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Special Issue: The Opioid Crisis in Canada – Enhancing Knowledge to Support Action, Part I

Guest Editor: Fiona Kouyoumdjian

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Commentary

Building the evidence base for sustained public health response to the opioid epidemic in Canada

Theresa Tam, BMBS, FRCPC

Over the past two years, the epidemic of opioid-related overdoses has been the most significant public health crisis, demanding a collective response from all levels of government working with front-line responders and other partners. Tragically, over 4000 apparent opioid-related deaths are projected for 2017, surpassing the almost 3000 deaths reported in Canada in 2016. Canadians from all socioeconomic groups and urban as well as suburban and rural communities across the country are affected.[1] While western Canada has been hardest hit to date, our most recent data show the trend is increasing in other parts of the country. Turning the tide of this complex public health crisis is a priority for public health authorities at all levels of government. A strong evidence base is critical for guiding our efforts toward urgent and targeted interventions to prevent overdose deaths and address the underlying causes of problematic substance use.

The Public Health Agency of Canada (PHAC) plays an integral role in the Government of Canada's coordinated response to the opioid crisis, which is led by Health Canada's Opioid Response Team. Federal action on opioids takes a collaborative approach through targeted public health emergency response activities across four pillars: prevention, treatment, harm reduction and enforcement. Underlying all four pillars is the need for a strong evidence base to better identify trends, support decisionmaking, target interventions and monitor impacts. PHAC is currently providing leadership on two targeted epidemiological studies as well as strengthening and expanding surveillance activities for opioid-related harms in order to further our understanding of the circumstances surrounding overdose deaths across Canada. These initiatives will fill gaps in our knowledge about the risk factors and causes of opioid-related overdose fatalities, helping us inform policy decisions and develop and better target interventions. PHAC is also providing technical support to the provinces and territories by placing Public Health Officers within provincial and territorial jurisdictions to support data collection efforts and improve surveillance infrastructure. Looking ahead, PHAC aims to work with First Nations, Inuit and Métis partners to develop surveillance strategies that can address crucial gaps in our understanding of the impact of this crisis on Indigenous Canadians.

I am acutely aware that no department or government can effectively address this epidemic on its own. Intergovernmental and cross-sectoral collaboration are critical. PHAC works closely with provincial and territorial health authorities through the Special Advisory Committee on the Epidemic of Opioid Overdoses, which I co-chair with Dr. Robert Strang, Chief Medical Officer of Health of Nova Scotia. Since its creation in December 2016, the Special Advisory Committee has enabled collaboration and information sharing between jurisdictions to better support harm reduction, improved surveillance and the development of prevention and treatment strategies.

This special issue of *Health Promotion and Chronic Disease Prevention in Canada: Research, Policy and Practice* is dedicated to the opioid crisis. Through this publication we seek to advance our collective understanding of this epidemic in Canada, including examining available data to quantify the burden to society; describe the distribution of harms, population risk factors and trends over time; explore the context and circumstances from which the crisis has arisen; and consider promising avenues for further investigation.

Two of the articles that appear in this issue, by authors Ye et al.[2] and Orpana et al.,[3] estimate the burden associated with opioid harms. The article by Ye et al.[2] examines the contribution of drug overdose deaths to life expectancy in British Columbia. These authors estimate that during the period 2014–2016, life expectancy at birth decreased by 0.38 years and that one-third of this decline was attributable to fatal overdoses (mainly opioids). Orpana et al.[3] address opioid-related morbidity and mortality, estimating that between 1990 and 2014 the age-standardized rate of opioid-related years of life lost (YLL) increased by more than 142% in Canada while decreasing globally by 10%.

Also in this issue, O'Connor et al.[4] examine national and provincial trends in hospitalizations due to opioid poisonings. These authors estimate that such hospitalizations increased by more than 50% in Canada during the 10-year period from 2007–2008 to 2016–2017. They also found that during the period from 2012–2013 to 2016–2017 the age-adjusted rate of emergency department visits due to opioid poisonings increased by more than 100% in Alberta and by nearly 50% in Ontario.

In their articles, Belzak and Halverson[5] and Bozat-Emre et al.[6] consider risk factors and sociodemographic characteristics associated with opioid-related harms. Belzak and Halverson[5] provide a national

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overview of what is currently known about the epidemic and touch on potential risk factors and observed variations with respect to age, sex and ethnicity. Bozat-Emre et al.[6] use data from the Government of Manitoba's Take-Home Naloxone program to identify sociodemographic characteristics associated with the Program's users.

Guan et al.[7] look at the issue of opioid prescriptions and estimate the impact of the 2016 delisting of high-strength opioids from Ontario's public drug formulary on physician prescribing patterns.

Finally, Tibebu et al.[8] explore how social media data may assist us in understanding public perceptions and opinion regarding opioid use and government response.

The research findings compiled in these articles contribute to our goal of building a strong evidence base to guide planning and decision making for more precise public health action.

A second special issue of the journal dedicated to opioids will be released in September 2018. This forthcoming issue will examine risk factors in the British Columbia Provincial Overdose Cohort; explore the role of opioids in suicide deaths in Alberta and opioid-related poisonings in young people; and describe the impact of changes to opioid-prescribing policy in Nova Scotia and a strategic approach to addressing the crisis in Ontario.

As a public health community, it is critical that we continue to raise awareness of the risks associated with problematic opioid use, underscoring that this crisis continues to affect Canadians of all ages, from all backgrounds. To this end, reducing the stigma associated with problematic substance use is also of vital importance as stigma presents a serious challenge to harm reduction efforts, even where interventions are well designed. Engagement of Canadians who have lived and living experience of opioid substance use disorder, including young people and Indigenous Canadians, is a priority.

First-hand knowledge can provide valuable insights for decisionmakers, researchers, physicians and public health practitioners alike. Continued collaborative action will be the key to reversing the current trajectory of the epidemic. By continuing to work across disciplines, sectors of society and all levels of government, we will be best placed to develop effective long-term solutions to prevent further tragic loss of life and to protect the health of Canadians.

I would like to take this opportunity to acknowledge the many individuals and organizations involved in responding to this crisis; I applaud and encourage your continued efforts to reduce mortality and prevent the serious harms associated with opioid substance use disorder across the country. I am confident that these articles will greatly contribute to the growing knowledge base needed to guide and support our collective efforts.

Dr. Theresa Tam
Chief Public Health Officer of Canada

References

1. Special Advisory Committee on the Epidemic of Opioid Overdoses. National report: apparent opioid-related deaths in Canada (January 2016 to June 2017) [Internet]. Ottawa (ON): Public Health Agency of Canada; 2017. Available from: https://www.canada.ca/en/public-health/services/publications/healthy-living/apparent-opioid-related-deaths-report-2016-2017-december.html

2. Ye X, Sutherland J, Henry B, et al. At-a-glance – Impact of drug overdose-related deaths on life expectancy at birth in British Columbia. Health Promot Chronic Dis Prev Can. 2018; 38(6):248-51.

3. Orpana HM, Lang JL, Baxi M, et al. Canadian trends in opioid-related mortality and disability from opioid use disorder from 1990 to 2014 through the lens of the Global Burden of Disease Study. Health Promot Chronic Dis Prev Can. 2018;38(6):234-43.

4. O'Connor S, Grywacheski V, Louie K. At-a-glance – Hospitalizations and emergency department visits due to opioid poisoning in Canada. Health Promot Chronic Dis Prev Can. 2018;38(6): 244-7.

5. Belzak L, Halverson J. The opioid crisis in Canada: a national perspective. Health Promot Chronic Dis Prev Can. 2018;38(6):224-33.

6. Bozat-Emre S, Marshall SG, Zhong C, et al. At-a-glance – Lessons learned from launching the Manitoba Take-Home Naloxone Program. Health Promot Chronic Dis Prev Can. 2018; 38(6):252-5.

7. Guan Q, Khuu W, Martins D, et al. Evaluating the early impacts of delisting high-strength opioids on patterns of prescribing in Ontario. Health Promot Chronic Dis Prev Can. 2018; 38(6):256-62.

8. Tibebu S, Chang VC, Drouin CA, et al. At-a-glance – What can social media tell us about the opioid crisis in Canada? Health Promot Chronic Dis Prev Can. 2018;38(6):263-7.

https://doi.org/10.24095/hpcdp.38.6.note

General note about the special issue

Data presented on government and institutional websites may differ from the data appearing in this issue due to the dynamic nature of this crisis and the data reported, as well as differences in measurement definitions used.

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Evidence synthesis

The opioid crisis in Canada: a national perspective

Lisa Belzak, MHSc; Jessica Halverson, MPH, MSW

This article has been peer reviewed.

Abstract

Introduction: This review provides a national summary of what is currently known about the Canadian opioid crisis with respect to opioid-related deaths and harms and potential risk factors as of December 2017.

Methods: We reviewed all public-facing opioid-related surveillance or epidemiological reports published by provincial and territorial ministries of health and chief coroners' or medical examiners' offices. In addition, we reviewed publications from federal partners and reports and articles published prior to December 2017. We synthesized the evidence by comparing provincial and territorial opioid-related mortality and morbidity rates with the national rates to look for regional trends.

