

# Baseline and Postfusion Opioid Burden for Patients With Low Back Pain

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Low back pain (LBP) is among the most prevalent and costly musculoskeletal conditions and is the second most common reason for physician visits in the United States.<sup>1</sup> The economic burden of LBP in the United States is between \$84 billion and \$625 billion, with significantly higher medical costs for patients with LBP than those without.<sup>1</sup> Despite the prevalence of LBP, there are inconsistent recommendations for treating this ailment.<sup>2,3</sup> Treatment options include nonsurgical and surgical approaches.<sup>2</sup> Nonsurgical treatments commonly include physical therapy, exercise-based multidisciplinary rehabilitation programs, and analgesics, such as nonsteroidal anti-inflammatory drugs, antidepressants, anticonvulsants, and opioids.

Opioids are the most common class of analgesic medication prescribed for chronic LBP,<sup>4</sup> and patients with chronic LBP have significantly greater opioid use than those without.<sup>1,5</sup> Opioids have shown short-term analgesic efficacy for LBP, but their long-term efficacy is unclear.<sup>6-8</sup> Some loss of long-term efficacy could stem from drug tolerance and emergence of hyperalgesia.<sup>7</sup> Opioid use for LBP has also been associated with greater disability after 6 months.<sup>9</sup>

Opioid use is not only ubiquitous among hospitalized patients undergoing surgical procedures,<sup>10</sup> but it is also common in many nonsurgical encounters.<sup>11</sup> The elevated use of opioids appears to contribute to increased misuse.<sup>12</sup> Moreover, opioid use has been linked to adverse events,<sup>10,11,13</sup> which can lead to longer hospital stays, higher costs, readmissions, and mortality.<sup>10,13</sup> Complications of opioid use for LBP include addiction and overdose-related mortality, which have risen along with prescription rates.<sup>7</sup>

As a reaction to the increased prescription rates in the United States, the CDC published guidelines in 2016 on prescribing opioids for chronic pain.<sup>14,15</sup> The guidelines expressed that clinicians need to carefully reassess evidence of individual benefits and risks when increasing opioid dosage to at least 50 morphine milligram equivalents (MME) per day. They also recommend avoiding or carefully justifying a decision for dosing at least 90 MME/day. These recommendations were driven, in part, by the risk of overdose doubling at a dosage of between 50 and 99 MME/day, and increasing by up to 9 times at 100 MME/day or more, compared with the risk at

## ABSTRACT

**OBJECTIVES:** To evaluate opioid usage patterns for patients with low back pain (LBP) with and without spinal fusion surgery (fusion patients and nonfusion patients, respectively), including long-term prescriptions post fusion.

**STUDY DESIGN:** Claims data of outpatient pharmaceutical prescriptions from privately insured patients.

**METHODS:** The 3-year utilization, cost, and morphine milligram equivalents (MME) of opioid prescriptions were evaluated for patients with LBP with and without lumbar fusion. For fusion patients, opioid prescriptions before and after fusion, as well as prescription use 3, 6, and 12 months following fusion surgery, were analyzed.

**RESULTS:** Thirty-one percent of patients with LBP had opioid prescriptions within the first 6 months of initial diagnosis, which increased to 42.1% within 3 years. More than twice as many fusion patients as nonfusion patients filled opioid prescriptions (87.2% vs 41.5%;  $P < .001$ ). Fusion patients had 62% and 48% more days with opioid dosages of at least 50 and at least 90 MME/day, respectively, than nonfusion patients ( $\geq 50$  MME/day, 84 days vs 52 days;  $\geq 90$  MME/day, 50 days vs 34 days; both  $P < .001$ ). Opioid burden was greater for fusion patients following surgery. Fusion patients continued to have 2 months' supply with at least 50 MME/day and 1 month's supply with at least 90 MME/day at least 12 months following surgery.

**CONCLUSIONS:** The opioid burden in the LBP population is high and is further elevated in those who subsequently undergo fusion surgery. Long-term opioid prescriptions persisted in 27% of fusion patients 12 months post surgery. Efforts to identify efficacious alternative therapies to treat LBP may reduce the societal burden of chronic opioid use.

