# Opioid use trends in patients undergoing elective thoracic and lumbar spine surgery

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**Background:** Opioid use in North America has increased rapidly in recent years. Preoperative opioid use is associated with several negative outcomes. Our objectives were to assess patterns of opioid use over time in Canadian patients who undergo spine surgery and to determine the effect of spine surgery on 1-year postoperative opioid use.

**Methods:** A retrospective analysis was performed on prospectively collected data from the Canadian Spine Outcomes and Research Network for patients undergoing elective thoracic and lumbar surgery. Self-reported opioid use at baseline, before surgery and at 1 year after surgery was compared. Baseline opioid use was compared by age, sex, radiologic diagnosis and presenting complaint. All patients meeting eligibility criteria from 2008 to 2017 were included.

**Results:** A total of 3134 patients provided baseline opioid use data. No significant change in the proportion of patients taking daily (range 32.3%–38.2%) or intermittent (range 13.7%–22.5%) opioids was found from pre-2014 to 2017. Among patients who waited more than 6 weeks for surgery, the frequency of opioid use did not differ significantly between the baseline and preoperative time points. Significantly more patients using opioids had a chief complaint of back pain or radiculopathy than neurogenic claudication ($p < 0.001$), and significantly more were under 65 years of age than aged 65 years or older ($p < 0.001$). Approximately 41% of patients on daily opioids at baseline remained so at 1 year after surgery.

**Conclusion:** These data suggest that additional opioid reduction strategies are needed in the population of patients undergoing elective thoracic and lumbar spine surgery. Spine surgeons can be involved in identifying patients taking opioids preoperatively, emphasizing the risks of continued opioid use and referring patients to appropriate evidence-based treatment programs.

**Contexte :** En Amérique du Nord, l'utilisation d'opioïdes a augmenté rapidement dans les dernières années. La prise d'opioïdes en période préopératoire est associée à plusieurs issues négatives. Cette étude visait à évaluer l'évolution des tendances dans l'utilisation d'opioïdes des patients canadiens ayant subi une chirurgie spinale, et de déterminer les effets de la chirurgie sur leur utilisation 1 an après l'opération.

**Méthodes :** Une analyse rétrospective a été réalisée à partir de données recueillies de manière prospective par le *Canadian Spine Outcomes and Research Network* pour les patients ayant subi une chirurgie thoracique ou une chirurgie spinale élective. On a comparé l'utilisation autodéclarée d'opioïdes au début du suivi, avant la chirurgie et 1 an après la chirurgie. L'utilisation d'opioïdes au départ a été comparée selon le sexe, l'âge, le diagnostic radiologique et le motif de consultation. Entre 2008 et 2017, tous les patients satisfaisant aux critères d'admissibilités ont été inclus dans l'étude.

**Résultats :** Au total, 3134 patients ont fourni des données sur leur prise d'opioïdes au début du suivi. Il n'y avait pas de changement significatif dans la proportion de patients utilisant quotidiennement (32,3 % à 38,2 %) ou occasionnellement (13,7 % à 22,5 %) des opioïdes entre les patients à l'étude avant 2014 et ceux à l'étude de 2014 à 2017. Parmi les patients qui ont attendu plus de 6 semaines avant la chirurgie, la fréquence de la prise d'opioïdes n'a pas changé de manière significative entre le début du suivi et la rencontre préopératoire. Une proportion significativement plus grande de patients qui utilisaient des opioïdes consultaient principalement pour des douleurs au dos ou une radiculopathie que pour une claudication neurogène ($p < 0{,}001$), et il y avait une proportion significativement plus grande de patients de moins de 65 ans qui utilisaient des opioïdes que de patients de 65 ans ou plus ($p < 0{,}001$). Environ 41 % des patients qui prenaient quotidiennement des opioïdes au départ le faisaient aussi 1 an après la chirurgie.

**Conclusion :** Ces données suggèrent que des stratégies supplémentaires de réduction de l'utilisation d'opioïdes sont nécessaires pour les patients qui subissent une chirurgie thoracique ou une chirurgie spinale élective. Il est possible de demander aux chirurgiens spécialisés dans ce domaine de repérer les patients qui prennent des opioïdes avant l'opération, puisque l'utilisation prolongée comporte des risques, et de les aiguiller vers un programme de traitement adéquat et fondé sur des données probantes.

