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Opioid prescribing patterns in British Columbia from 2013 to 2017: A population-based study

A 5-year retrospective analysis of community-dispensed opioids in BC showed that the number of opioid prescriptions issued declined slightly, and the types of opioids prescribed varied by medical specialty and over the study period.

ABSTRACT

Background: Prescription opioids initiated in opioid-naive patients are associated with long-term opioid use and opioid-related death.

Methods: We examined trends in prescribing practices using a data set of outpatient opioid prescriptions in BC from 2013 to 2017.

Note: All supplementary tables and figures (e.g., Table S1) are available online at bcmj.org.

Results: In total, 19 785 practitioners prescribed 15 693 867 prescriptions that were dispensed to 1 692 035 patients. In 2017, 11.5% of British Columbians were given at least one prescription for opioids. Over the 5-year period, opioid prescription rates declined by 1.6%; however, the proportion of patients who received more than 90 morphine milligram equivalents per day increased by 8%. There was heterogeneity of opioid prescriptions across and within specialty groups.

Conclusions: We provide population-level data to inform prescribers that there is a need to be aware of opioid prescription variability and its potential effect on long-term opioid use.

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Opioids are an essential component of multimodal therapy for acute and cancer pain management. Legitimate opioid prescription use in this setting is not considered to be a major contributor to chronic opioid misuse.[1,2] However, transition to persistent opioid use, distinct from opioid misuse, in an opioid-naive patient is reported to be the most common complication occurring after elective surgery, and the rate of use may be as high as 1 in 15.[3,4] For example, persistent opioid use following lumbar fusion surgery has been reported in 12.8% of opioid-naive patients.[5] An initial prescription of opioids carries a 5.3% risk of persistent opioid use at 1 year and a 2.9% risk at 3 years.[6] Certain patterns of initial opioid prescriptions are known risk factors for persistent opioid use in previously opioid-naive patients. These include prescriptions for long-acting (versus short-acting) opioids, induction with tramadol, higher morphine milligram equivalent (MME) doses, increasing number of days of opioids supplied with the first prescription, and instigation of a repeat prescription on initiation of opioids.[6,7] However, increased risk is independent of the initial indication for the opioid prescription.[6]

There is wide variation in opioid drug and dosage prescribing after common surgical procedures, yet as much as 70% to 80% of the drugs are not used and contribute to an opioid source within the community.[8,9] These opioids are often kept for future potential emergency pain use but become a source for recreational misuse or diversion.[10]

Long-term use of legitimate prescription opioids or unused community opioids is a potential gateway to subsequent opioid use disorder and transition to illicit drug use. Four to six percent of individuals who use prescription opioids will make this transition, especially when prescription drugs become less available.[11-13] Canadians were the third highest consumer of prescription narcotic drugs per capita in 2018.[14]

The introduction of synthetic drugs such as fentanyl and carfentanyl into the illicit drug market has resulted in a surge of unintended opioid-related deaths since 2015. British Columbia declared this opioid crisis a public health emergency in 2016.[15] One response to this crisis was *The 2017 Canadian Guideline for Opioids for Chronic Non-Cancer Pain*, which suggests that prescribers should restrict patients to 90 MME per day.[16] Despite this and other recommendations, the 2019 Canadian opioid overdose-related death rates remained the highest in BC at a rate of 20.0 per 100 000, twice the national average of 10.2.[17]

It is important to understand the variability in opioid prescriptions among prescribers in an attempt to reduce the quantity of opioids within the community. Previous studies have described physician specialty-specific prescribing trends. However, they studied mainly patient populations in the US, and often did not describe prescriptions in relation to other factors such as patient age and sex.[18-20] Analyzing prescriptions by these characteristics is particularly important in understanding opioid use in age-specific populations because their opioid prescriptions can vary significantly by provider specialty.[21,22]

We describe opioid prescribing patterns in BC from 2013 to 2017 with the primary goal of determining the relationship between prescriptions and patient age and sex, and prescriber types.

Methods

A 5-year retrospective longitudinal analysis of all community-dispensed opioids within BC was conducted. Ethical approval was obtained from the University of British Columbia Children's and Women's Research Ethics Board (H18-01006). The study conforms to the rules regarding data reporting as set out by Population Data BC and the provincial government.

Opioid classification

A list of all possible prescription opioids for the study period was created based on the World Health Organization Collaborating Centre for Drug Statistics Methodology Anatomical Therapeutic Chemical Classification System.[23] The categories for "opioids" and "drugs used in

opioid dependence" were included, and each was searched within the Health Canada Drug Product Database. In total, 691 drug identification numbers were identified.