Results: The opioid crisis has affected every region of the country, although some jurisdictions have been impacted more than others. As of 2016, apparent opioid-related deaths and hospitalization rates were highest in the western provinces of British Columbia and Alberta and in both Yukon and the Northwest Territories. Nationally, most apparent opioid-related deaths occurred among males; individuals between 30 and 39 years of age accounted for the greatest proportion. Current evidence suggests regional age and sex differences with respect to health outcomes, especially when synthetic opioids are involved. However, differences between data collection methods and reporting requirements may impact the interpretation and comparability of reported data.

Conclusion: This report identifies gaps in evidence and areas for further investigation to improve our understanding of the national opioid crisis. The Public Health Agency of Canada will continue to work closely with the provinces, territories and national partners to further refine and standardize national data collection, conduct special studies and expand information-sharing to improve the evidence needed to inform public health action and prevent opioid-related deaths and harms.

Keywords: *opioid, overdose, crisis, harms, deaths, fentanyl, Canada*

Highlights

- The opioid crisis is growing in Canada, driven by both illegal and prescription opioid use. Fentanyl and analogues appear to be fuelling the rise in opioid-related deaths.
- This crisis is having a devastating impact on the health and lives of Canadians, their families and communities across the country. In 2016 alone, there were 2861 opioid-related deaths and 16 opioid-related hospitalizations each day.
- While the opioid crisis has affected every region of the country, western Canada (British Columbia and Alberta) and the northern territories (Yukon and Northwest Territories) have experienced the highest burden.
- Nationally, most apparent opioid-related deaths occurred among males (74%); individuals between 30 and 39 years of age accounted for the greatest proportion (28%).
- Evidence reveals that this crisis is not restricted to opioids; 82% of apparent opioid-related deaths from January 2016 to June 2017 also involved one or more non-opioid substances.

Introduction

The opioid crisis is growing in Canada, driven by both illegal and prescription opioids. In 2016, there were 2861 apparent opioid-related deaths* in Canada, which is equivalent to eight people dying each day,[1] and is greater than the average number of Canadians killed daily in motor vehicle collisions in 2015.[2] However, this statistic represents just the tip of the iceberg; on average, 16 Canadians were hospitalized each day due to opioid-related poisonings in Canada in 2016.[3] This is not a problem restricted to persons who use illegal or street drugs; rather, this is a national public health crisis that affects people in communities across Canada, across all ages and across all socioeconomic groups.

Methods

The purpose of this review was to provide a summary of the existing body of evidence on the Canadian opioid crisis, based on available data, to assist with identifying trends and gaps in knowledge and to provide policy makers with a national perspective. In order to better

* An apparent opioid-related death (AORD) is "a death caused by intoxication/toxicity (poisoning) as a result of drug use, where one or more of the drugs involved is an opioid."[1]

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understand the crisis and its impact on Canadians across the country, we reviewed all public-facing, opioid-related surveillance and epidemiological reports published by provincial and territorial ministries of health and chief coroners' and medical examiners' offices. In addition, we reviewed available reports and published articles from federal partners and external organizations mentioning opioid-related harms, opioids, opiates, fentanyl, fentanyl analogues or synthetic opioids published or shared prior to December 2017. We synthesized the data by comparing provincial and territorial historical opioid-related mortality and morbidity trends (where available), and by comparing current provincial and territorial rates with the national rates to identify regional trends and differences. Information collected through bilateral discussions with the provinces and territories on opioid-related health outcomes and data from Health Canada on prescribing practices and analysis of seized drug shipments were included to provide the context for the national synthesis.

At the time of this review, all provinces and territories were reporting opioid-related mortality data to the Public Health Agency of Canada (PHAC) through the Opioid Overdose Surveillance Task Group (OOSTG). The OOSTG includes federal, provincial and territorial (FPT) partners, as well as other national partners. The OOSTG is responsible for coordinating national surveillance of opioid-related harms, including the development of national case definitions (such as "apparent opioid-related deaths").

Individually, six provinces had reported historical data on opioid-related mortality. Eight provinces had published reports on the opioid crisis, with all reporting on mortality; four reported data from emergency medical services (EMS) or first responders; and four reported data on community-based naloxone distribution programs. Three of the provinces included analysis of potential risk factors in their published reports. The information from these reports forms the basis of this synthesis.

Results

Prescription opioids: use, supply and access

The current opioid epidemic follows on the enormous growth in use of prescription opioids in Canada in recent decades. Since the early 1980s, the volume of opioids sold to hospitals and pharmacies for prescriptions in Canada has increased by more than 3000%.[4] In 2016, over 20 million prescriptions for opioids were dispensed,[5] which is equivalent to nearly one prescription for every adult over the age of 18 years, making Canada the second-largest consumer of prescription opioids in the world, after the USA.[6]

In Canada, prescription opioid–related harms and rates of nonmedical prescription opioid use ("misuse") have been increasing since 1999.[6] According to estimates, by 2008 nonmedical prescription opioid use was the fourth most prevalent form of substance use (after alcohol, tobacco and cannabis), making it more common to misuse a prescription opioid than to use heroin or cocaine.[7]

The prevalence of prescription opioid use in Canada ("within the previous 12 months") is estimated to be one in six (from the 2015 Canadian Tobacco, Alcohol and Drugs Survey [CTADS]).[8] While the CTADS found just 2% of those who used a prescription opioid reported misusing them, a more recent online survey from Health Canada (2017) found that nearly one-third of those who had used an opioid in the past year did not always have a prescription. This proportion increased to almost half in teens younger than 18 years and 88% among persons using illegal drugs.[9]

There are many routes that allow for prescription opioids to be diverted for nonmedical use, including sharing with family members, "double doctoring," prescription fraud and forgery, street drug markets, thefts and robberies and Internet purchases, making it difficult to estimate the proportion diverted.[7] Through its surveys, Health Canada found that the most common source of opioids used without a prescription was a family member.[9]

No national measures of prevalence of illegal opioid use were found. Nationally, in 2015 the prevalence of illicit drug use ("within the previous 12 months") was 2% (1% females; 3% males). This included use of crack, cocaine, ecstasy, speed or methamphetamines, hallucinogens or heroin and therefore was not specific to opioids.[8]

The rising presence of fentanyl and other synthetic opioids: evidence from illegal drug seizures and death investigations

In 2016, opioids were among the top 10 controlled substances most frequently detected by Health Canada's Drug Analysis Service (DAS), ranking just below marijuana, cocaine and methamphetamines among all samples tested from substances confiscated by police and border security from across the country. Heroin, fentanyl and its analogues, hydromorphone, oxycodone and morphine were the most frequently detected opioids in samples analyzed by DAS.[10]

Synthetic opioids such as fentanyl, W-18 and U-47700, to name but a few, are extremely potent. Fentanyl and its analogues (e.g. carfentanil, furanylfentanyl, acetylfentanyl) are becoming more prevalent on the illegal drug market and are increasingly combined with other controlled substances, which increases their potential toxicity and the risk of an overdose. In 2017, Health Canada found fentanyl or an analogue in more than 50% of heroin samples tested by DAS (tested between January 2012 and September 2017), and has also started to detect it in samples of methamphetamines and cocaine (2% each).[11] A review of available literature found that fentanyl was first reported in British Columbia and Alberta in 2011.[12,13] Since then, the proportion of deaths involving fentanyl in these provinces has risen dramatically.[12,13]

The pattern of apparent opioid-related deaths is changing along with the increasing presence of synthetic opioids in the illegal market. Fentanyl has now been detected in the illegal drug supply in all Canadian jurisdictions.[10,14] Nationally, the proportion of reported apparent opioid-related deaths involving fentanyl or an analogue was 53% in 2016[1] and appears to be on the rise, according to preliminary reports for 2017.

In British Columbia, fentanyl was involved in 68%[1] of the 985 illicit drug deaths[†] in 2016, up from 4% in 2012.[12,15] During the first half of 2017, the proportion of deaths involving fentanyl or an analogue in the province rose to 83%.[1] In contrast, the number of illicit drug overdose deaths not

[†] British Columbia reports on all illicit drug overdoses and deaths, including but not limited to opioids, and includes "street drugs" (both controlled and illegal drugs); "medications not prescribed to the decedent but obtained/purchased on the street, from unknown means or where the origin of the drug [was] not known"; and combinations of the previous two with prescribed medications.[15,p.1]

involving fentanyl has remained relatively stable, at 300 per year[15] (Figure 1).