Opioid use has increased rapidly in the last 20 years in the United States and Canada.[1–3] While previous studies have suggested opioids are safe and efficacious in patients with spine pathology,[4–6] many health-related and socioeconomic problems associated with opioid use have become apparent. Recent research in patients who undergo hip and knee arthroplasty and spinal procedures has indicated that patients on preoperative opioids have more difficulty with pain control in the perioperative period,[7,8] increased hospital length of stay (LOS)[9] and worse postoperative outcomes than patients not regularly using opioids preoperatively.[10–13]

It is estimated that nearly one-quarter of patients who undergo orthopedic surgery and 19% of patients who undergo neurosurgery are on opioids preoperatively.[14] In Canada, there is a lack of research documenting the proportion of patients presenting to tertiary spine surgery clinics who are taking opioids. To our knowledge, no publication has investigated whether increased physician awareness of the adverse effects associated with regular opioid usage has resulted in fewer patients being prescribed opioids for spine-related pain.

Recent clinical guidelines have recommended against opioid use for the management of low-back pain.[15] A recent randomized controlled trial indicated that treatment with opioids was not superior to treatment with nonopioid medications for improving pain-related function over 12 months in patients with moderate to severe chronic back pain.[16]

The aims of this study were to determine the proportion of patients presenting to tertiary spine surgery clinics in Canada who indicated opioid use, examine trends over time and investigate 1-year postoperative opioid use. Ultimately, our goal was to evaluate the need for surgeons to be proactive in addressing opioid use and reducing harms associated with opioid prescribing.[17] The authors hypothesize that, owing to the increase in media attention regarding opioid use and physician awareness of associated risks, a decrease in opioid use will be observed during the study period.

## Methods

### *Study design*

We conducted a multicentre, retrospective review of consecutive patients undergoing thoracic and lumbar spine surgery who were enrolled by the Canadian Spine Outcomes and Research Network (CSORN) between October 2008 and August 2017. The network is a group of more than 50 neurosurgical and orthopedic spine surgeons from 18 tertiary care academic and nonacademic hospitals across Canada that prospectively collects data on patients with spinal conditions on an ongoing and voluntary basis. This database serves as a national registry, which was created to answer research questions and to facilitate the implementation of best practices.

A national database research coordinator audits data quality and performance and sends reports to each contributing hospital site coordinator on a quarterly basis. Reports track data completion and follow-up rates to facilitate internal data validation at each site. A national privacy and security framework was created for CSORN that includes a governance structure, standard operating procedures, training processes, physical and technical security and privacy impact assessments. This model ensures that personal health information is kept private and secure. Written informed consent is obtained from all participating patients. Patient information is anonymized to ensure that patients in the network cannot be individually identified. Twelve sites contributed to this specific project. Each site obtained research ethics board approval before any data collection. Decisions regarding data collection, storage and analysis are independent of any particular company or commercial interest.

### *Patient sample*

Local research coordinators enrolled eligible patients at each site. To be eligible, patients had to be 18 years of age or older and must have undergone elective surgery involving the thoracic and/or lumbar spine (decompression or decompression and fusion) and answered the question pertaining to opioid pain medication on the baseline questionnaire. Exclusion criteria were as follows: emergency cases, fractures, revision surgery, tumour, surgery at cervical levels and a chief complaint other than back pain, neurogenic claudication and/or radiculopathy. Chief complaint was documented by the surgeon at the time the surgical procedure was booked. Patients were asked to report opioid use at the initial visit with a spine surgeon (baseline), preoperatively (if the surgical date was more than 6 weeks after the initial visit) and at 1-year postoperative follow-up.

### *Patient variables*

Baseline preoperative patient characteristics included sociodemographic factors, use of opioid and nonopioid medications, comorbidities, symptom duration and symptom intensity. The specific focus of this study was on the question "Do you take opioid pain medication for your back problem?" Examples of generic opioids were provided. The response choices were "never," "intermittent" or "daily."

### *Study measures*

The treating surgeons recorded operative and postoperative variables including type of procedure, number of levels, chief complaint and primary radiologic diagnosis. Research coordinators collected patient-reported outcomes and information on medication use at baseline, preoperatively (> 6 wk from baseline, before surgery) and 12 months postoperatively. The additional preoperative data point was reported by only 5 of the 12 sites because of limitations in the availability of staff resources. Data were collected in person, via post or through an emailed hyperlink to an online patient portal.