Data sources

Dispensed prescriptions

A list of all prescriptions dispensed in BC between 1 January 2013 and 31 December 2017 was obtained from the PharmaNet database[24] through Population Data BC. PharmaNet, regulated by the BC Ministry of Health, records every prescription dispensed in community pharmacies, regardless of a patient's insurance status. The final list of opioid prescriptions included all those matching the 691 identified drug identification numbers.

For each prescription, the following data were collected: drug identification number, date dispensed, quantity dispensed, days supplied, and patient age and sex. Additionally, the following drug-specific details were obtained: chemical/generic name, drug strength, drug form units, and dosage form description (e.g., 3 [drug form units] tablets [dosage form description]). The field "directions for use" was requested but not obtained due to privacy/confidentiality concerns.

All patients and prescribers were given a unique study ID by Population Data BC in order to create a de-identified data set.

Opioid details

The Health Canada Drug Product Database was searched for each specific opioid within a drug to obtain the corresponding opioid strength.[25] Additionally, the oral MME was calculated for each drug using conversion factors obtained from the US Centers for Disease Control's 2017 oral MME guide.[26] Formulations were then aggregated by opioid type into 12 groups [Table]. Tramadol and tapentadol were combined due to their similar mechanism of action.[27] Codeine and tramadol/tapentadol were characterized as weak opioids; the remainder were characterized as strong opioids.

Prescriber details

Data on each physician's type of practice were obtained by linking their unique de-identified study ID to their listed specialty (or specialties)

from the BC College of Physicians and Surgeons database.[28] Physicians with multiple specialties were categorized by the primary specialty as designated by Population Data BC. Prescribers were then aggregated into the following categories: anesthesiology, specialty dentistry, general dentistry, diagnostics, general practice, medicine, nurse practitioner, pediatrics, pharmacy, physician: unknown specialty, psychiatry, surgery, and other (includes allied health professionals, optometrists, naturopathic physicians, midwives, and podiatrists).

BC population details

Annual population data for BC, stratified by age and sex, were obtained from published Government of British Columbia estimates.[29]

Data cleaning

Prescriptions with unidentified sexes or with ages greater than 113 (the oldest identified British Columbian during the study period) were set to missing. Prescriptions from prescriber types that were not present in BC during the study period were excluded because they were perceived as data errors. Daily MMEs and days supplied greater than twice the 99th percentile were excluded because they were considered data errors. Physicians' specialities that could not be identified from the BC College of Physicians and Surgeons database were categorized as an "unknown" speciality. The prescriber for prescriptions with misclassified prescriber designations were also set to "unknown."

Statistical analyses

Patients, prescribers, and prescriptions were classified descriptively overall and by year using medians and interquartile ranges (IQRs) for continuous variables and counts for categorical variables. Using age- and sex-specific reference population totals from the BC general population, prescription rates per 1000 were calculated for each study year. Data were stratified by prescriber group type. The total number of prescriptions per provider was calculated overall and for each of the three most common opioid groups prescribed within the prescriber speciality group.

Trends in the number of prescriptions issued over time by opioid group, both overall and within prescriber groups, were assessed

visually and via Poisson regression, including a cubic spline for calendar month from the start of the study period. All analyses were conducted using R statistical software.[30]

Data cleaning, editing, and analysis was conducted on a secure server in the Population Data BC Secure Research Environment. Analysis exports conformed to the rules and limitations set by Population Data BC and were restricted to counts greater than or equal to 5.

Results

Details on opioid prescriptions and patient cohorts are presented in the **Table**. Between 2013 and 2017, 15 693 867 opioid prescriptions were dispensed in BC. Ten prescriptions were excluded from analysis due to unidentified sex; 35 were excluded for ages greater than 113. Prescriptions from prescriber types that were not present in BC during the study period were excluded (n = 792). Daily MMEs and days supplied greater than twice the 99th percentile were excluded (n = 3923 and 23 375, respectively). Physicians' specialities that could not be identified were categorized as an "unknown" speciality (n = 229, accounting for 2 015 101 prescriptions). A further 111 996 prescriptions had misclassified prescriber designations; in these cases, the practitioner was also set to "unknown."

