioid Use

	Odds Ratio	P Value	95% CI
Periprocedural opioid prescription	2.35	< 0.001*	1.51 to 3.66
Age, yr (ref group: 18–39)			
40–49	1.00	0.966	0.51 to 1.91
50–59	1.05	0.886	0.56 to 1.96
60–64	1.18	0.661	0.56 to 2.48
Male	0.87	0.505	0.56 to 1.33
Race (ref group: white)			
Nonwhite	0.55	0.079	0.29 to 1.07
Unknown	0.81	0.738	0.229 to 2.84
Education (ref group: high school diploma or less)			
Less than bachelor's degree	0.50	0.001*	0.28 to 0.72
Bachelor's degree plus	0.373	0.003*	0.193 to 0.72
Unknown	0.98	0.986	0.160 to 6.05
Geographic region (ref group: South Atlantic)			
West South Central	2.43	0.003*	1.35 to 4.40
East North Central	1.34	0.396	0.68 to 2.64
East South Central	0.42	0.406	0.055 to 3.23
Middle Atlantic	2.14	0.094	0.88 to 5.22
Mountain	1.25	0.548	0.61 to 2.58
Pacific	0.77	0.630	0.258 to 2.27
West North Central	0.89	0.774	0.41 to 1.93
Procedure year	0.97	0.448	0.90 to 1.05
Charlson comorbidity index category (ref group: 0)			
1 or 2	0.89	0.650	0.55 to 1.46
3 or more	1.92	0.199	0.71 to 5.22
Tobacco use	1.25	0.412	0.74 to 2.11
Anxiety disorder	1.37	0.304	0.75 to 2.49
Alcohol and substance abuse disorder	0.90	0.891	0.21 to 3.86
Other mental health disorders	1.15	0.604	0.68 to 1.93
Pain diagnoses (other than low back pain)†	0.90	0.615	0.58 to 1.38

Note: 69 observations were dropped because geographic region of New England and Unknown predicted no persistent use perfectly.

\*Statistically significant.

†Pain diagnoses included other pain diagnoses, not low back pain. Pain diagnoses included were headache including migraine, rheumatoid arthritis and related conditions, osteoarthritis, abdominal pain, and other nontraumatic joint disorders (Supplemental Digital Content 3, <http://links.lww.com/ALN/C233>).

**Table 3.** Sensitivity Analysis Using Alternate Definitions of New Persistent Opioid Use and Associated Results

Persistent Use Definition	No Periprocedural Fill, n (%)	Periprocedural Fill, n (%)	Adjusted Odds Ratio	P Value for Adjusted Odds Ratio	95% CI
Opioid prescription in 8- to 90-day and 91- to 180-day periods after procedure (primary outcome)	63 (2.8)	34 (5.6)	2.35	< 0.001	1.51 to 3.66
Opioid prescription in the 305- to 365-day postprocedural period <sup>20,21</sup>	235 (10.3)	104 (17.0)	1.84	< 0.001	1.42 to 2.39
Opioid prescription in the 91- to 180-day postprocedural period <sup>3</sup>	196 (8.61)	75 (12.3)	1.61	0.001	1.20 to 2.15
≥ 10 prescriptions or 120 days' supply in the 91- to 365-day postprocedural period <sup>22</sup>	54 (2.4)	23 (3.8)	1.73	0.036	1.04 to 2.89
≥ 1 prescription in each quarter in the postprocedural period, excluding the perioperative fill	26 (1.1)	18 (3.0)	2.97	0.001	1.58 to 5.60

23 patients (3.8%) who did. The adjusted odds ratio for new persistent opioid use in this scenario was 1.73 ( $P = 0.036$ ; 95% CI, 1.04 to 2.9).

The final sensitivity analysis selected was also more restrictive than the primary outcome and was defined as at least one opioid fill in each of the four quarters after

radiofrequency ablation, excluding the perioperative fill. In this case, 1.1% (26) of patients became new persistent opioid users if they did not fill a periprocedural opioid, in contrast to 3% (18) who did fill a periprocedural opioid. The adjusted odds ratio for new persistent opioid use was 2.97 ( $P = 0.001$ ; 95% CI, 1.58 to 5.60).