### *Statistical analysis*

The registry started as a pilot at 1 site in 2008, expanded to 3 sites in 2012 and gradually grew over the subsequent years to encompass 18 sites; patients who had surgery between 2008 and 2013 were grouped together for the analysis owing to the relatively small number of patients in the early years of the database. Opioid use was stratified by year (pre-2014, then annually through to and including 2017) at baseline, preoperatively in those patients who waited longer than 6 weeks after their initial visit for surgery, at 1 year postoperatively, and by chief complaint, age and primary radiologic diagnosis. $\chi^2$ testing, with significance set a priori at 5%, was used to compare opioid use by enrolment year, time point (baseline presentation, preoperative and 1-year postoperative), sex, age, symptom duration, radiologic diagnosis and chief complaint. Patients with both baseline and preoperative data were compared using paired-samples *t* tests to assess the impact of an extended wait time before surgery.

## Results

Of the 4267 patients who met the inclusion criteria, 26.6% did not provide complete baseline data on opioid use. Thus, the evaluated sample was 3134 patients. There were no differences in age, sex, number of levels or symptom duration between patients who answered the question on opioid use and those who did not. Table 1 provides baseline characteristics for the sample population.

A total of 34.5% of the patients reported daily opioid use, 19.8% intermittent use and 45.8% no opioid use. There was no change in the proportion of opioid use over time ($p$ = 0.39; Fig. 1): the proportion of patients taking opioids daily ranged from 32.3% to 38.2%, and the proproportion of patients taking opioids intermittently ranged from 13.7% to 22.5%. There was no significant difference in opioid use by sex: 36.5% of women used opioids daily, 20.7% used them intermittently and 42.8% never used them, whereas 32.4% of men used opioids daily, 18.9% used them intermittently and 48.8% never used them ($p$ = 0.42). There was also no significant difference in opioid use by symptom duration: 43.7% of patients who had had symptoms for less than 2 years and 46.7% of patients who had had symptoms for 2 or more years never used opioids ($p$ = 0.11). Significantly more patients under age 65 years were taking opioids, compared with those aged 65 years or older ($p$ < 0.001; Fig. 2). Significantly fewer patients with a chief complaint consistent with neurogenic claudication were taking opioid medications than those with radiculopathy or back pain ($p$ < 0.001; Fig. 3).

**Table 1. Baseline characteristics of patients**

| Characteristic | Patients who did not use opioids | Patients who used opioids |
|---|---|---|
| Sex, % male | 54.3 | 48.3 |
| Age, yr, mean ± SD (range) | 60.8 ± 14.4 (18–89) | 56.2 ± 14.5 (18–89) |
| Age, % of patients | | |
| < 65 yr | 52.9 | 67.9 |
| ≥ 65 yr | 47.1 | 32.1 |
| Diagnosis, % of patients | | |
| Deformity | 4.6 | 4.3 |
| Degenerative disc disease | 5.1 | 9.0 |
| Disc herniation | 17.2 | 27.6 |
| Spondylolisthesis | 37.3 | 28.8 |
| Stenosis | 35.8 | 30.3 |
| Chief complaint, % of patients | | |
| Back pain | 11.5 | 14.8 |
| Neurogenic claudication | 46.5 | 34.0 |
| Radiculopathy | 42.0 | 51.1 |
| Type of surgery, % of patients | | |
| Decompression alone | 38.3 | 33.5 |
| Decompression and fusion | 61.7 | 66.5 |
| No. of surgical levels, % of patients | | |
| 1 | 63.6 | 61.8 |
| 2 | 21.7 | 21.6 |
| ≥ 3 | 14.6 | 16.6 |
| No. of comorbidities, % of patients | | |
| 0 | 10.3 | 6.5 |
| 1 | 21.8 | 19.6 |
| 2 | 22.6 | 20.3 |
| ≥ 3 | 45.3 | 53.6 |
| Symptom duration, % of patients | | |
| < 1 yr | 18.6 | 23.3 |
| 1–2 yr | 16.2 | 14.3 |
| ≥ 2 yr | 65.2 | 62.4 |
| Numeric pain rating, mean ± SD (range) | | |
| Back | 6.42 ± 2.45 (0–10) | 7.28 ± 2.13 (0–10) |
| Leg | 7.06 ± 2.26 (0–10) | 7.5 ± 2.1 (0–10) |

SD = standard deviation.

Significantly more patients with a primary radiologic diagnosis of degenerative disc disease were taking opioids (67.6%) than those with a primary diagnosis of deformity, spondylolisthesis or stenosis ($p < 0.01$; Fig. 4). Similarly, significantly more patients with a primary radiologic diagnosis of disc herniation reported taking opioids (65.4%) than those with a primary diagnosis of deformity, spondylolisthesis or stenosis ($p < 0.01$; Fig. 4).