*Am J Manag Care.* 2018;24(8):e234-e240

less than 20 MME/day. Moreover, in a study of patients with chronic pain receiving opioids, patients who died of opioid overdose were prescribed higher opioid dosages than controls (average, 98 vs 48 MME/day).<sup>14</sup>

One surgical option for treating LBP is spinal fusion.<sup>2,16</sup> However, many patients with LBP still continue to experience pain 1 to 8 years following the surgery.<sup>16</sup> Lumbar fusion surgery is also associated with long-term analgesic medication use.<sup>17</sup> Postoperative opioid usage may also be influenced by preoperative use; those who take opioids prior to surgery may have higher peri- or postoperative narcotic consumption.<sup>18-21</sup> Moreover, greater healthcare costs are associated with patients with LBP who chronically use opioids after spinal fusion.<sup>19</sup>

With the prevalence of LBP, along with the growing societal burden of opioid use, this study aims to address the following hypotheses: (1) The majority of patients with LBP are prescribed opioids, (2) opioid prescriptions are higher for patients with LBP who undergo spinal fusion surgery (fusion surgery vs no fusion surgery; post fusion surgery vs pre-fusion surgery), and (3) a substantial proportion of spinal fusion surgery patients continue to be prescribed opioids 3, 6, and 12 months following the surgery.

## METHODS

The MarketScan Commercial Claims and Encounters Database and Medicare Supplemental Database (Truven Health Analytics LLC; Ann Arbor, Michigan) were used for this study. The combined data sets contain medical and prescription drug claims data for patients who are privately insured by employer-sponsored plans. The claims data are contributed by more than 260 employers, 350 unique carriers, and 40 health plans. The outpatient pharmaceutical data are from mail order or card program prescription drug claims.

Patients with LBP were identified from a 5-year period of the data set (October 1, 2011, to September 30, 2016) based on a diagnosis of LBP (*International Classification of Diseases, Ninth Revision [ICD-9]* diagnosis codes 721.3, 722.52, 724.2, 724.5; *International Classification of Diseases, Tenth Revision [ICD-10]* diagnosis codes M47.816, M47.817, M51.36, M51.37, M54.5). The study included patients who had their first LBP diagnosis between October 1, 2011, and September 30, 2013, to allow for 3 years of follow-up from the time of the first LBP diagnosis. Patients without 6 months of continuous enrollment prior to or without 3 years continuous enrollment following their first LBP diagnosis were excluded due to an incomplete claim history for evaluating the patient's prior health history/comorbidities and medical resource utilization following LBP diagnosis. Continuous enrollment for each patient was determined from the enrollment file, which indicated whether the patient was or was not enrolled in a given month, regardless of whether they incurred any claims.

## TAKEAWAY POINTS

Patients with low back pain (LBP) have a high opioid burden, which increases following fusion surgery; 27% of patients who underwent fusion surgery (fusion patients) filled opioid prescriptions at least 12 months post surgery.

- ▶ Within 3 years after diagnosis, 42.1% of patients with LBP had opioid medications.
- ▶ Patients who did not undergo fusion surgery had opioid dosages of at least 50 and at least 90 morphine milligram equivalents (MME) per day on a mean of 52 and 34 days per patient, respectively.
- ▶ Fusion patients had opioid dosages of at least 50 and at least 90 MME/day on a mean of 84 and 50 days per patient, respectively.
- ▶ Fusion patients continued to have 2 months' supply with at least 50 MME/day and 1 month's supply with at least 90 MME/day at least 12 months following surgery.

In the 3-year period following the first LBP diagnosis, lumbar fusion patients were identified using Current Procedural Technology (CPT) codes 22558, 22612, 22630, or 22633 (number of additional levels fused from CPT codes 22585, 22614, 22632, and 22634). Patients with fusions of 3 or more levels were excluded due to the potential that these more complex fusions were used to treat other spinal etiologies, whereas the remaining patients without lumbar fusion or with 1- or 2-level lumbar fusions were retained. Patients who had not undergone lumbar fusion were further screened for an inpatient lumbar fusion procedure (*ICD-9* procedure codes 81.05-81.08, 81.36-81.38; *ICD-10* procedure codes ORGA\*\*\*, OSGO\*\*\*, OSG1\*\*\*, OSG3\*\*\*) during the follow-up period as verification. If they had a nonspecific 1- or 2-level fusion (*ICD-9* procedure code 81.62) or a single-level fusion (*ICD-10* procedure codes OSGO\*\*\* or ORGA\*\*\*), they were recategorized to the 1- or 2-level fusion group. If they had fusions of 3 or more levels or unknown number of levels fused, they were excluded.