The 15 665 732 prescriptions included in the analysis (15 693 867 minus 28 135 excluded) were prescribed by 19 785 practitioners to 1 692 035 patients, yielding an average annual opioid prescription per capita rate of 124 per 1000 (median 50 years, 51% female) [Table]. The median daily MMEs increased from 32 in 2013 to 34 in 2017. Opioid prescription rates per capita declined by 1.6% across all prescriber groups over the 5 years. The top three opioid prescriber groups were general practitioners (42%), pharmacists (13%), and general dentists (13%) [Figure S1, Table S1]. The top 20% of prescribers were responsible for 86% of opioid prescriptions over the study period; the top 10% were responsible for 66% of prescriptions. Overall, four drugs collectively accounted for more than 75% of all prescriptions: codeine (35%), hydromorphone (18%), morphine (12%), and oxycodone (12%). The median number of days the drugs were prescribed was consistently 7 throughout 2013–2017 [Table]. However, the

TABLE. Cohort description and summary of opioid prescriptions, 2013–2017. Continuous data are displayed as a median interquartile range; categorical data are displayed as N (%) unless otherwise specified.

Population	2013	2017	Absolute change
British Columbia population	4 630 077	4 924 233	+6.3%
Total number with prescription	605 726 (13.1)	565 776 (11.5)	-1.6%
Sex			
Female	318 836 (52.6)	298 414 (52.3)	–
Male	286 890 (47.4)	267 362 (47.3)	–
Age	52 [37, 65]	54 [38, 68]	–
Prescribers			
Total number	13 340	14 786	+10.8%
Type			
Anesthesiology	130 (1.0)	96 (0.6)	-0.4%
Specialty dentistry	549 (4.1)	440 (3.0)	-1.1%
General dentistry	1920 (14.4)	2026 (13.7)	-0.7%
Diagnostics	110 (0.8)	61 (0.4)	-0.4%
General practice	5658 (42.4)	6819 (46.1)	+3.7%
Medicine	1127 (8.4)	960 (6.5)	-1.9%
Nurse practitioner	116 (0.9)	240 (1.6)	+0.7%
Other*	87 (0.7)	122 (0.8)	+0.1%
Pediatrics	120 (0.9)	85 (0.6)	-0.3%
Pharmacy	1232 (9.2)	1520 (10.3)	+1.1%
Physician: unknown specialty	942 (7.1)	1321 (8.9)	+1.8%
Psychiatry	313 (2.3)	224 (1.5)	-0.8%
Surgery	1036 (7.8)	872 (5.9)	-1.9%
Prescriptions			
Total number	3 010 634	3 223 935	
Prescriptions per 1000	650.2	654.7	+0.7
Opioid group			
Codeine	1 180 364 (39.2)	964 686 (29.9)	-9.3%
Hydromorphone	501 661 (16.7)	581 887 (18.0)	+1.3%
Morphine	395 902 (13.2)	309 830 (9.6)	-3.6%
Oxycodone	435 044 (14.5)	282 000 (8.7)	-5.8%
Buprenorphine	109 730 (3.6)	632 777 (19.6)	+16.0%
Tramadol/Tapentadol	270 460 (9.0)	330 004 (10.2)	+1.2%
Fentanyl	83 947 (2.8)	60 492 (1.9)	-0.9%
Methadone	15 197 (0.5)	52 843 (1.6)	+1.1%
Meperidine	13 901 (0.5)	6284 (0.2)	-0.3%
Opium	2420 (0.1)	2027 (0.1)	0.0%
Butorphanol	892 (0.0)	695 (0.0)	0.0%
Pentazocine	1113 (0.0)	410 (0.0)	0.0%
Dose prescribed			
Days prescribed	7 [4, 25]	7 [2, 15]	0 days
Prescriptions ≥ 3 days	2 542 684 (84.5)	2 316 653 (71.9)	-12.6%
Prescriptions ≥ 31 days	125 233 (4.2)	102 379 (3.2)	+1.0%
Oral MME† (per unit)	5.0 [4.5, 15.0]	7.5 [4.5, 30.0]	+2.50 MMEs
Oral MME (daily)	32.00 [18.00, 60.00]	33.75 [18.00, 90.00]	+1.75 MMEs
Oral MME (daily) ≥ 90	536 636 (17.9)	837 747 (26.0)	+8.1%
Oral MME (daily) ≥ 120	408 684 (13.6)	732 120 (22.7)	+9.1%

*Includes allied health professionals, optometrists, naturopathic physicians, midwives, and podiatrists
† MME = morphine milligram equivalent

number of prescriptions with a daily MME greater than 90 and 120 increased by 8% and 9% during the study period, respectively.