In summary, the adjusted odds ratio for new persistent opioid use with an opioid fill after radiofrequency ablation was significant across all definitions used, inclusive of the most conservative definitions of new persistent open use.

## Discussion

This study demonstrates that filling an opioid after radiofrequency ablation was independently associated with new persistent opioid use when compared to those that did not fill an opioid. Previous work on radiofrequency ablation has largely used chronic post intervention opioid use as a secondary outcome. Given the significant patient risks and societal costs of chronic opioid use, it is worth investigating factors that may contribute to new chronic opioid use in previously opioid-naïve patients having an interventional procedure for chronic low back pain. More than half of the patients in the current cohort did not fill an opioid, thereby suggesting that opioid prescribing for radiofrequency ablation is discretionary.

### Opioid Exposure Is an Independent Risk Factor for New Chronic Opioid Use after Radiofrequency Ablation

The current study demonstrates that filling an opioid immediately before or after radiofrequency ablation was independently associated with new persistent opioid use in previously opioid-naïve individuals. Our definition of new persistent opioid use was defined *a priori* and informed by the previous literature, as well as studies by our group.<sup>3,19–22</sup> In this cohort, 5.6% of patients who filled a periprocedural opioid went on to become persistent opioid users in the 6 months after radiofrequency ablation, compared to 2.8% of patients who did not have an opioid exposure periprocedurally. Overall, periprocedural opioid fills were associated with an increased odds ratio of 2.27 (95% CI, 1.461 to 3.523;  $P < 0.001$ ) after adjustment for other patient factors when compared to those that did not fill an opioid.

In order to more rigorously address whether our primary definition of new persistent opioid use had an effect on our findings, we performed a robust set of sensitivity analyses using other definitions from previous studies. While our primary definition examined opioid fill patterns in the 6 months after radiofrequency ablation, we examined opioid fill patterns up to 1 yr after the index procedure (table 3).<sup>20–22</sup> Our findings were consistent across the range of definitions. Even in the setting of our most restrictive definitions of new persistent opioid use, opioid fill in the peri–radiofrequency ablation period was independently associated with new persistent opioid use.

Opioid prescribing has shifted over the last two decades, and has become a major target for intervention from a public health standpoint.<sup>1</sup> In the setting of our study, which examines data from 2006 to 2016, the year of procedure was not significantly associated with a decrease in the risk of new persistent opioid use. As prescribing continues to

change, future studies should assess the impact of prescribing changes on outcomes such as new persistent opioid use.

Radiofrequency ablation is the second most commonly performed pain management procedure in the United States. Previous studies have demonstrated that the rate of persistent opioid use between major and minor surgical procedures is similar, and thus may be multifactorial and not a sole consequence of pain.<sup>3</sup> Persistent opioid use is associated with exposure in multiple studies and was more common in those filling a higher dose of opioids after surgery.<sup>3,23</sup> The safety and efficacy of opioids as a long-term management strategy for pain relief has not been demonstrated with most studies, suggesting that opioids are not efficacious for patients with low back pain.<sup>23,24</sup> In our dataset, 28% of previously opioid-naïve patients had an opioid fill periprocedurally. It can be reasonably assumed that the number of opioid fills is less than the number of prescriptions provided to patients. Given the number of radiofrequency ablation procedures performed in the United States yearly, it is worth revisiting whether opioids should be used for acute postprocedural pain in the peri–radiofrequency ablation period, given the risk of chronic use and subsequent significant health and societal costs.

Our findings are consistent with previous literature, which demonstrated that persistent use was highly associated with opioid fills (a reflection of exposure) in previously opioid-naïve patients. The rate of persistent opioid use after radiofrequency ablation in this study is comparable to previous findings. Deyo *et al.*<sup>23</sup> found a 5% rate of persistent use after the first opioid exposure using data from the Oregon Prescription Drug Monitoring Program, which also includes nonoperative opioid prescribing. In contrast, Sun *et al.*<sup>22</sup> found a much lower incidence of postsurgical opioid use, however, their definition of opioid use (more than 10 opioid prescriptions fulfillments or more than 120 days supplied between 3 to 12 months after surgery) likely captures the upper extreme of chronic opioid use. The rates of chronic opioid use in previously opioid-naïve populations having total hip replacement and total knee arthroplasty are 4 and 8%, respectively.<sup>25</sup> As discussed in previous articles, postsurgical pain should be resolved well before the 90- and 180-day outcome periods used in this study. Thus, any use in these periods would suggest inappropriate opioid use in an initially opioid-naïve patient cohort.