In Alberta, there were 611 apparent opioid-related deaths in 2016.[1,16] From 2014 to 2016, the proportion of deaths involving fentanyl or an analogue increased from 26% to 63%,[16] while deaths due to other opioids remained constant and non-opioid-related overdose deaths declined by almost 200%.[16] This trend continued during the first six months of 2017 in Alberta, with the proportion of opioid-related overdose deaths involving fentanyl or an analogue rising to almost 80%.[1,16]

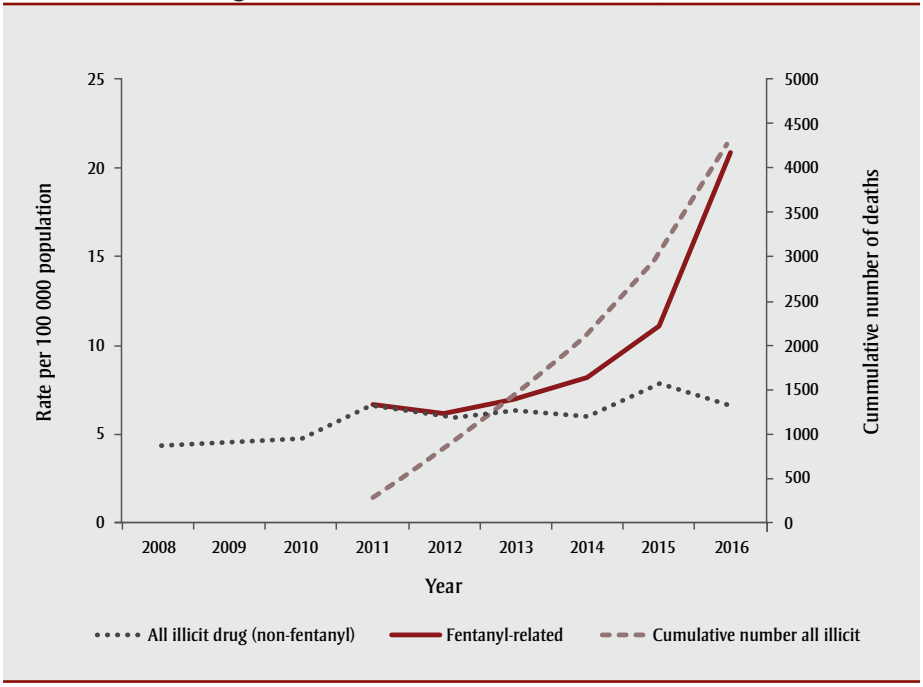
Ontario has also reported a rising proportion of fentanyl-related deaths.[1,17] In 2016, there were 867 apparent opioid-related deaths. From 2012 to 2016, the proportion of deaths involving fentanyl increased from 26% to 41%[17] (Figure 2).

Carfentanil, which is 100 times more powerful than fentanyl, presents another growing concern and has been detected in British Columbia,[15,18] Alberta,[16] Manitoba[19] and Ontario.[17] In 2016/17, DAS tested 91 seized samples of carfentanil: 56% from British Columbia, 17% from Alberta, 19% from Manitoba and 7% from Ontario.[20] In Alberta, there were 29 deaths in 2016 involving carfentanil, and in the first six months of 2017 there were at least 89 deaths.[16]

Health outcomes: apparent opioid-related deaths

By 2016, apparent opioid-related death rates revealed a national public health crisis. The opioid epidemic had affected communities across the country (Figure 3). Nationally, the rate of apparent opioid-related deaths was 7.9 per 100 000 population in 2016.[1] However, there were pronounced regional differences, with western provinces reporting some of the highest death rates: British Columbia reported a rate of 20.7 per 100 000 population (985 illicit drug overdose deaths) and Alberta reported a rate of 14.4 per 100 000 population (611 opioid-related overdose deaths). Based on available data, these two provinces alone accounted for the majority (56%) of opioid-related deaths in 2016.[1] Yukon and the Northwest Territories also reported high rates of 18.4 and 11.2 per 100 000 population, respectively.[1] Rates for apparent opioid-related deaths were relatively lower in the other jurisdictions, but suggest a possible rise in some provinces, including Ontario.[1,17,19,21,22]

FIGURE 1
Illicit drug overdose death rates in British Columbia, 2008–2016



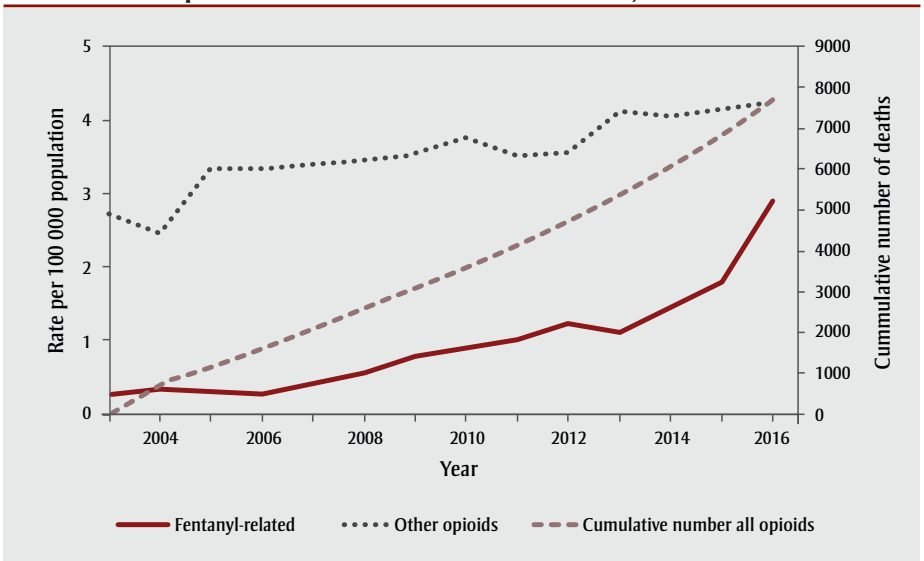
Source: Adapted with permission from British Columbia Coroners Service. Illicit drug overdose deaths in BC, January 1, 2008 – February 28, 2018. Burnaby (BC): Ministry of Public Safety and Solicitor General; 2017 [cited 2017 Sep]. Available from: https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/death-investigation/statistical/illicit-drug.pdf.

Notes: Groupings may not be mutually exclusive (other illicit drugs may be involved with fentanyl-related deaths). These data represent suspected illicit drug overdose cases only and are subject to change.

Age and sex

In 2016, the highest percentage (28%) of apparent opioid-related deaths in Canada occurred among individuals between the ages of 30 and 39.[1] Though age at death does not appear to vary greatly across jurisdictions, age may be a factor when the type of opioid is considered. In Alberta, when fentanyl and its analogues were involved, younger men represented

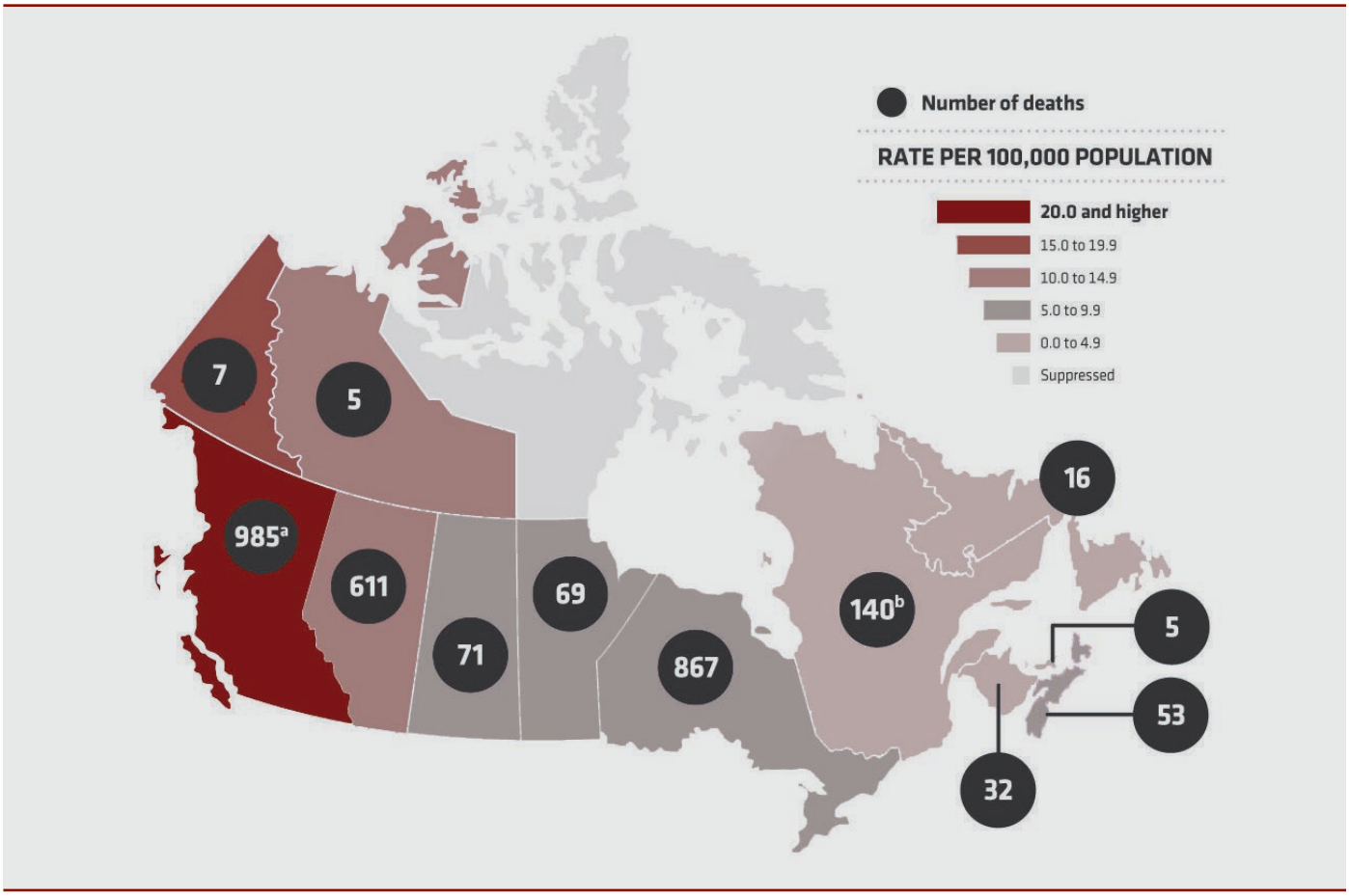
FIGURE 2
Opioid-related overdose death rates in Ontario, 2003–2016



Data source: Public Health Ontario. Interactive Opioid Tool. Toronto (ON): Queen's Printer for Ontario; 2018 [cited 2017 Dec]. Available from: www.publichealthontario.ca/en/DataAndAnalytics/Pages/Opioid.aspx

Note: Groupings may not be mutually exclusive (other opioids may be involved with fentanyl-related deaths).