The overall utilization (prescription fills) of analgesic medications (pharmaceutical therapeutic classes 58 to 62, 69, 74, and 75, as well as pregabalin and gabapentin) was evaluated during the 3-year period. The utilization and cost of opioid prescriptions were also determined using generic drug names and specific product names in the opiate agonist and opiate partial agonist therapeutic classes (**Table 1**). Analysis was limited to LBP-associated claims by requiring that prescriptions were preceded in the prior 30 days by at least 1 medical claim with an LBP diagnosis. Claims with 0 reimbursements were excluded. The prescription claims were evaluated for the number of prescriptions, number of days of supply, average wholesale price (AWP), ingredient cost, and total payment. The AWP represents the average price at which wholesalers sell drugs to physicians, pharmacies, and other customers, and it is often equated to a "sticker price" or "list price." Ingredient cost corresponds to the cost or charge associated with the drug; for most plans, this represents the discount from the AWP. The total payment represents gross payment to the provider for the service. Payments or costs from the payer perspective were adjusted to June 2017 US dollars, based on the Consumer Price Index for medical care services.

**TABLE 1.** Opioid Products and Corresponding MME Conversion Factors

Generic Product Name <sup>a</sup>	Specific Product Name <sup>a</sup>	MME Conversion Factor <sup>b</sup>
Buprenorphine <sup>c</sup>	Butrans, Belbuca, Buprenex	10 (tablet or film) 12.6 (patch)
Butorphanol		7
Codeine		0.15
Fentanyl <sup>d</sup>	Fentora, Lazanda, Subsys, Abstral, Actiq, Sublimaze, Duragesic	0.13 (tablet or lozenge/troche) 0.18 (film or oral spray; includes Subsys) 0.16 (nasal spray; includes Lazanda) 7.2 (patch; includes Duragesic)
Hydrocodone	Zohydro, Hysingla, Vicoprofen	1
Hydromorphone	Exalgo, Dilaudid	4
Levorphanol		11
Meperidine	Demerol	0.1
Methadone or methadose	Dolophine, Methadose	4 (if daily strength >0 and ≤20 mg) 8 (if >20 and ≤40 mg) 10 (if >40 and ≤60 mg) 12 (if >60 mg)
Morphine	MS Contin, Oramorph, Embeda, Kadian, Infumorph, Astramorph, Duramorph, Avinza	1
Nalbuphine		1
Oxycodone	Xtampza, OxyContin, Xartemis, Percocet, Oxecta, Roxicodone, Targiniq	1.5
Oxymorphone	Opana	3
Pethidine		0.4
Tramadol	Conzip, Ultram, Ultracet	0.1
Tapentadol	Nucynta	0.4
Pentazocine		0.37
Dihydrocodeine		0.25

MME indicates morphine milligram equivalent; THERCLS, therapeutic class.

<sup>a</sup>Requires classification as opiate agonists (THERCLS, 60) or opiate part agonist (THERCLS, 61).

<sup>b</sup>MME conversion factor based on dosage in milligrams, unless otherwise stated.

<sup>c</sup>MME conversion factor based on dosage in micrograms per hour for patch and milligrams for film and tablet.

<sup>d</sup>MME conversion factor based on dosage in micrograms per hour for patch and micrograms for remaining finished dosage forms.

MME were calculated by first evaluating the daily strength for each prescription and then using the corresponding MME conversion factor (Table 1) to calculate the MME/day over the course of the prescription duration. The daily strength was based on the daily number of units (ie, total number of units divided by the corresponding number of days of supply) and the corresponding strength of each unit. For each patient with overlapping opioid prescriptions, the MME/day was summed for the overlapping periods. The number of days that each patient’s MME/day was at least 50 or at least 90 was determined. The MME/day was then summed for each patient to calculate the cumulative total MME.