For both males and females, the annual rate of opioid prescriptions per capita decreased from 2013 to 2017 [Figure S2]. The per capita rate of prescriptions increased with increasing age for both sexes [Figure S2]. For males and slightly more for females, there was a substantial increase in weak opioid prescriptions between the ages of 10 and 19 years [Figure S2]. General dentists were responsible for 32% of prescriptions within this age range, compared to only 3% in the total study population. The opioid most commonly prescribed to patients between the ages of 10 and 19 years was codeine, with median daily MME of 34 and median of 4 days supplied. In patients between the ages of 80 and 89 years, the most commonly prescribed

opioid was hydromorphone, with a median daily MME of 24, and median of 7 days supplied.

Declines in the overall number of prescriptions issued were related primarily to reductions in prescriptions for codeine, oxycodone, and morphine [Figure, Table S2, Figure S3]. Conversely, the number of buprenorphine, tramadol/tapentadol, and methadone prescriptions increased during the study period. On a per prescriber basis, there was large variability in drug choice between practitioner types [Table S1]. Number of days supplied and daily MMEs also varied between prescribers and drugs, and were generally higher for oxycodone, morphine, and hydromorphone than for codeine and tramadol/tapentadol. Methadone, buprenorphine, and fentanyl made up 14% of all prescriptions and had the greatest MME and number of days supplied.

General practitioners were responsible for most total prescriptions (74%) [Table S1, Figure S1 and S4]. The most common opioids prescribed varied by practitioner type [Figure S5]. Codeine was one of the top three most commonly prescribed opioids among almost all practitioner types, with a median 26 (IQR 15–36) daily MME for a median 8 (IQR 5–25) days supplied. Tramadol/tapentadol was favored by surgical specialities, and represented 35% of their opioid prescriptions, with a median 22 (IQR 15–30) daily MME for a median 9 (IQR 5–28) days supplied. On average, psychiatrists prescribed the greatest MME per day, with a median daily MME of 64. Trends in prescribing patterns over the study period differed by practitioner type [Figure S1]. General practitioners had declining prescription rates (between -25% and -35%) for most of their favored opioid
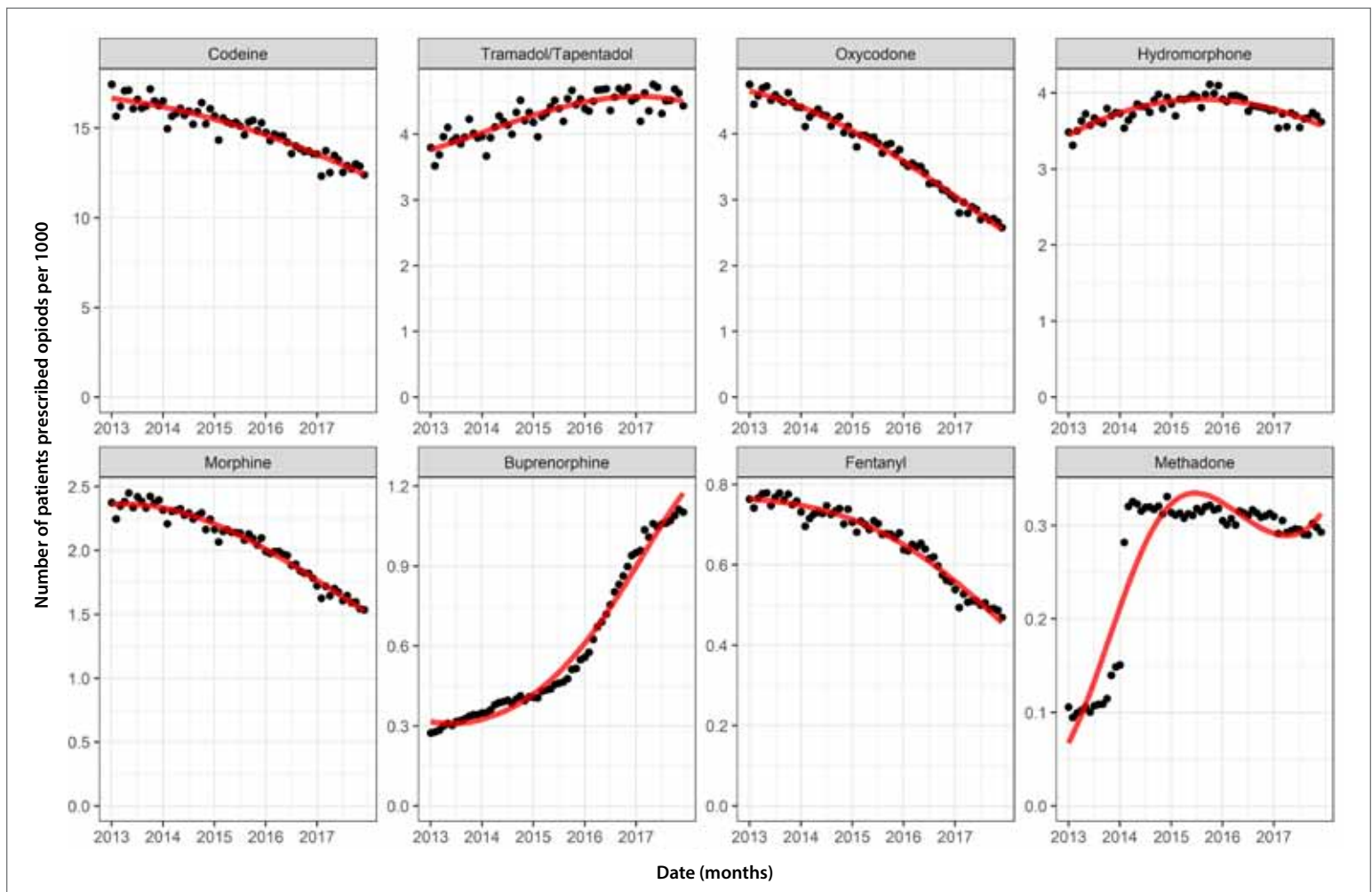