FIGURE 3
Apparent opioid-related death rates (per 100 000 population) by province or territory, Canada, 2016



Source: Reprinted with permission from Government of Canada. National report: apparent opioid-related deaths in Canada (December 2017), Figure 1. Ottawa (ON): Government of Canada; 2017 [modified 2017 Dec 18]. Available from: https://www.canada.ca/en/public-health/services/publications/healthy-living/apparent-opioid-related-deaths-report-2016-2017-december.html

[a] British Columbia reports unintentional deaths related to all illicit drugs including, but not limited to, opioids.

[b] Expected to rise.

more deaths (mean age: 38 years) as compared to deaths involving other opioids (mean age: 42 years).[16]

From January 2016 to June 2017, most apparent opioid-related deaths in the nation occurred among males (74%). However, information collected from the provinces and territories indicates that the sex of individuals dying from an apparent opioid-related overdose may vary by region. In the western jurisdictions of British Columbia, Alberta, Yukon and the Northwest Territories, more men are dying than women (approximately 4:1); in Ontario, men are also more likely to die than women (2:1). However, in some Prairie and eastern provinces (Saskatchewan, Manitoba, New Brunswick, Nova Scotia and Newfoundland and Labrador), women represent nearly as many opioid-related deaths as do men (1:1 to 3:2)[1] (Figure 4).

In some jurisdictions there appear to be other important variations by age and sex. In Alberta and Ontario, where data segregated by age and sex were presented, older women (aged 44 years and older) represented more deaths from an opioid-related overdose than their younger male counterparts.[16,17] This pattern was also reflected in recent studies of registered First Nations in British Columbia and Alberta, where First Nations women dying of an opioid-related overdose were on average 15 to 20 years older than their male counterparts.[23,24]

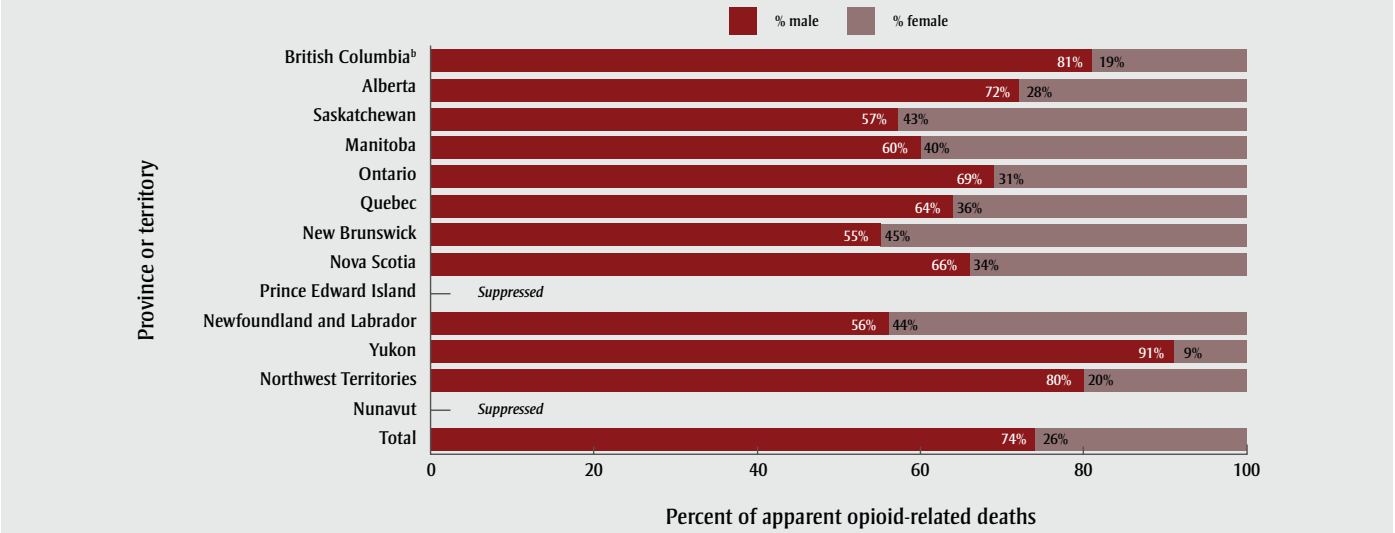
These differences in death rates may reflect some jurisdictional differences in the death investigation process, death classification method, toxicology testing or type of data reported (e.g. the inclusion or exclusion of suicide deaths) and thus caution should be used when interpreting these numbers.

Risk factors for apparent opioid-related deaths

Several reports published by the provinces also looked at risk factors. The reports we reviewed from British Columbia, Alberta and Manitoba showed that the majority of opioid-related overdose deaths occurred indoors, in private residences, in larger urban centres, though many deaths also occurred on the periphery of these urban centres and in a large number of smaller communities as well.[15,16,18,19] In Alberta and Ontario, those who died tended to reside in lower- to middle-income neighbourhoods; however, deaths occurred in neighbourhoods across all socioeconomic groups.[16,25]

Combined use of opioids with non-opioid substances, such as alcohol, benzodiazepines, cocaine and W-18, to name a few, may also be a risk factor. According to available data, approximately 82% of

FIGURE 4
Sex distribution of apparent opioid-related deaths by province or territory, Canada, January 2016 to June 2017[a]



Source: Reprinted with permission from Government of Canada. National report: apparent opioid-related deaths in Canada (December 2017), Figure 2. Ottawa (ON): Government of Canada; 2017 [modified 2017 Dec 18; [cited 2017 Dec]. Available from: https://www.canada.ca/en/public-health/services/publications/healthy-living/apparent-opioid-related-deaths-report-2016-2017-december.html

Note: "Suppressed" indicates that data were suppressed in provinces or territories with low numbers of cases.

[a] Not all provinces and territories were able to report data for the full time period (January 2016 to June 2017). This figure includes 2016 data only for Quebec, 2016 data and 2017 data limited to May to June only for Ontario, and data from January 2016 to March 2017 only for Manitoba and Newfoundland and Labrador. Saskatchewan, Quebec and Prince Edward Island report closed cases only.

[b] British Columbia reports unintentional deaths related to all illicit drugs including, but not limited to, opioids.

apparent opioid-related deaths from January 2016 to June 2017 also involved one or more non-opioid substances.[1]

Previous access to certain prescribed medications was also analyzed by three provinces. In Manitoba, a chart review performed by the Office of the Chief Medical Examiner found the most frequently prescribed medications, six months prior to an apparent opioid-related death, were an opioid (60%), an antidepressant (52%) and a benzodiazepine (47%).[19]

The Alberta report also found differences in the proportions of deaths from an opioid-related overdose involving an opioid other than fentanyl, and deaths in which fentanyl was involved. Specifically, individuals who died of an opioid-related overdose involving an opioid other than fentanyl were nearly twice as likely to have accessed a (listed) health care service (77% vs. 41%),[16] or to have been dispensed an opioid (66% vs. 23%) or antidepressant (38% vs. 14%) from a community pharmacy in the 30 days prior to their death (Figure 5). This suggests that there may be differences in the risk factors for opioid-related deaths when fentanyl is involved and those involving other opioids.

Special populations

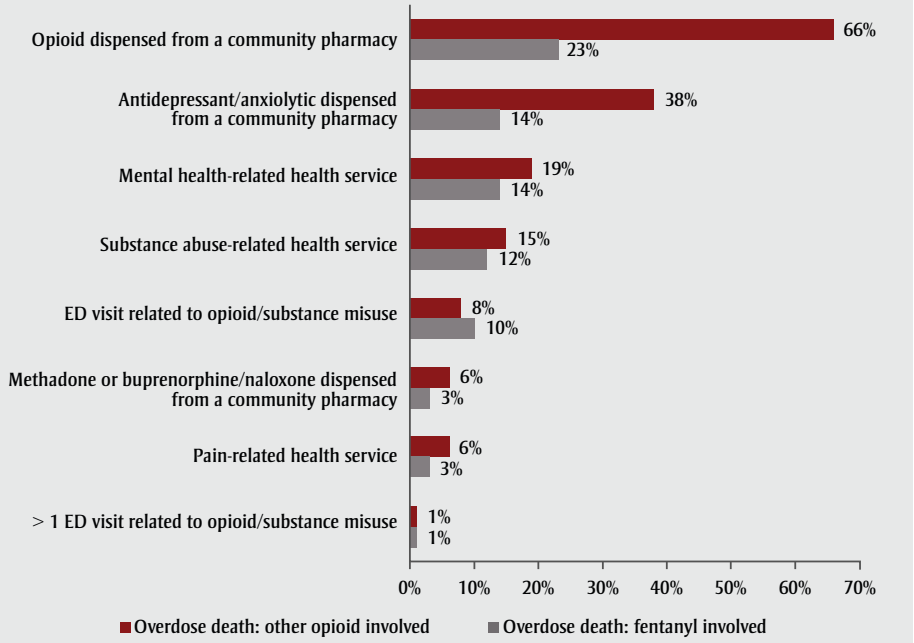
First Nations[‡] populations across the country are heavily impacted by high rates of problematic substance use.[26] As early as 2014, First Nations communities were raising the alarm about the number of opioid-related overdose deaths on reserves in southern Alberta.[27] The provinces of British Columbia and Alberta published reports highlighting the impact of the opioid crisis on First Nations communities from January 2016 to March 2017. Both reported similar findings: First Nations people were five times more likely than their non–First Nations counterparts to experience an opioid-related overdose event and three times more likely to die from an opioid-related overdose.[23,24] In Alberta, fentanyl was involved in 18% more opioid-related deaths among First Nations people than non–First Nations.[23] No distinction for type of opioid involved was available from the British Columbia report.