At 5 of the 12 sites, updated questionnaires were administered to patients who waited longer than 6 weeks for surgery. Analysis of these data (for 895 patients) revealed no significant difference in the proportions of opioid use between the baseline and preoperative time points (at baseline 37.2% of patients reported daily use, 21.9% reported intermittent use and 41.0% reported no use of opioids; at the preoperative time point 36.8% reported daily use, 21.6% reported intermittent use and 41.7% reported no use of opioids; $p > 0.05$).

Of the 3134 patients in this study, 2329 passed the 1-year mark from surgery and were eligible for 1-year follow-up; 1624 were reached for follow-up (69.7%). Within this cohort, at 1-year postoperative follow-up there was a significant decrease in the proportion of patients taking daily opioids from baseline (34.7% to 16.9%, $p < 0.01$) and an increase in the proportion of patients not taking opioids (45.8% to 71.4%, $p < 0.01$; Fig. 5). Of the patients not taking opioids at baseline, at 1-year follow-up, 3.9% reported taking opioids daily and 5.4% intermittently; 676 (90.7%) did not take opioids at baseline nor at 1-year follow-up. Of the patients taking intermittent or daily opioids at baseline, 54.7% reported taking no opioids at 1-year follow up. Of the patients who took opioids daily at baseline, 13.8% went down to intermittent use and 45.7% reported taking no opioids at 1-year follow-up.

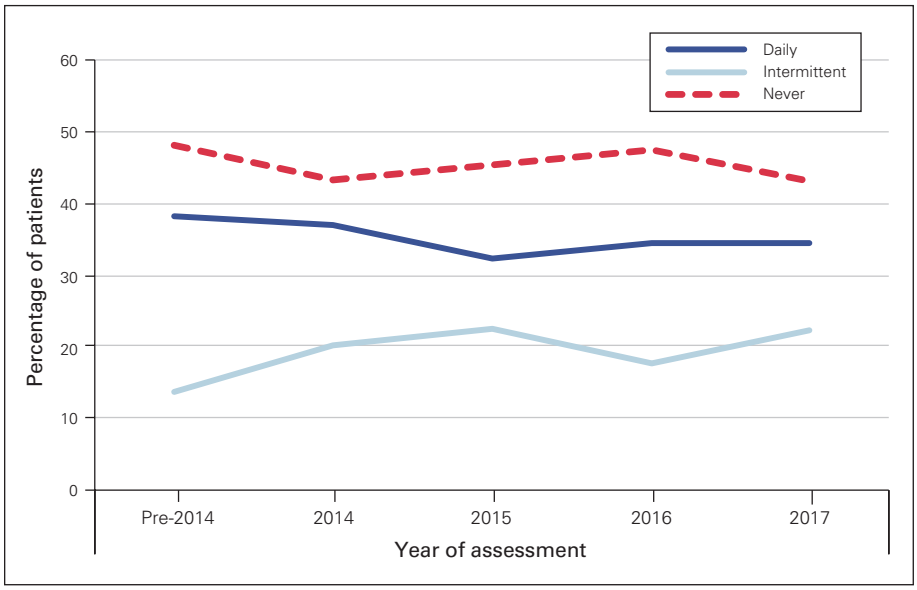


**Fig. 1.** Opioid use at baseline by year.

## Discussion

With data from the CSORN, we investigated the proportions of patients undergoing spine surgery who used opioids and the concomitant changes in opioid use over time. Fifty-two percent of patients presenting to Canadian tertiary spine surgery clinics