Descriptive statistics were used to summarize the opioid prescriptions and corresponding MME over the 3-year period. The percentage of patients with a filled opioid prescription was compared between those with and without fusion using univariate  $\chi^2$  tests. For patients

who filled an opioid prescription, the corresponding mean usage and cost were compared between those with and without fusion using univariate *t* tests. Univariate *t* tests were also used to compare the per patient cumulative total MME, MME/day, and number of days with MME/day of at least 50 or 90. As a sensitivity analysis, multivariate statistics (general linear model) were also used to compare the opioid results between the fusion and nonfusion patients. The model variables included age, Charlson Comorbidity Index (CCI) score, Census region, gender, year of diagnosis, diagnosis of chronic pain (ICD-9 codes 338.29 or 338.4; ICD-10 codes G89.29 or G89.4), and fusion surgery. For fusion patients, the percentage of those with a filled opioid prescription and the corresponding prescription variables before and after fusion during the 3-year period were also compared, using the statistical approaches described previously. For fusion patients prescribed opioids, the prescription variables were further stratified into those at least 3, 6, and 12 months following the fusion surgery. All statistical analyses were performed using SAS version 9.4 (SAS Institute Inc; Cary, North Carolina).

**Role of Funding Organization**

One of the authors (AAE) is an employee of the funding organization; he provided input into the design of the study, provided analysis and interpretation of the data, and reviewed the manuscript.

**RESULTS**

We identified 852,111 patients with LBP in the data set; 75.3% of patients had a CCI score of 0, and 58.4% were female (Table 2). Roughly two-thirds of the patients (69.1%) filled prescriptions for analgesic medications, with opiate agonists being the most common class of drug. Of all patients with LBP, 31.0% filled opioid medications within the first 6 months of their LBP diagnosis, which increased to 42.1% within 3 years. Over the 3-year period, an average of 6.7 ± 11.0 prescriptions were filled per patient (Table 3). During the 3 years, patients filled opioid prescriptions with a dosage of at least 50 MME/day on an average of 53 ± 149 days and of at least 90 MME/day on 34 ± 124 days per patient.

A substantial proportion (41.5%) of patients who did not receive fusion surgery (nonfusion patients) filled opioid prescriptions during the 3-year period. Per patient, nonfusion patients had an average of 6.6 opioid prescriptions and at least 1.5 months with dosages of at least 50 MME/day (52 ± 149 days) and 1 month with dosages of at

least 90 MME/day (34 ± 124 days) (Table 3). The rate of prescriptions (87.2%) was further elevated for fusion patients ( $P < .001$ ). Fusion patients filled 65% more opioid prescriptions per patient than nonfusion patients ( $P < .001$ ), and these prescriptions were at 25% higher MME/day dosages per patient ( $P < .001$ ). Fusion patients had opioid dosages of at least 50 MME/day on 62% more days (84 ± 162 days per patient) and of at least 90 MME/day on 48% more days (50 ± 130 days per patient) than nonfusion patients (both  $P < .001$ ). Using multivariate statistics, the sensitivity analysis showed that all of the opioid prescription measures were significantly greater for fusion patients compared with nonfusion patients (all  $P < .001$  at 3 years).

Before fusion surgery, 67.7% of fusion patients filled opioid prescriptions, which increased to 75.5% post surgery. All measures of opioid use increased after surgery (Table 4). The mean daily dosages increased by 25% (55.5 ± 86.5 MME to 69.2 ± 82.1 MME per patient;  $P = .009$ ), and the number of days with at least 50 MME/day and at least 90 MME/day increased by 26% (45 ± 101 to 57 ± 114 days per patient;  $P < .001$ ) and 35% (26 ± 80 to 34 ± 94 days per patient;  $P < .001$ ), respectively, from the period between the index LBP diagnosis and fusion to the period between fusion and 3 years post LBP diagnosis.

Long-term opioid prescriptions persisted in 27.2% of fusion patients 12 months post surgery. Fusion patients with opioid prescriptions more than 12 months post surgery had greater MME/day than those who had opioids more than 3 months post surgery. Fusion patients still filled a significant number of opioid prescriptions (average 6.0 per patient) and had 2 months' supply with at least 50 MME/day and 1 month's supply with at least 90 MME/day per patient at least 12 months following surgery (Table 5).