In both provinces, First Nations men and women were almost equally likely to experience an opioid-related overdose event.[23,24] In Alberta, First Nations men and women were also equally likely to die from an opioid-related overdose, while in British Columbia, First Nations males were more likely to die than females (5:3) from an opioid-related overdose. In both provinces, First Nations women were more likely to die than non–First Nations women, who represented less than 30% of non–First Nations deaths.[1] In both British Columbia and Alberta, older First Nations women (aged 50 to 54 years) represented a higher proportion of all opioid-related deaths in both provinces, whereas First Nations men were younger (30 to 34 years),[23,24] which is in keeping with apparent opioid-related death rates for men in the general Canadian population.[1]

Alberta's report also examined hospitalizations and emergency department (ED) visits. In Alberta, First Nations individuals were five times more likely than non–First Nations people to be hospitalized and six times more likely to present at an ED for an opioid poisoning. First Nations people were also twice as likely to be dispensed an opioid as non–First Nations individuals, and tended to be at least five years

[‡] The reports cited in this section for First Nations populations concerned individuals self-identifying as First Nations and did not include data on Métis or Inuit.

FIGURE 5
Proportion of apparent opioid-related accidental toxicity deaths by medical history within 30 days before death, January 1–September 30, 2017, Alberta, Canada



Source: Adapted with permission from Alberta Health. Opioids and substances of misuse: Alberta report (for Q1 2017 May 19; Q2 2017 Aug 16) [Internet]. Edmonton (AB): Government of Alberta; 2017 [cited 2018 Jan]. Available from: https://open.alberta.ca/publications/opioids-and-substances-of-misuse-alberta-report

Abbreviation: ED, emergency department.

younger at the time the drug was dispensed than non–First Nations individuals.[23] Because information from First Nations and other ethnic populations are not readily available in other jurisdictions, regional comparisons were not possible at this time.

Homeless populations are also at risk of opioid-related harms. In British Columbia, data collected in EDs found that unstable housing (i.e. no fixed address or unknown address) was reported by approximately 30% of those presenting for a known or suspected overdose, and by almost 50% of young people aged 13 to 18 years.[12]

Another at-risk population resides in provincial and territorial prisons and federal penitentiaries. These institutions house populations with a high prevalence of problematic substance use. From 2011/12 to 2013/14, Correctional Service Canada reported 92 unintentional overdose events, 12% of which were fatal. In 2014/15, there were 6 fatal overdoses (13.5 per 100 000 population). Male inmates with a reported prior substance use problem were most likely to overdose. Illegally obtained (as opposed to prescription) drugs were most commonly linked with fatal overdoses.[28]

Health outcomes: hospitalizations

Hospitals use the term *opioid poisoning* to describe an opioid-related overdose, according to International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10-CAii) version 2015 coding.§ The Canadian Institute for Health Information (CIHI) extracts data from the Hospital Morbidity Database (HMDB) for hospitalizations (100% national reporting). From March 2016 to March 2017, opioid poisonings were responsible for an average of 16 hospitalizations per day in Canada. This represents an increase of over 50% nationally in the past 10 years, with the largest increases occurring in the past three years.[3] Adults aged 45 years and older had the highest rates of hospitalization for opioid poisonings, although the fastest growing rates were seen in the younger age groups (15 to 44 years). Rates varied across the country. The highest rates for opioid-related hospitalizations (in 2016/17) as well as the fastest growing rates (occurring between 2014 and 2017) were in the western provinces of British Columbia (25.0 per 100 000 population) and Alberta (23.1 per 100 000 population) and in the territories (34.5 per 100 000 population) excluding Nunavut[3] (Figure 6). In 2016/17, more than half of the hospitalizations for opioid poisonings were considered unintentional, 31% were considered intentional and 17% were of unknown intent.[3] The majority (63%) of the unintentional poisonings occurred in people aged 65 years and older while intentional poisonings were more prevalent in the younger age group of 15 to 24 years.[3] Nationally, hospitalization rates have increased by 24% over the past three years for men and 10% for women. In 2016/17, the rate of hospitalization of males surpassed that of females for the first time.[3] There did not appear to be notable regional differences with respect to age or sex for opioid-related hospitalizations.[25]

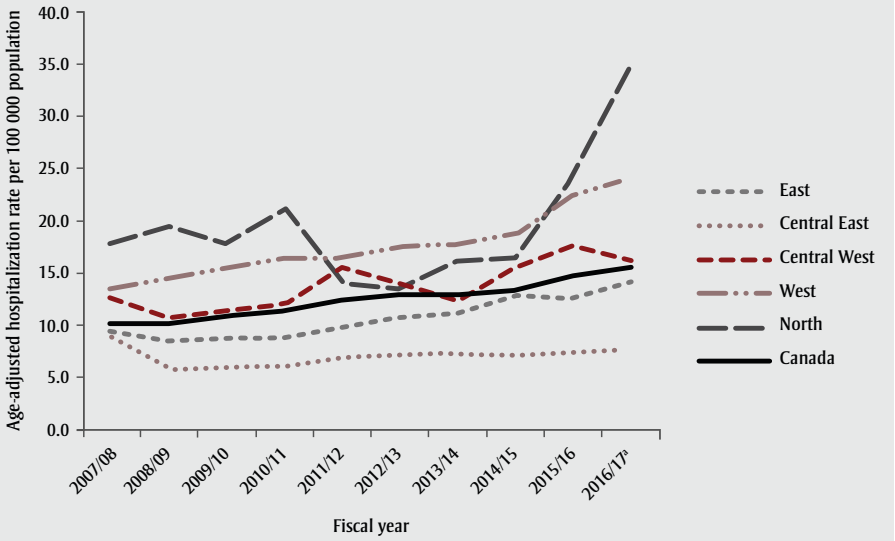
Health outcomes: emergency department (ED) visits

Data are collected by EDs and reported to CIHI to the National Ambulatory Care Reporting System (NACRS) (64% national coverage; 100% coverage in ON, AB, YK)[3] using ICD10-CAii version 2015 coding. As these data are not nationally representative, where possible they have been supplemented by surveillance reports from provinces where available. In light of these different data sources, regional comparisons are not possible for ED visits.

In Alberta, over the past five years, opioid-related ED visits have more than doubled, reaching 88.6 per 100 000 population in 2016/17. Contributing to this increase, heroin and synthetic opioid (including fentanyl) poisonings rose nearly tenfold each to approximately 20 per 100 000 population (for both) in 2016/17. During this same time period, opioid-related ED visits tripled for males and almost doubled for females. The greatest increases were observed in the younger age groups (15 to 44 years), for which rates have tripled, reaching more than 150 per 100 000. Most

§ ICD-10-CAii version 2015 codes used to identify opioid poisonings that resulted in hospitalizations and ED visits (T40.0–T40.4, and T40.6) (excluding "suspected" diagnosis). Hospitalizations and ED visits were categorized as: accidental (X42), intentional (X62) and unknown (Y12 and "missing data"). This analysis was limited to "significant opioid poisonings," using the diagnosis types M, 1, 2, 6, W, X and Y.[3]

FIGURE 6
Age-standardized rates per 100 000 population for significant opioid-poisoning hospitalizations in Canada, by region and fiscal year, 2007/08 to 2016/17



Data sources: Canadian Institute for Health Information (CIHI). Opioid-related harms in Canada: chartbook September 2017. Ottawa (ON): CIHI; 2017. Available from: https://www.cihi.ca/sites/default/files/document/opioid-harms-chart-book-en.pdf; Canadian Institute for Health Information (CIHI). Hospitalizations from opioid poisoning in Canada: data tables. Ottawa (ON): CIHI; 2016. Available from: https://www.cihi.ca/en/access-data-reports/results?query=opioids&Search+Submit

Note: Regional breakdown is: East: Newfoundland and Labrador, New Brunswick, Nova Scotia, Prince Edward Island; Central East: Ontario, Quebec; Central West: Manitoba, Saskatchewan; West: British Columbia, Alberta; North: Yukon, Northwest Territories, Nunavut.