FIGURE. Change in opioid use for the eight most common opioid types, 2013–2017. Black dots represent raw data; red curves are the fitted values from a Poisson regression model with a cubic spline for date. Panes are organized from most to least common opioid group.

groups, while surgical groups had increasing use of tramadol/tapentadol (12%) and decreasing use of codeine (-12%) between 2013 and 2017 [Figure S1]. Psychiatry had a notable drop in buprenorphine prescriptions (-70%) between 2014 and 2017 [Figure S1]. Most other rates were consistent over time.

Supplementary data tables detailing prescribing patterns for all subspecialties and drugs prescribed are available online [Table S1 and S2, respectively].

Discussion

This review of all opioid prescriptions filled at community pharmacies in BC between 2013 and 2017 showed an overall reduction in opioid prescription rates across all prescriber groups by 1.6%. The overall prevalence rate of opioid prescriptions in BC in 2017 was 12%. General practitioners prescribed 74% of all community opioids. There was a marked reduction in prescription rates among psychiatrists. Opioid dispensing rates increased with patient age, with a marked upturn for weak opioid prescriptions between ages 10 and 19 years. Within this age range, general dentists were the predominant prescribers. The opioids prescribed varied by specialty and over the study time period. Codeine and oxycodone prescription rates decreased from 2013 to 2017 in all groups, with surgical specialties transitioning to tramadol/tapentadol. Prescriptions for harm reduction opioids such as methadone and buprenorphine increased.

These data are extremely important because opioid prescription patterns are known to be a risk factor for subsequent persistent opioid use in previously opioid-naive patients.[7] The overall prevalence of prescription opioids seems concerning. However, without comparison to other North American regions, it is undetermined whether this is a factor in BC's opioid crisis. The heterogeneity of prescriptions across prescriber groups may be a contributing factor to the unused opioid mass in the community, which is a potential risk factor for opioid misuse and diversion.

Reduced opioid prescription rates by psychiatrists may be secondary to a shift in practice patterns due to addiction medicine specialists assuming care of patients with opioid use

disorder in 2014. Pharmacists were the third largest group of opioid prescribers. Although they prescribed primarily codeine-containing medications, 10% of prescriptions were documented to be for hydromorphone. Pharmacists' responsibility for opioid prescriptions may be due to BC's provincial opioid prescription monitoring strategies in which pharmacists can be the recorded prescribers of opioids when providing emergency supplies and in certain rural communities for over-the-counter opioid-containing prescriptions.