## DISCUSSION

This study found that more than one-third (42.1%) of patients with LBP were prescribed opioids over the 3-year follow-up period. Indeed, opiate agonists were the most commonly prescribed analgesic medication. In addition, the opioid burden for nonfusion patients within a 3-year period was substantial, with an average of 6.6 opioid prescriptions per patient, as well as at least 1.5 months with dosages of at least 50 MME/day and 1 month with dosages of at least 90 MME/day per patient. The opioid prescription burden was further elevated by patients with LBP who subsequently underwent lumbar fusion surgery. Fusion patients filled more than twice as many opioid prescriptions and had 62% and 48% more days with opioid dosages of at least 50 and at least 90 MME/day, respectively, than nonfusion patients. The baseline opioid burden was not reduced following fusion surgery. Instead, all measures of opioid use increased postoperatively. Long-term prescriptions still persisted for fusion patients; at 12 months post surgery, those with opioids had an average 2 months' supply with at least 50 MME/day and 1 month's supply with at least 90 MME/day per patient.

Many studies have found increasing use of opioids in the United States,<sup>12,13,22</sup> and specifically for treating LBP.<sup>17,23,24</sup> Our study revealed a

**TABLE 2.** Demographic Summary of Patients

	Total		No Fusion		Fusion	
	n	%	n	%	n	%
Total	852,111	100	841,887	100	10,224	100
Male	354,349	41.6	350,092	41.6	4257	41.6
Female	497,762	58.4	491,795	58.4	5967	58.4
Age, years						
<35	147,122	17.3	146,595	17.4	527	5.2
35-44	144,609	17.0	143,551	17.1	1058	10.3
45-54	215,969	25.3	213,660	25.4	2309	22.6
55-64	185,139	21.7	182,193	21.6	2946	28.8
65-69	50,377	5.9	49,040	5.8	1337	13.1
70-74	38,165	4.5	37,121	4.4	1044	10.2
75-79	31,852	3.7	31,162	3.7	690	6.7
80-84	23,798	2.8	23,537	2.8	261	2.6
≥85	15,080	1.8	15,028	1.8	52	0.5
CCI score						
0	641,259	75.3	634,190	75.3	7069	69.1
1-2	171,509	20.1	168,968	20.1	2541	24.9
3-4	30,004	3.5	29,526	3.5	478	4.7
≥5	9339	1.1	9203	1.1	136	1.3
Geographic region						
Northeast	162,418	19.1	161,331	19.2	1087	10.6
Midwest	217,362	25.5	213,585	25.4	3777	36.9
South	343,452	40.3	339,374	40.3	4078	39.9
West	128,879	15.1	127,597	15.2	1282	12.5

CCI indicates Charlson Comorbidity Index.

high opioid burden in patients with LBP, even for those who did not undergo fusion. The results of a study of claims data also showed higher prevalence of opioid prescriptions (37.0% vs 14.8%;  $P < .0001$ ) and more prescriptions (median, 3.0 vs 1.0;  $P < .0001$ ) for patients with chronic LBP versus controls with no LBP diagnosis.<sup>1</sup> Another study's findings showed that opioids were the most commonly prescribed LBP medication, with 41.6% of medication-receiving patients with LBP taking opioids.<sup>5</sup> In our cohort of patients with LBP, we found that 42.1% received opioids, with opiate agonists being the most commonly prescribed analgesic medication.

The already substantial opioid burden in the LBP population was further escalated for those who underwent fusion surgery. We found significantly higher use of opioids for patients undergoing fusion surgery for all time points and metrics of interest. Another study showed that 4.4% of patients who underwent lumbar spinal surgeries had an unplanned 30-day readmission, of which pain was the second-highest (22.4%) cause for readmission.<sup>25</sup> Increased pain due to spinal fusion may explain the higher initial rates of opioid prescriptions; however, at least a quarter of the fusion patients in this study still had opioids more than 12 months post surgery. A prospective clinical study found that 29% of patients were dependent on narcotic medications at 4 to 6 weeks post lumbar surgery, which persisted for 18% at 8 to 12 weeks postoperatively.<sup>18</sup>