[a] Quebec and Nunavut data are from 2015/16 (the most recent year of data available).

of these increases have occurred over the past three years.[3]

In Ontario, over the past five years, opioid-related ED visits increased by almost 50%. More specifically, ED visits for heroin rose fourfold to 5.7 per 100 000 population and more than doubled for synthetic opioid poisonings (including fentanyl), reaching 5.5 per 100 000 population in 2016/17. Rates have increased by 65% among males and 30% among females. The increases were greatest in the younger age groups (25 to 44 years), where rates almost doubled, reaching 57 per 100 000 population in 2016/17. Again, these increases mostly occurred over the past three years.[3]

In British Columbia, males made up 66% of ED visits for suspected opioid overdoses. Nearly two-thirds of the patients were aged 20 to 39 years, and most ED visits occurred in larger urban centres. (This information was reported from 47 EDs in three regional health authorities between June 2016 and March 2017).[12]

In Manitoba, over the past five years, age-standardized ED admission rates for the Winnipeg Regional Health Authority have remained stable. In 2016, females represented 65% of all ED visits for suspected opioid overdoses; over half of them were younger than 24 years.[19]

Health outcomes: emergency medical services (EMS), first responders and 911 calls

Information from EMS and first responders is collected in most provinces and territories at either the provincial/territorial level or, as in Ontario and Quebec, within municipalities.[29] This is a rich data source that may provide a glimpse into overdoses in communities. British Columbia, Alberta and Manitoba have analyzed and reported on these data, while other jurisdictions and municipalities are collecting and sharing EMS data with their respective health departments.

In British Columbia, during 2016, the estimated rate of illicit drug overdoses attended by paramedics was 190 per 100 000, which means that for every illicit drug overdose death in the province, paramedics responded to almost 10 overdose events. With the emergence of fentanyl into the illegal drug supply, the severity of overdose events where naloxone is administered has been increasing along with the number of repeat overdoses in both sexes.[12]

In Alberta, during 2016, EMS responded to over 1600 opioid-related events, which means that for every apparent opioid-related death in the province, EMS responded to almost three opioid-related overdose events. Eighty percent of these events occurred in the non-central urban cores of Edmonton and Calgary.[16]

In Manitoba, between 2015 and 2016, EMS calls for opioid-related events increased by 70%. The majority of cases were males aged 20 to 29 years; females were on average substantially older (≥ 50 years). Of the suspected overdose events attended by EMS, 18% were never transported to an ED or a hospital.[19]

Health outcomes: Community-based naloxone distribution and use

Additional information on opioid-related harms and overdoses occurring in communities may come from monitoring the distribution and use of naloxone take-home kits ("kits") in communities and from data collected at supervised injection sites and overdose prevention sites (BC). Kit distribution and use are currently being monitored in approximately half of the provinces and territories by collecting information on opioid-related overdose events reported when used kits are replaced.[29] Currently, British Columbia, Alberta and Manitoba report on the numbers of kits distributed and used in communities and provide some information on overdose events. In British Columbia, from August 2012 to June 26, 2017, 459 303 kits were distributed and 10 000 were reported used to reverse an overdose on self or other.[30] Between January 1, 2016, and June 30, 2017, 18 852 kits were dispensed in Alberta and 1707 overdose-event reversals were reported.[16] Between December 29, 2016, and March 31, 2017, 258 kits were distributed across Manitoba and 30 kits were reported used during overdose events.[19] Because information collected on kit use is not consistently reported across the country, regional comparisons were not possible at this time.

Discussion

The objective of this review was to synthesize the published evidence to describe the epidemic of opioid-related harms

occurring in Canada. The current body of evidence points to a national opioid crisis—no region is unaffected by opioids; however, there are notable regional differences. In 2016, rates of apparent opioid-related deaths and hospitalization were highest in the western provinces of British Columbia and Alberta and in both Yukon and the Northwest Territories; preliminary data from 2017 suggest that rates are continuing to climb in parts of the country. Nationally, most apparent opioid-related deaths occurred among males; individuals between 30 and 39 years of age accounted for the greatest proportion. While there did not appear to be regional differences with respect to age and sex for opioid-related hospitalizations and ED visits, increasing rates in the younger age groups are a source of concern.

Prescription opioid use appears to be an early driver of the current crisis. However, the increasing toxicity of substances on the illegal market is likely driving the recent rise in deaths in many Canadian jurisdictions. As of September 2016, fentanyl was detected in the illegal drug supply in all Canadian jurisdictions and is increasingly being detected in other illegal drugs as well. The impact of this trend in the illegal market can be observed in available data on health outcomes. In 2016, the proportion of reported apparent opioid-related deaths involving fentanyl or an analogue was 53% nationally, and this trend appears to be continuing in 2017. In both British Columbia and Alberta, the provinces hardest hit by this crisis to date, it has become more and more evident that illegally manufactured fentanyl and its analogues are responsible for the observed increases in drug overdose deaths. Dr. Perry Kendall, the former Provincial Health Officer for British Columbia who was at the forefront of the crisis, summed up the evolving situation concisely: "If we've got fentanyl and carfentanil now replacing heroin and other safer opioids on the streets, then this might be the new normal in terms of danger and a toxic drug supply."[31]

Initial analysis of potential risk factors found the majority of opioid-related deaths occurred when the individual was alone, indoors in a private residence located in a larger urban centre; those who died tended to reside in lower- to middle-income neighbourhoods; and more than 80% of deaths involved one or more non-opioid substances. The first reports focusing on First Nations communities in western Canada confirmed that First Nations people are more likely than their non–First Nations counterparts to experience and die from an opioid-related overdose event, especially First Nations women. Other at-risk communities appear to be individuals with unstable or unknown housing status and incarcerated populations. Additional research is necessary to understand underlying risk factors and the effect of health issues such as mental health on health outcomes.

Available data from first responders, EMS, supervised injections sites and harm reduction agencies were not sufficient to make regional comparisons on opioid-related overdoses occurring in communities at this time. However, preliminary information from EMS and community-based kit distribution and use monitoring programs are beginning to reveal the extent of opioid-related overdose events not captured through the health care system, and suggest that we are only seeing the tip of the iceberg of impact on health outcomes from opioids. At the time of this report, the three provinces collecting data on kit use combined reported a total of almost 12 000 kits used to reverse opioid overdoses in communities.

Obtaining reliable information on overdose events in the community is a challenge. It is complicated by the stigma attached to opioid use and the lack of knowledge in the general population of problematic substance use and overdoses. A recent survey by Statistics Canada found that less than one-third of Canadians would recognize the signs of an overdose and only 7% would know how to obtain and administer naloxone to treat an overdose.[32] Another national study, by the Canadian Centre on Substance Use and Addiction (CCSA), that looked at the use of kits in the community found that 911 was not called in 30% to 65% of the instances when naloxone was administered by a member of the community. The reason most commonly cited (33%) for not calling was concern about police involvement and possible arrest.[33]

This report also identified gaps in evidence and areas for further investigation to improve our understanding of the opioid-related harms. These gaps include risk factors; accurate estimates of prevalence of opioid use; nonfatal opioid-related events occurring outside the health care system; national estimates of opioid-related ED visits; and data on special populations including but not limited to Indigenous and other ethnic groups more broadly, as well as marginalized groups such as homeless individuals.

Strengths and limitations

For this report, we reviewed all public-facing, opioid-related surveillance and epidemiological reports published by provincial and territorial ministries of health and chief coroners' and medical examiners' offices on opioid-related deaths, harms and potential risk factors.

There are, however, limitations to the evidence we reviewed. Data sources were constantly being updated throughout the writing of this article, and new, more comprehensive evidence published after January 2018 is not included in this review. This synthesis does not present new information, and extensive reviews of health outcomes, the nonmedical use of prescription opioids, and risk factors for problematic substance use were beyond its scope. It is also important to underscore the significant role of stigma around problematic substance use and marginalized communities, which may contribute to underreporting and subsequent underestimates of the prevalence of use of opioids in the Canadian population. In addition, technology for toxicology screening is constantly improving to keep pace with new drugs. This may impact capacity to detect synthetic opioids such as fentanyl and its analogues and should be considered when evaluating trends. Furthermore, jurisdictional differences in case investigation methods, case definitions, classification methods and toxicology testing may also limit the extent to which comparisons can be made. Therefore, caution should be used when drawing conclusions at this time.

Conclusion

In this review we endeavoured to synthesize available evidence in order to provide a national summary that might be used to support public health action. We also identified gaps in evidence and areas for further investigation to improve our understanding of the national opioid crisis.

A more comprehensive evidence base is essential to inform a concerted, national response to prevent and reduce further

opioid-related harms. To provide the evidence necessary to inform and tailor an effective public health response, PHAC will continue to work with federal, provincial and territorial partners to further refine and standardize national data collection as well as to explore the expansion of information sharing to include nontraditional data sources. PHAC will also continue to support our federal partners through the Federal Action on Opioids,[34] and collaborate with provincial and territorial officials through the Special Advisory Committee on the Epidemic of Opioid Overdoses and its Surveillance Task Group (OOSTG) to improve the quality and accessibility of evidence. Better quality evidence will lead to an improved understanding of which populations are at greater risk of death and harms related to the problematic use of opioids, and will allow for more informed and targeted programs and policies to effectively reduce the impact of this crisis on Canadians.

Acknowledgements

The data presented in this synthesis represent the published work of health and justice officials, first responders and community leaders across the country who are working tirelessly and collaborating extensively to contribute to the knowledge base in order to combat this crisis.

Conflicts of interest

The authors declare no conflicts of interest.

Authors' contributions and statement

JH conceived the review and provided guidance and input throughout the process. LB designed the methodology, researched and synthesized the information and wrote the paper.

The content and views expressed in this article are those of the authors and do not necessarily reflect those of the Government of Canada.