> **The increase in dispensed opioids to teenage patients suggests the need for consistent assessment of indication and intensity of opioid prescriptions given the higher prevalence of opioid misuse in this population.**

The increased use of harm reduction opioids is consistent with the recognized efficacy of these drugs in treating opioid use disorder.[31] The reduced preference for codeine may be related to increased awareness of the pharmacogenetic variability of codeine metabolism following the 2012 Food and Drug Administration's black box warning regarding the use of codeine in children less than 12 years of age who were undergoing tonsillectomy.[32]

The marked increase in opioid prescriptions in patients between ages 10 and 19 years raises questions about the appropriateness of these prescriptions in this vulnerable population. Similar to our study, Volkow and colleagues found dentists to be predominant prescribers of opioids in patients between 10 and 19 years in the United States.[33] A study of BC dentists between 1997 and 2013 identified increasing codeine prescription rates, and reported that most dentists prescribed codeine for an

inappropriate duration of more than 3 days.[34] Furthermore, a survey of BC dentists and endodontists showed that they often prescribed opioids when not indicated.[35] The increase in dispensed opioids to teenage patients identified in our study suggests the need for consistent assessment of indication and intensity of opioid prescriptions given that there is an association between higher prevalence of prescription opioid misuse with greater medical use of prescription opioids in this population.[36]

Smolina and colleagues described determinants of opioid consumption trends in BC between 2005 and 2012, and found a 31% increase in opioid prescriptions in terms of MME.[37] In the US, Levy and colleagues found a 3.7% increase in opioid prescription rates from 2007 to 2012.[18] Our study employed different selection criteria and is, therefore, not directly comparable to the aforementioned studies. We found consistent decreases in opioid prescription rates per capita, with an overall 1.6% decrease between 2013 and 2017 but an 8% increase in prescriptions with daily MME greater than 90. There appears to be a significant change from a 31% increase over 7 years to a 1.6% decrease over the subsequent 5 years, which may be due to a combination of increased practitioner recognition of opioid-associated risks and pervasive prescription regulation. Opioid dispense rates in most Canadian provinces peaked between 2011 and 2016.[38]

Previous research has described opioid prescriptions by prescriber type.[18,39] Studies were limited to an examination of one surgical specialty or specific opioids such as buprenorphine or tramadol.[40-43] Wen and colleagues found an overall 2.2-fold increase in psychiatry buprenorphine prescriptions between 2006 and 2014 in the US, which contrasts with our 0.7-fold decrease.[40] This discrepancy may be due to the different study periods. Similar to the results of our study, tramadol dispensing rates increased in all Canadian provinces between 2007 and 2016, with the greatest increase leading up to 2009.[43] Unique to our study is the evaluation of variability in opioid prescription patterns of both prescriber groups and opioid types. These results demonstrate heterogeneity in both the drugs prescribed and daily MME of prescriptions.

The outcomes of our study are strengthened by the use of population-level data and the linkage of multiple data sources with complete descriptions of practitioner types. Our study is limited by the lack of inpatient opioid prescription data, unknown rates of illicit opioid consumption, and lack of prescription indications. Furthermore, our study examined dispensed opioids as a proxy for total prescriptions, which is further used as a proxy for opioid consumption. The data set also contained data inconsistencies such as obsolete prescriber groups, patient ages, and days supplied deemed improbable, as well as missing data. Physician specialty descriptions were also not available for 13% of prescriptions. This highlights the challenge of collecting, verifying, editing, and maintaining a large database, and implies the need to tighten guidelines for the collection and reporting of such data.

This retrospective population-based study describes the variation and temporal changes in opioid prescription patterns among prescribers in BC. Providers currently have limited access to data that describe prescribing patterns within their specialties; therefore, they may struggle to identify where their practice falls on this spectrum. Currently, practitioners in Alberta and Nova Scotia can request a peer comparison report as part of their province's opioid review program.[44,45] Since its implementation of a peer assessment program, Alberta has demonstrated reduced MME prescription rates per capita.[45] Permitting prescribers to compare their prescriptions with their peers in other jurisdictions has also demonstrated efficacy in reducing opioid prescription rates.[46,47]

Conclusion and future directions

This analysis of opioid prescriptions in BC between 2013 and 2017 demonstrated an overall 1.6% reduction in opioid prescription rates. Opioids were more frequently prescribed in older patients, but the greatest age-specific gradient was observed between children and young adults. Notably, there was heterogeneity in opioid type and prescription MME among prescriber groups. This data set is currently being analyzed to characterize and report on long-term opioid prescriptions. This review provides evidence to support the development of physician peer comparison reports in BC. However, this should be an aim for all provinces so that national and international comparisons can be made in speciality-specific prescription practices. ∎

Permitting prescribers to compare their prescriptions with their peers has demonstrated efficacy in reducing opioid prescription rates.