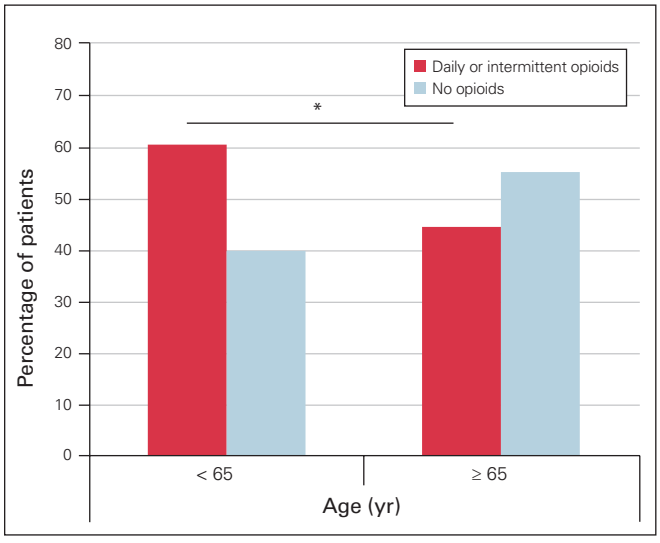


**Fig. 2.** Opioid use at baseline by age. *Denotes significant difference ($p < 0.001$).

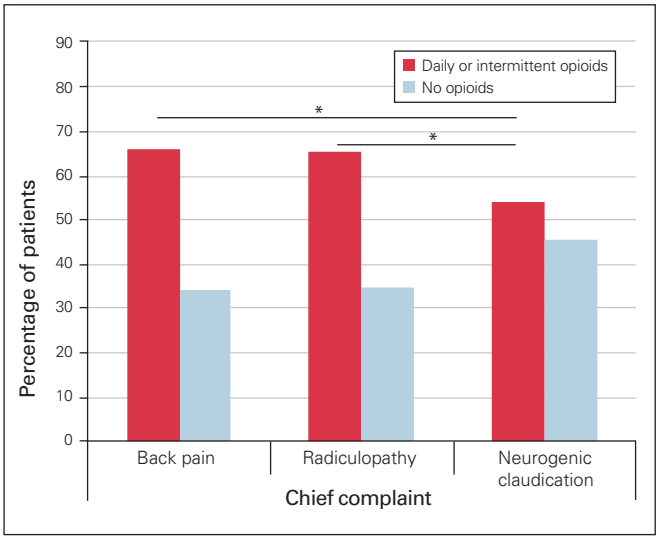


**Fig. 3.** Opioid use at baseline by chief complaint. *Denotes significant difference ($p < 0.001$).

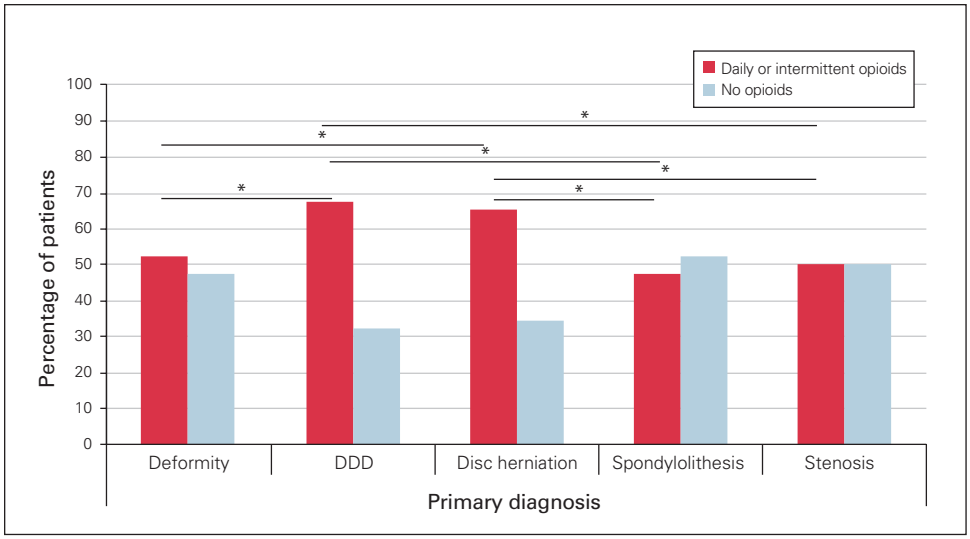


**Fig. 4.** Opioid use at baseline by primary diagnosis. Patients in the stenosis category did not have spondylolisthesis. *Denotes significant difference ($p < 0.01$). DDD = degenerative disc disease.