References

1. Special Advisory Committee on the Epidemic of Opioid Overdoses. National report: apparent opioid-related deaths in Canada (January 2016 to June 2017) [Internet]. Ottawa (ON): Public Health Agency of Canada; 2017. Available from: https://www.canada.ca/en/public-health/services/publications/healthy-living/apparent-opioid-related-deaths-report-2016-2017-december.html

2. Public Health Agency of Canada. What can CHIRPP tell us about the opioid crisis? Internal presentation, August 2017. Ottawa (ON): Public Health Agency of Canada; 2017. Unpublished report.

3. Canadian Institute for Health Information (CIHI). Opioid-related harms in Canada: chartbook, September 2017. Ottawa (ON): CIHI; 2017. Available from: https://www.cihi.ca/sites/default/files/document/opioid-harms-chart-book-en.pdf

4. Pain & Policy Studies Group, University of Wisconsin/WHO Collaborating Center. Canada: opioid consumption in morphine equivalence (ME), mg per person [Internet]. Madison (WI): University of Wisconsin; 2015. Available from: http://www.painpolicy.wisc.edu/sites/www.painpolicy.wisc.edu/files/country_files/morphine_equivalence/canada_me_methadone.pdf

5. Laroche J. (Health Canada). Prescriptions of opioids dispensed by pharmacies in Canada, 2012–2017 (based on QuintilesIMS data, June, 2017). Ottawa (ON): Health Canada; 2017 Aug 23. (Email message to Lisa Belzak [Public Health Agency of Canada], unpublished.)

6. International Narcotics Control Board (INCB). Report of the International Narcotics Control Board for 2013. New York (NY): United Nations; 2014. Available from: www.incb.org/documents/Publications/AnnualReports/AR2013/English/AR_2013_E.pdf

7. Fischer B, Rehm J. Deaths related to the use of prescription opioids. CMAJ. 2009;181(12):881-2. doi: 10.1503/cmaj.091791.

8. Government of Canada. Canadian Tobacco, Alcohol and Drugs Survey (CTADS): 2015 Summary [Internet]. Ottawa (ON): Government of Canada; 2015. Available from: https://www.canada.ca/en/health-canada/services/canadian-tobacco-alcohol-drugs-survey/2015-summary.html

9. Health Canada. Baseline survey on opioid awareness, knowledge and behaviours for public education research report. Ottawa (ON): Prepared by Earnscliffe Strategy Group for Health Canada; 2017. Unpublished report.

10. Health Canada. Drug Analysis Service: summary report of samples analysed [Internet]. Ottawa (ON): Health Canada; [modified 2017 Dec 12; cited 2017 Sep and Dec]. Available from: https://www.canada.ca/en/health-canada/services/health-concerns/controlled-substances-precursor-chemicals/drug-analysis-service/2016-drug-analysis-service-summary-report-samples-analysed.html

11. Archambault B (Health Canada, Drug Analysis Services [DAS]). Ottawa (ON): Health Canada; 2017 Oct 26. (Email message to Lisa Belzak [Public Health Agency of Canada], unpublished).

12. British Columbia Observatory, Population and Public Health (BCOPPH) and BC Centre for Disease Control (BCCDC). The BC public health opioid overdose emergency: March 2017 update [Internet]. Vancouver (BC): BCOPPH/BCCDC; 2017. Available from: http://www.bccdc.ca/resource-gallery/Documents/Educational%20Materials/Epid/Other/Public%20Surveillance%20Report_2017_03_17.pdf

13. Canadian Centre on Substance Abuse (CCSA), Canadian Community Epidemiology Network on Drug Use. CCENDU bulletin: deaths involving fentanyl in Canada, 2009–2014. Ottawa (ON): CCSA; 2015. Available from: http://www.ccdus.ca/Resource%20Library/CCSA-CCENDU-Fentanyl-Deaths-Canada-Bulletin-2015-en.pdf#search=Death%20Involving%20Fentanyl%20in%20Canada%2C%202009%2D2014

14. Nunavut Department of Health. Fentanyl in Kugluktuk [Internet]. Kugluktuk (NU): Government of Nunavut; 2016 [cited 2017 Oct]. Available from: http://www.gov.nu.ca/health/news/fentanyl-kugluktuk

15. British Columbia Coroners Service. Statistical reports into BC fatalities: illicit drug overdose deaths in BC [Internet]. Burnaby (BC): BC Coroners Service; 2017 [updated monthly; cited 2017 June, Aug, Sept, Oct and Dec]. Available from: http://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/death-investigation/statistical/illicit-drug.pdf

16. Alberta Health. Opioids and substances of misuse: Alberta report (for Q1 May 19, 2017, Q2 Aug 16, 2017, Q3, Nov 27, 2017) [Internet]. Edmonton (AB): Government of Alberta; 2017 [cited 2017 Aug and Nov]. Available from: https://open.alberta.ca/publications/opioids-and-substances-of-misuse-alberta-report

17. Public Health Ontario. Opioid-related morbidity and mortality in Ontario [Internet]. Toronto (ON): Public Health Ontario; [modified 2018 Mar 7; cited 2017 Sept and Dec, and 2018 Feb]. Available from: http://www.publichealthontario.ca/en/DataAndAnalytics/Pages/Opioid.aspx#/drug

18. British Columbia Coroners Service. Statistical reports into BC fatalities: fentanyl-detected illicit drug overdose deaths in BC [Internet]. Burnaby (BC): BC Coroners Service; 2017 [updated monthly; cited 2017 June, Sept, Oct and Dec]. Available from: https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/death-investigation/statistical/fentanyl-detected-overdose.pdf

19. Manitoba Health. Surveillance of opioid misuse and overdose in Manitoba: January 1–March 31, 2017 (Manitoba Health, Seniors and Active Living epi-report) [Internet]. Winnipeg (MB): Government of Manitoba; 2017. Available from: http://www.manitoba.ca/health/publichealth/surveillance/docs/q1_opioid.pdf

20. Archambault A, Laing R. Update on DAS analyses and activities related to the opioid crises. Ottawa (ON); Oct 2017. (Presentation at the Special Advisory Committee on the Epidemic of Opioid Overdoses, unpublished.)

21. Government of New Brunswick. Apparent deaths related to opioid overdose in New Brunswick (2016 and 2017 [Quarter 1] Data.) [cited 2017 Aug and Dec]. Available from: http://www2.gnb.ca/content/dam/gnb/Departments/h-s/pdf/en/MentalHealth/ApparentDeathsRelatedOpioidOverdose.pdf

22. Institut national de santé publique du Québec (INSPQ). Décès attribuables aux intoxications par opioïdes au Québec, 2000 à 2012: mise à jour 2013–2016 [Internet]. Québec (QC): INSPQ; 2017 [cited 2017 Aug]. Available from: https://www.inspq.qc.ca/publications/2298

23. Alberta Health and the Alberta First Nations Information Governance Centre. Opioids and substances of misuse among First Nations people in Alberta: Alberta report, 2017 [Internet]. Edmonton (AB): Government of Alberta; 2017 [cited 2017 Nov]. Available from: open.alberta.ca/dataset/cb00bdd1-5d55-485a-9953-724832f373c3/resource/31c4f309-26d4-46cf-b8b2-3a990510077c/download/Opioids-Substances-Misuse-Report-First Nations-2017.pdf

24. First Nations Health Authority. Overdose data and First Nations in BC: preliminary findings [Internet]. West Vancouver (BC): First Nations Health Authority; 2017. Available from: http://www.fnha.ca/newsContent/Documents/FNHA_OverdoseDataAndFirstNationsInBC_PreliminaryFindings_FinalWeb.pdf

25. Public Health Agency of Canada. Analysis of opioid related poisonings/hospitalizations from the Discharge Abstract Database. Ottawa (ON): PHAC; 2017. Unpublished report.

26. Assembly of First Nations. 2016 Special Chiefs Assembly—Gatineau, QC: final resolutions [Internet]. (QC resolution no. 82/2016); 2016. Available from https://www.afn.ca/uploads/files/resolutions/sca-2016.pdf

27. Southwick, R. Fentanyl brings tragedy to Blood Tribe [Internet]. Calgary Herald. 2015 Mar 29 [modified 2015 Dec 2; cited 2017 Sep]. Available from: http://calgaryherald.com/news/local-news/fentanyl-brings-tragedy-to-blood-tribe

28. Correctional Service Canada. Annual report on deaths in custody 2014/15 [Internet]. Ottawa (ON): Government of Canada; 2016 Mar [cited Sep 2017]. Available from: http://www.csc-scc.gc.ca/research/005008-3008-eng.shtml

29. Public Health Agency of Canada. Summary of bilateral discussions on data sources and opportunities for opioid-related harms surveillance. 2017 Dec 1. Presentation at the Opioid Overdose Surveillance Task Group Teleconference, unpublished.