References
1. Miech R, Johnston L, O'Malley PM, et al. Prescription opioids in adolescence and future opioid misuse. Pediatrics 2015;136:e1169-1177.
2. Fitzgerald Jones K, Fu MR, Merlin JS, et al. Exploring factors associated with long-term opioid therapy in cancer survivors: An integrative review. J Pain Symptom Manage 2021;61:395-415.
3. Brummett CM, Waljee J, Goesling J, et al. New persistent opioid use after minor and major surgical procedures in US adults. JAMA Surg 2017;152:e170504.
4. Clarke H, Soneji N, Ko DT, et al. Rates and risk factors for prolonged opioid use after major surgery: Population based cohort study. BMJ 2014;348:g1251.
5. Deyo RA, Hallvik SE, Hildebran C, et al. Use of prescription opioids before and after an operation for chronic pain (lumbar fusion surgery). Pain 2018;159:1147-1154.
6. Shah A, Hayes CJ, Martin BC. Characteristics of initial prescription episodes and likelihood of long-term opioid use – United States, 2006-2015. MMWR Morb Mortal Wkly Rep 2017;66:265-269.
7. Deyo RA, Hallvik SE, Hildebran C, et al. Association between initial opioid prescribing patterns and subsequent long-term use among opioid-naïve patients: A statewide retrospective cohort study. J Gen Intern Med 2017;32:21-27.
8. Hill MV, McMahon ML, Stucke RS, Barth RJ. Wide variation and excessive dosage of opioid prescriptions for common general surgical procedures. Ann Surg 2017;265:709-714.
9. Hill MV, Stucke RS, Billmeier SE, et al. Guideline for discharge opioid prescriptions after inpatient general surgical procedures. J Am Coll Surg 2018;226:996-1003.
10. Lewis ET, Cucciare MA, Trafton JA. What do patients do with unused opioid medications? Clin J Pain 2014; 30:654-662.
11. Compton WM, Jones CM, Baldwin GT. Relationship between nonmedical prescription-opioid use and heroin use. N Engl J Med 2016;374:154-163.
12. Carlson RG, Nahhas RW, Martins SS, Daniulaityte R. Predictors of transition to heroin use among initially non-opioid dependent illicit pharmaceutical opioid users: A natural history study. Drug Alcohol Depend 2016;160:127-134.
13. Muhuri PK, Gfroerer JC, Davies MC. Associations of nonmedical pain reliever use and initiation of heroin use in the United States. 2013. Center for Behavioural Health Statistics and Quality Data Review. Accessed 17 July 2021. https://www.samhsa.gov/data/sites/default/files/DR006/DR006/nonmedical-pain-reliever -use-2013.htm.
14. International Narcotics Control Board. Narcotic drugs: Estimated world requirements for 2020 — statistics for 2018. Accessed 17 July 2021. https://www.incb .org/incb/en/narcotic-drugs/Technical_Reports/2019/ narcotic-drugs-technical-report-2019.html.
15. Province of British Columbia. How the Province is responding - Accessed 13 July 2020. www2.gov.bc.ca/gov/content/overdose/how-the-province-is-responding.
16. Busse JW, Craigie S, Juurlink DN, et al. Guideline for opioid therapy and chronic noncancer pain. CMAJ 2017; 189:E659-E666.
17. Government of Canada. Opioid- and stimulant-related harms in Canada. Accessed 19 May 2020. https:// health-infobase.canada.ca/substance-related-harms/ opioids-stimulants.
18. Levy B, Paulozzi L, Mack KA, Jones CM. Trends in opioid analgesic–prescribing rates by specialty, U.S., 2007–2012. Am J Prev Med 2015;49:409-413.
19. Ringwalt C, Gugelmann H, Garrettson M, et al. Differential prescribing of opioid analgesics according to physician specialty for Medicaid patients with chronic noncancer pain diagnoses. Pain Res Manag 2014;19:179-185.
20. Guy GP, Zhang K. Opioid prescribing by specialty and volume in the U.S. Am J Prev Med 2018;55:e153-e155.
21. Meckler GD, Sheridan DC, Charlesworth CJ, et al. Opioid prescribing practices for pediatric headache. J Pediatr 2019;204:240-244.e2.
22. Musich S, Wang SS, Slindee LB, et al. Concurrent use of opioids with other central nervous system-active medications among older adults. Popul Health Manag 2020;23:286-296.

23. World Health Organization. Anatomical therapeutic chemical (ATC) classification. Accessed 9 June 2020. https://www.who.int/tools/atc-ddd-toolkit/atc-classification.

24. BC Ministry of Health (2020): PharmaNet. V2. BC Ministry of Health. Data Extract. Data Stewardship Committee (2020). www.popdata.bc.ca/data.

25. Health Canada. Drug product database online query. 2012. Accessed 9 June 2020. https://health-products.canada.ca/dpd-bdpp/index-eng.jsp.