### Opioid Exposure Should Be Eliminated for Minimally Invasive Procedures When Possible

While opioids continue to be an important factor in the treatment of acute postoperative pain, current data suggest that long-term use of opioids is ineffective for the management of chronic pain, and there are significant risks associated with long-term opioid use.<sup>24</sup> As previously noted, new persistent opioid use after surgery should be considered an adverse long-term outcome.<sup>3</sup> In addition to medical costs, societal costs of chronic opioid use remain

significant; early opioid prescription in patients with low back injury has been found to increase the risk for subsequent disability status.<sup>26–28</sup> In this study, our cohort of individuals aged 18 to 64 yr represents a population that is at risk for long-term adverse outcomes with chronic opioid use in the setting of socioeconomic and familial contributions.

Radiofrequency ablation of the facet joints is a minimally invasive, percutaneous procedure. Given that opioid exposure is a significant risk factor for new persistent opioid use in this population, patients should be counseled that they may experience discomfort in the days after their procedure. Clinicians should be prudent in their use of opioids in this patient population, and give significant consideration to the use of nonsteroidal antiinflammatory drugs and acetaminophen as core components of a post-radiofrequency ablation pain management regimen in the immediate post-procedural period.

## Strengths and Limitations

The strengths of the study include the use of a large, national sample of patients having radiofrequency ablation. Moreover, the use of claims data allowed for assessment of a long time period before and after the radiofrequency ablation (12 months before and after). Lastly, the removal of additional anesthetics removes opioid fills that may be attributable to other pain procedures or surgeries which could contribute to additional opioid exposures unrelated to the radiofrequency ablation.

Despite the many strengths, there are some limitations to our study. It is possible that the postoperative prescriptions for opioids were not related to the index radiofrequency ablation procedure. To mitigate this, we excluded all patients with claims related to anesthesia codes or radiofrequency ablation codes the 15 to 180 days after the index radiofrequency ablation procedure, and also excluded patients with anesthesia codes not associated with another radiofrequency ablation procedure in the 14 days period after the index radiofrequency ablation procedure, to try to rule out other potential reasons for the continued opioid fills. In addition, claims data only capture prescription fills and hence, we could not obtain information for patients who were prescribed opioids but did not fill their prescription. We also could not ascertain the amount that was consumed by patients who filled the prescription. We did, however, use a definition of multiple opioid fills during a period of time beyond which would be considered normal recovery from radiofrequency ablation, and conducted a robust set of sensitivity analyses which all showed independent associations with the periprocedural opioid fill. Finally, our cohort consisted of privately insured patients aged 18 to 64 yr from a single payer, and thus the findings may not be generalizable to patients who are uninsured or under-insured or are 65 yr and older.

## Conclusions

Periprocedural opioid use after radiofrequency ablation was associated with new persistent use in previously opioid-naïve patients, suggesting that new exposure to opioids is an independent risk factor for persistent use in patients having radiofrequency ablation for chronic back pain. Given that most opioid-naïve patients do not fill opioids around the time of their radiofrequency ablation, opioid prescribing after radiofrequency ablation should be reevaluated and likely discontinued in this population.

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## Competing Interests

Dr. Brummett reports a patent for Peripheral Perineural Dexmedetomidine licensed to University of Michigan, not related to the current work. Dr. Brummett received research funding from Neuros Medical Inc. (Willoughby Hills, Ohio) and is a consultant for Heron Therapeutics (San Diego, California), not related to the current work. Dr. Waljee serves as an unpaid consultant for 3M Health Information Systems (Falls Church, Virginia). The other authors declare no competing interests.

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