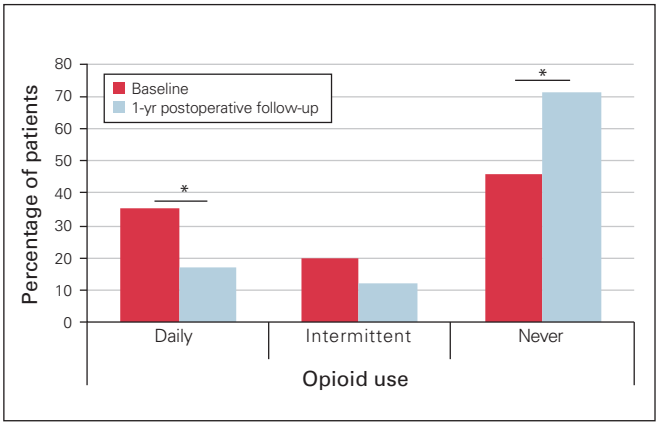


**Fig. 5.** Opioid use at baseline versus 1 year postoperatively. *Denotes significant difference ($p < 0.01$).

before 2014 reported taking opioids on a daily or intermittent basis, a finding that was relatively consistent across the study period (2008 to 2017). We found that significantly fewer patients aged 65 years and older took preoperative opioids than patients younger than 65 years of age. This is probably attributable to the finding that fewer patients with a radiologic diagnosis of stenosis and chief complaint of neurogenic claudication were on preoperative opioids than those with other diagnoses, and neurogenic claudication secondary to stenosis is more common in older patients (average age at the time of surgery was 63.8 yr in a Canadian cohort, as compared with 35.8 yr for radiculopathy).[18,19] Another possible reason for the difference in opioid use by age is that neurogenic claudication symptoms tend to be relieved with rest and many patients do not take analgesics for this problem; rather, they modify their activities to control symptoms.

At 1 year after surgery, daily opioid use among our patient population was significantly lower than at the time of the initial visit with the spine surgeon; however, almost 30% of patients continued to take opioids on a daily or intermittent basis. Nearly half of patients (45%) who were taking opioids before surgery remained on opioids at 1-year follow-up, and, alarmingly, nearly 10% of patients who were opioid naïve before surgery were found to be taking opioids 1 year after surgery.

A recent study by Dunn and colleagues investigated opioid use in patients undergoing elective spinal fusion of 2 levels or more at a university hospital in the United States.[20] They found that 72% of patients were taking opioids before surgery. In comparison, 54% of patients in our study were taking opioids at the first assessment with a spine surgeon. The greater proportion of patients taking opioids preoperatively in the study by Dunn and colleagues may reflect a difference in inclusion criteria (i.e., all elective thoracic and lumbar surgery cases versus elective spinal fusions of 2 levels or more). Nonetheless, 52% of those patients taking opioids preoperatively were still taking opioids at 1-year follow-up, which is similar to the follow-up findings of our study.[20]

Pugely and colleagues studied patients in the United States undergoing cervical spine fusion between 2007 and 2014 and found that 52% were taking opioids before surgery.[21] At 1-year follow-up, 45% of patients who had used opioids preoperatively remained on opioids. Both of these results are comparable to the findings of our study. Furthermore, the authors found preoperative opioid use was associated with an increased likelihood of postoperative opioid use after 12 months, a finding consistent with several studies in patients who undergo spine surgery.[7,21,22]

Regular opioid use in patients who undergo spine surgery is concerning for many reasons, with reported associations including inferior clinical outcomes, lower return to work rates, increased pain intensity in the perioperative period and increased hospital LOS.[8–11,23] Our results indicate that approximately 45% of preoperative opioid users remained on opioids 1 year after their spine surgery. Given this result and the fact that preoperative opioid use is a risk factor for continued

use at 1 year after surgery, there is a need for opioid reduction strategies and for spine surgeons to assist in efforts to decrease opioid use preoperatively.

### *Limitations*

Our study relied heavily on data from patient self-administered questionnaires, and it is therefore subject to limitations inherent to such surveys, including skipped answers and misunderstood questions.[24] Our analysis is also limited to those patients who admitted to taking opioids for their back problem. It is possible that a proportion of patients may have chosen not to answer this question because of a perceived stigma associated with opioid use. This limitation may have led to an underreporting bias of opioid use in our patient sample. Conversely, it is possible that our study overreports the proportion of patients using opioids by excluding those who did not specifically answer "none" to the opioids question even though they were not taking opioids. Furthermore, we do not have data on the quantity or dose of opioids taken by the patients included in this study. A 1-year follow-up rate of 70% is another limitation. It is possible that many patients for whom we do not have data at 1 year could have been uncontactable because they were doing well and were no longer seeking medical treatment. However, there are several possible reasons for losing patients to follow-up regardless of their condition. including unwillingness of the patient to be contacted, a change in contact information or failure of correspondence.

## Conclusion

The prevalence of opioid use in patients who undergo spine surgery in Canada remains high, with nearly half of patients who take opioids before surgery remaining on these medications 1 year after their procedure. There is an opportunity to improve clinical outcomes by decreasing opioid use in this population. Spine surgeons may have a role to play in identifying patients taking opioids preoperatively, helping to emphasize the risks of continued opioid use and referring patients to appropriate evidence-based treatment programs.

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