26. Centers for Disease Control and Prevention, Injury Center. Data resources. Drug overdose. 2019. Accessed 20 May 2020. www.cdc.gov/drugoverdose/resources/data.html.

27. O'Connor J, Christie R, Harris E, et al. Tramadol and tapentadol: Clinical and pharmacologic review. 2019. World Federation of Societies of Anaesthesiologists. Accessed 17 July 2021. https://resources.wfsahq.org/atotw/tramadol-and-tapentadol-clinical-and-pharmacologic-review.

28. British Columbia Ministry of Health (2020). Medical Service Plan (MSP) practitioner file. Population Data BC. Data extract. The College of Physicians and Surgeons of British Columbia (2020). www.popdata.bc.ca/data.

29. Government of BC. Population estimates—province of British Columbia. Accessed 20 May 2020. www2.gov.bc.ca/gov/content/data/statistics/people-population-community/population/population-estimates.

30. R: The R project for statistical computing. Version 3.5.3. Vienna, Austria: R Foundation for Statistical Computing. Accessed 9 June 2020. www.r-project.org.

31. Connock M, Juarez-Garcia A, Jowett S, et al. Methadone and buprenorphine for the management of opioid dependence: A systematic review and economic evaluation. Health Technol Assess 2007;11:1-171, iii-iv.

32. U.S. Food and Drug Safety Administration. Safety review update of codeine use in children; new Boxed Warning and Contraindication on use after tonsillectomy and/or adenoidectomy. 2020. Accessed 9 June 2020. www.fda.gov/media/85072/download.

33. Volkow ND, McLellan TA, Cotto JH, et al. Characteristics of opioid prescriptions in 2009. JAMA 2011;305:1299-1301.

34. Etminan M, Nouri MR, Sodhi M, Carleton BC. Dentists' prescribing of analgesics for children in British Columbia, Canada. J Can Dent Assoc 2017;83:h5.

35. Buttar R, Aleksejūnienė J, Shen Y, Coil J. Antibiotic and opioid analgesic prescribing patterns of dentists in Vancouver and endodontic specialists in British Columbia. J Can Dent Assoc 2017;8.

36. McCabe SE, Schulenberg J, McCabe VV, Veliz PT. Medical use and misuse of prescription opioids in US 12th-grade youth: School-level correlates. Pediatrics 2020;146:e20200387.

37. Smolina K, Gladstone E, Morgan SG. Determinants of trends in prescription opioid use in British Columbia, Canada, 2005-2013. Pharmacoepidemiol Drug Saf 2016;25:553-559.

38. Jones W, Vojtila L, Kurdyak P, Fischer B. Prescription opioid dispensing in Canada: An update on recent developments to 2018. J Pharm Policy Pract 2020;13:68.

39. Axeen S. Trends in opioid use and prescribing in Medicare, 2006–2012. Health Serv Res 2018;53:3309-3328.

40. Wen H, Borders TF, Cummings JR. Trends in buprenorphine prescribing by physician specialty. Health Aff (Millwood) 2019;38:24-28.

41. Boddapati V, Padaki AS, Lehman RA, et al. Opioid prescriptions by orthopaedic surgeons in a Medicare population: Recent trends, potential complications, and characteristics of high prescribers. J Am Acad Orthop Surg 2021;29:e232-e237.

42. Feng H, Kakpovbia E, Petriceks AP, et al. Characteristics of opioid prescriptions by Mohs surgeons in the Medicare population. Dermatol Surg 2020;46:335-340.

43. Fischer B, Kurdyak P, Jones W. Tramadol dispensing patterns and trends in Canada, 2007-2016. Pharmacoepidemiol Drug Saf 2019;28:396-400.

44. Furlan AD, MacDougall P, Pellerin D, et al. Overview of four prescription monitoring/review programs in Canada. Pain Res Manag 2014;19:102-106.

45. College of Physicians & Surgeons of Alberta. Physician prescribing practices. Accessed 17 July 2021. https://cpsa.ca/physicians-competence/physician-prescribing-practices.

46. Suffoletto B, Landau A. Nudging emergency care providers to reduce opioid prescribing using peer norm comparison feedback: A pilot randomized trial. Pain Med 2020;21:1393-1399.

47. Andereck JW, Reuter QR, Allen KC, et al. A quality improvement initiative featuring peer-comparison prescribing feedback reduces emergency department opioid prescribing. Jt Comm J Qual Patient Saf 2019;45:669-679.