**TABLE 3.** Opioid Prescriptions for All Patients With LBP and Those With and Without Spinal Fusions<sup>a</sup>

Per Patient Burden	Time Since LBP Diagnosis	All With LBP		No Fusion		Fusion		Difference Between No Fusion and Fusion
		Mean	SD	Mean	SD	Mean	SD	P
Prescriptions (n)	0 to 6 months	2.6	2.6	2.5	2.6	3.6	3.2	<.001
	0 to 1 years	3.5	4.5	3.5	4.5	5.3	5.5	<.001
	0 to 2 years	5.2	7.9	5.1	7.8	8.2	9.5	<.001
	0 to 3 years	6.7	11.0	6.6	10.9	10.9	13.1	<.001
Days' supply (n)	0 to 6 months	49	71	49	71	66	74	<.001
	0 to 1 years	72	122	72	121	102	131	<.001
	0 to 2 years	113	212	111	211	166	234	<.001
	0 to 3 years	151	297	149	296	226	328	<.001
Ingredient cost (\$)	0 to 6 months	193	1051	192	1046	236	1215	.004
	0 to 1 years	294	1646	292	1644	369	1712	<.001
	0 to 2 years	476	2779	472	2783	631	2622	<.001
	0 to 3 years	665	4149	659	4162	898	3584	<.001
Total payment (\$)	0 to 6 months	198	1051	197	1047	242	1216	.004
	0 to 1 years	301	1649	299	1647	377	1703	<.001
	0 to 2 years	485	2785	481	2789	640	2610	<.001
	0 to 3 years	675	4176	670	4190	907	3575	<.001
Average wholesale price (\$)	0 to 6 months	399	3254	396	3268	549	2587	<.001
	0 to 1 years	620	5348	614	5371	886	4342	<.001
	0 to 2 years	1078	10,536	1064	10,586	1626	8339	<.001
	0 to 3 years	1569	15,716	1546	15,791	2492	12,372	<.001
Total MME (cumulative MME units)	0 to 6 months	3501.1	12,325.8	3483.1	12,332.1	4256.8	12,035.9	<.001
	0 to 1 years	5487.5	21,316.3	5451.3	21,313.5	6934.3	21,378.7	<.001
	0 to 2 years	8847.0	36,461.9	8775.8	36,489.9	11,622.9	35,242.7	<.001
	0 to 3 years	11,912.3	49,893.6	11,804.0	49,925.9	16,156.1	48,422.4	<.001
MME/day	0 to 6 months	52.8	104.5	52.7	104.8	59.0	86.9	<.001
	0 to 1 years	51.6	100.3	51.4	100.6	59.5	86.7	<.001
	0 to 2 years	50.1	94.3	49.8	94.7	59.8	77.5	<.001
	0 to 3 years	49.1	89.5	48.8	89.8	60.8	75.6	<.001
Days with ≥50 MME/day (n)	0 to 6 months	15	35	15	35	21	38	<.001
	0 to 1 years	23	61	23	61	35	65	<.001
	0 to 2 years	38	106	38	106	59	114	<.001
	0 to 3 years	53	149	52	149	84	162	<.001
Days with ≥90 MME/day (n)	0 to 6 months	9	30	9	30	12	30	<.001
	0 to 1 years	15	51	15	51	20	53	<.001
	0 to 2 years	25	89	25	89	35	93	<.001
	0 to 3 years	34	124	34	124	50	130	<.001

LBP indicates low back pain; MME, morphine milligram equivalents.

<sup>a</sup>Zero-cost patients were excluded; mean based on patients with LBP who filled opioid prescriptions. All dollar amounts were converted to June 2017 US\$. For each patient, the MME/day over the course of the days of supply was calculated for each prescription. The MME/day was summed for the overlapping periods if there were overlapping prescriptions for a patient. The number of days that each patient's MME/day was at least 50 MME/day or at least 90 MME/day was determined. The MME/day was then summed for each patient to calculate the cumulative total MME for that patient.

It is concerning that both fusion and nonfusion patients had extended periods with opioid dosages of at least 50 MME/day (almost 3 months for fusion and 2 months for nonfusion per patient), which is the level at which the CDC recommends clinicians reassess evidence of individual benefits and risks of the treatment.<sup>14</sup> The patients also had fairly extended prescription supplies of at least 90 MME/day

(1.5 months for fusion and 1 month for nonfusion per patient), which the CDC recommends avoiding or carefully justifying.

We found that patients who underwent lumbar fusion surgery had baseline levels of opioid prescriptions that did not decrease post surgery and instead increased after fusion surgery. Thus, for many patients, the fusion surgery does not adequately address

**TABLE 4.** Opioid Prescriptions for Spinal Fusion Patients Before and After Surgery Within the 3-Year Follow-Up After LBP Diagnosis\*

Per Patient Burden	Before Fusion		After Fusion		P
	Mean	SD	Mean	SD	
Prescriptions (n)	6.4	8.0	6.8	9.0	<.001
Days' supply (n)	135	206	140	227	<.001
Ingredient cost (\$)	481	2014	605	2656	<.001
Total payment (\$)	488	2009	610	2644	<.001
Average wholesale price (\$)	1185	5645	1815	10,716	<.001
Total MME (cumulative MME units)	9131.0	30,470.7	10,471.7	31,139.6	<.001
MME/day	55.5	86.5	69.2	82.1	.009
Days with ≥50 MME/day (n)	45	101	57	114	<.001
Days with ≥90 MME/day (n)	26	80	34	94	<.001

LBP indicates low back pain; MME, morphine milligram equivalents.

\*Zero-cost patients were excluded; mean based on patients with LBP who filled opioid prescriptions. All dollar amounts were converted to June 2017 US\$. For each patient, the MME/day over the course of the days of supply was calculated for each prescription. The MME/day was summed for the overlapping periods if there were overlapping prescriptions for a patient. The number of days that each patient's MME/day was at least 50 MME/day or at least 90 MME/day was determined. The MME/day was then summed for each patient to calculate the cumulative total MME for that patient.

their pain. Others have observed correlations between preoperative and postoperative opioid use. Some have shown that preoperative narcotic use is a strong predictor of postoperative use,<sup>19</sup> with those who consume opioids presurgery 5.3 times more likely to have elevated postoperative narcotics use compared with patients who have never taken opioids.<sup>18</sup> Another study showed that longer duration of presurgical opioid use increased the odds of long-term opioid use (>1 year postoperative).<sup>21</sup>

Long-term opioid therapy has been defined by the CDC as the use of opioids on most days for at least 3 months,<sup>14</sup> but others have also considered narcotic use for more than 12 months to indicate long-term use.<sup>21</sup> Based on these timeframes, we found that almost half of the fusion patients (44.9%) continued to have opioids after 3 months post surgery, which persisted for a quarter of fusion patients more than 12 months post surgery. Even in the period after 12 months post surgery, those with opioid prescriptions had 2 months' supply with at least 50 MME/day and 1 month's supply with at least 90 MME/day per patient. The prevalence of long-term opioid use has also been reported by others. A study observed that 50% of lumbar fusion patients received opioids 3 months after surgery, 40% used opioids for 6 months, 30% for 12 months, and 17% for 24 months.<sup>21</sup> Another study showed that 57.4% of patients were chronic opioid users, with supply more than 1 year after lumbar fusion surgery.<sup>19</sup> We observed that the total MME declined after the 3 month postfusion period to the 12 month postfusion period following fusion surgery, which was consistent with the declining percentage of patients with filled prescriptions during

**TABLE 5.** Opioid Prescriptions for Spinal Fusion Patients in the Period Following 3, 6, and 12 Months After Surgery\*

Per Patient Burden	Time Post Surgery (months)		Mean	SD
	≥3	≥6		
Prescriptions (n)	≥3	≥6	7.3	9.1
	≥6	≥12	7.0	8.5
	≥12		6.0	6.9
Days' supply (n)	≥3	≥6	172	240
	≥6	≥12	167	226
	≥12		145	186
Ingredient cost (\$)	≥3	≥6	777	2992
	≥6	≥12	779	2888
	≥12		671	2359
Monthly payment (\$)	≥3	≥6	782	2986
	≥6	≥12	784	2884
	≥12		675	2359
Average wholesale price (\$)	≥3	≥6	2226	10,841
	≥6	≥12	2247	10,826
	≥12		2054	10,121
Total MME (cumulative MME units)	≥3	≥6	12,790.0	33,458.0
	≥6	≥12	12,446.7	30,710.6
	≥12		10,673.8	24,350.0
MME/day	≥3	≥6	67.6	105.7
	≥6	≥12	70.2	113.1
	≥12		75.1	125.4
Days with ≥50 MME/day (n)	≥3	≥6	67	124
	≥6	≥12	65	118
	≥12		56	99
Days with ≥90 MME/day (n)	≥3 months	≥6 months	41	103
	≥6 months	≥12 months	41	98
	≥12 months		35	82

LBP indicates low back pain; MME, morphine milligram equivalents.

\*Zero-cost patients were excluded; mean based on patients with LBP who filled opioid prescriptions. All dollar amounts were converted to June 2017 US\$. For each patient, the MME/day over the course of the days of supply was calculated for each prescription. The MME/day was summed for the overlapping periods if there were overlapping prescriptions for a patient. The number of days that each patient's MME/day were at least 50 MME/day or at least 90 MME/day was determined. The MME/day was then summed for each patient to calculate the cumulative total MME for that patient.

those periods. However, the MME/day had an opposite trend, which reflects increasing MME quantities for those patients who continued to have long-term prescriptions.

**Limitations**

Our study has several limitations that we feel do not outweigh the benefits of the conclusions drawn. This study used administrative claims data, rather than clinical data, and thus may contain missing information. It has been shown that some drug claims, such as out-of-pocket payments and spousal benefits, may not be fully captured.<sup>26</sup> Hence, our estimates of the opioid prescriptions may be conservative. Although our study used multivariate statistics to adjust for any potential differences in the patient characteristics

between the fusion and nonfusion cohorts, patient-reported pain and disability data are not available in the data set, which prevented us from accounting for these in our analysis. Filled prescriptions also do not equate to consumption rates.<sup>27</sup> Nonetheless, prescription claims still provide more robust data than self-reported usage. One cannot directly link the prescriptions with LBP, but we attempted to provide linkage by requiring an LBP medical claim in the 30 days preceding the prescription fill. Although we did not examine the sensitivity of the 30-day assumption, the duration provided a lag for the patient to fill the prescription following their LBP-associated claim. However, it is unclear to what extent the prescriptions may also be associated with other etiologies. It was also not within the scope of the study to differentiate between short- and long-acting opioids.

Conversely, our study has an advantage in the use of a large LBP patient population. Our cohort had 3 years of continuous enrollment and robust longitudinal history and data with no disruption in insurance coverage. With these criteria, our study excluded sicker patients on disability, who lost their employment due to LBP, or who died. The vast majority of our cohort also had a CCI score of 0. Thus, our estimates of opioid prescriptions may be conservative because the study population may be biased toward healthier patients.

## CONCLUSIONS

The use and cost of opioid treatment for managing LBP is substantial, especially following fusion surgery. These patients have a substantial opioid burden in terms of their dosages exceeding the CDC guidelines of at least 50 and at least 90 MME/day, which raises questions about how patients are selected for opioid prescriptions and how those prescriptions are managed or monitored. It also emphasizes the importance of the development of alternative therapies for treating LBP to reduce the burden of chronic opioid use. ■

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**Source of Funding:** Our firm (Exponent, Inc) received funding from Relieva Medsystems, Inc, for this study.

**Author Disclosures:** Dr Ong, Dr Stoner, Dr Yun, and Mr Lau are employees of Exponent, Inc, which received funding from Relieva Medsystems, Inc, for this study. Dr Ong reports that Exponent has been paid fees for his consulting services for DJO, Ethicon, Ferring Pharmaceuticals, Medtronic, Ossur, Pacira Pharmaceuticals, Paradigm Spine, Stryker Orthopaedics, Sanofi, St Jude Medical, and Zimmer Biomet. Mr Lau reports that Exponent was paid for his consulting services for Stryker Orthopedics, Boston Scientific, Ethicon, and Ferring Pharmaceuticals. Dr Edidin is an employee of Relieva Medsystems, Inc, the study sponsor.

**Authorship Information:** Concept and design (KLO, EL, AAE); acquisition of data (EL); analysis and interpretation of data (KLO, KES, BMY, EL, AAE); drafting of the manuscript (KLO, KES, BMY, EL, AAE); critical revision of the manuscript for important intellectual content (KLO, KES, EL, AAE); statistical analysis (EL); obtaining funding (KLO, AAE); administrative, technical, or logistic support (BMY); and supervision (KLO, AAE).

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