30. BC Centre for Disease Control. The history of the take home naloxone in British Columbia [Internet]. Vancouver (BC): BC Centre for Disease Control; 2017. Available from: http://www.bccdc.ca/resource-gallery/Documents/THN%20timeline%20bw%2020170628.pdf

31. Bell R. Little pills, big trouble: how Alberta's fentanyl crisis escalated despite years of warning [Internet]. Toronto (ON): CBC News; 2017 May 24 [cited Nov 2017]. Available from: http://www.cbc.ca/news2/interactives/fentanyl-crisis-alberta/

32. Statistics Canada. Results of the Survey on Opioid Awareness, November, 2017 [Internet]. The Daily, 2018 Jan 9. Ottawa (ON): Statistics Canada; 2018. Available from: http://www.statcan.gc.ca/daily-quotidien/180109/dq180109a-eng.pdf

33. Canadian Centre on Substance Abuse (CCSA) and Canadian Community Epidemiology Network on Drug Use (CCENDU). CCENDU Bulletin: Calling 911 in drug poisoning situations [Internet]. Ottawa (ON): CCENDU; 2017. Available from: http://www.ccsa.ca/Resource%20Library/CCSA-CCENDU-Calling-911-Drug-Poisoning-2017-en.pdf

34. Government of Canada. Government of Canada actions on opioids: 2016 and 2017 [Internet]. Ottawa (ON): Government of Canada; 2017 [cited 2017 Sep]. Available from: https://www.canada.ca/en/health-canada/services/publications/healthy-living/actions-opioids-2016-2017.html

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Original quantitative research

Canadian trends in opioid-related mortality and disability from opioid use disorder from 1990 to 2014 through the lens of the Global Burden of Disease Study

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Abstract

Introduction: Several regions in Canada have recently experienced sharp increases in opioid overdoses and related hospitalizations and deaths. This paper describes opioid-related mortality and disability from opioid use disorder in Canada from 1990 to 2014 using data from the Global Burden of Disease (GBD) study.

Methods: We used data from the GBD study to describe temporal trends (1990–2014) in opioid-related mortality and disability from opioid use disorder using common metrics: disability-adjusted life years (DALY), deaths, years of life lost (YLL) and years lived with disability (YLD). We also compared age-standardized YLL and DALY rates per 100 000 population between Canada, the USA and other regions.

Results: The age-standardized opioid-related DALY rate in Canada was 355.5 per 100 000 population in 2014, which was higher than the global rate of 193.2, but lower than the rate of 767.9 in the United States. Between 1990 and 2014, the age-standardized opioid-related YLL rate in Canada increased by 142.2%, while globally this rate decreased by 10.1%. In comparison with YLL, YLD accounted for a larger proportion of the overall opioid-related burden across all age groups. Health loss was greater for males than females, and highest among those aged 25 to 29 years.

Conclusion: The health burden associated with opioid-related mortality and disability from opioid use disorder in Canada is significant and has increased dramatically from 1990 to 2014. These data point to a need for public health action including enhanced monitoring of a range of opioid-related harms.

Keywords: *opioids, substance use, health burden, DALY, dependence, mortality, years of life lost, disability-adjusted life years, death, years lived with disability*

Highlights

- Long-term national trends data on opioid-related mortality and disability from opioid use disorder have not been previously presented for Canada.
- From 1990 to 2014, the age-standardized years-of-life-lost rate due to opioid-related mortality increased by 142.2%, compared to a 10.1% global decrease.
- These estimates of the health burden of disability and mortality related to opioid use are likely an underestimate. More work is needed to capture the full range of health and social consequences of opioid use.

Introduction

Canada is experiencing a public health crisis; significant and sharp increases in opioid-related overdoses and mortality in multiple regions over the last few years have prompted federal, provincial/territorial and municipal responses.[1-3] The most recent count of apparent opioid-related

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mortality from national public health surveillance was 2861 in 2016. If the current trend continues, the number of opioid-related deaths in 2017 is anticipated to be greater than 4000.[2] While information on opioid-related mortality is available through vital registration data and more recently through public health surveillance, no consistent national data are available on the overall burden of health loss associated with opioid use.[4-7]

The Canadian Tobacco, Alcohol and Drugs Survey, which reports biennially on national drug-related behaviour, does not include information on all opioids, and prevalence or frequency information does not support a full understanding of the health burden associated with drug consumption. For example, in 2015, 2% of respondents reported using psychoactive substances, including cocaine or crack, ecstasy, speed or methamphetamines, hallucinogens or heroin,[8] but this does not include other forms of opioids. Of those reporting taking prescription opioids, 2% reported abusing them, which represents about 0.3% of Canadians aged 15 years and older.[8] However, survey sources of data on illegal drug use likely provide underestimates of the true magnitude of the issue because of respondents' concerns around reporting drug use and the associated stigma.[9] In addition, household survey methods do not reach some of the populations who may be more likely to use substances. This is particularly important when measuring the health burden disproportionately present in socially disadvantaged groups, such as people experiencing homelessness.[10] Based on other sources of data, the number of people using heroin, fentanyl and other synthetic opioids is steadily rising, representing a shift from prescription to non-prescription opioid use.[4-6] Apart from the direct health impacts of opioid use, including deaths and overdoses, other health and social harms related to opioid use include increased risk of chronic and infectious diseases and a higher risk of family problems, self-harm, problems at work and school, and contact with the criminal justice system.[4,5,11-13]

The Global Burden of Disease (GBD) study is an international collaborative effort to systematically quantify health loss due to more than 300 diseases, injuries and risk factors in 195 countries from 1990 to 2016.[14] In this paper, we use the GBD framework to quantify the health burden of opioid-related mortality and disability from opioid use disorder in Canada from 1990 to 2014 to allow comparisons across time and regions. The purpose of this paper is to describe the burden of opioid-related mortality and disability from opioid use disorder in Canada over the last quarter century, through the lens of the GBD study, by sex and by age. A secondary goal is to compare levels and trends in Canada with those in the United States of America (USA) and those in GBD study super-regions (i.e. Southeast Asia, East Asia and Oceania; Central Europe, Eastern Europe and Central Asia; High Income; Latin America and Caribbean; North Africa and Middle East; South Asia; and Sub-Saharan Africa).[14]

Methods

The GBD 2016 estimates and analyses adhere to the Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER).[15] Comprehensive details on the GBD methodology are available in the 2016 GBD capstone papers,[14,16,17] and Degenhardt et al. (2014) [18] provide further details on GBD methods related to the modelling of opioid-related mortality and disability from opioid use disorder. All GBD results can be accessed online through the GBD Data Visualization Hub (https://vizhub.healthdata.org/gbd-compare/).

Data sources

The GBD study identifies data through comprehensive systematic reviews of published and grey literature and through environmental scans of national and subnational data sources.[19-22] The full list of data sources used to model Canadian GBD estimates can be found at http://ghdx.healthdata.org/geography/canada.

Estimation of mortality and years of life lost

Opioid-related mortality estimates were modelled using the Cause of Death Ensemble modelling (CODEm) statistical package. CODEm uses the best available data to model consistent estimates by using ensemble models of various techniques (linear mixed effects models, spatial–temporal models and Gaussian process regression) that incorporate temporal trends of the estimate.[23]

The GBD study undertakes a standard process to ensure that international data are comparable and to correct for "garbage codes" (i.e. deaths that are coded to causes that cannot cause death or are intermediate causes of death). Because of the low number of deaths due to opioid dependence (International Classification of Diseases [ICD-10] code F11), it is difficult to obtain internally consistent models that capture all mortality associated with opioid use. As a result, deaths due to accidental poisoning from narcotics were reclassified as deaths associated with opioid use, thereby collapsing ICD-10 Codes X42 and F11 into a single category (as described by Degenhardt et al., 2014[18]). Because not all jurisdictions capture detailed information about the specific drugs associated with drug-related deaths, the higher-level category—mortality due to drug use disorders—was modelled first. When data on specific drug-related deaths were available, such as in Canada, these data were used to distribute deaths between different types of drug-related deaths. When data on specific drug deaths were not available, other methods were used to proportionally distribute drug-related deaths between each drug included in the GBD framework.[14] Garbage codes, including unintentional poisoning by exposure to other and unspecified drugs (ICD-10 X44), are redistributed proportionally to specific drugs as described in the GBD causes of death capstone paper.[14] We did not distinguish between prescription and non-prescription opioid use in relation to opioid mortality.

Mortality estimates were then combined with time-invariant world standard life expectancy tables to calculate years of life lost (YLL), describing the number of years lost to premature mortality.[14] The GBD study takes changes to the ICD into account by recalculating all estimates with each annual iteration and accommodating annual changes in methodology. The 2016 iteration of the GBD study incorporated Canadian mortality data up to 2012, as reported to the World Health Organization by Statistics Canada. As a result, we report GBD estimates up to 2014 because after this point, the modelled estimates do not reflect the recent, large increases in opioid-related mortality.

We also present crude mortality data from 2000 to 2014 using Canadian vital statistics (from CANSIM; Canadian Socio-Economic Information Management System),

incorporating ICD-10 codes X42 (Accidental poisoning due to narcotics and hallucinogens)[7] and F11 (Mental disorders due to the use of opioids).[24] We extracted deaths associated with these codes and combined them into a single category—deaths related to opioid use—in order to provide data consistent with the presentation of the GBD opioid-related mortality data. Age-standardized rates were calculated using the GBD world standard population. While more recent vital statistics data for Canada are available, we have reported these to correspond with the date range of GBD estimates that we are reporting.

Estimation of years lived with disability

To estimate the prevalence of opioid use disorder in order to calculate the associated disability, we defined opioid use disorder in accordance with the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV-TR; code 304.00)[25] and the ICD-10 (code F11.2)[26] diagnostic criteria (as described by Degenhardt et al., 2014[18]). This case definition means that people experiencing morbidity associated with opioid use, but not opioid dependence, are excluded in our disability estimates.

Prevalence estimates for opioid use disorder were calculated using the Disease Modelling – Meta-Regression II (DisMod-MR II) software, which implements Bayesian meta-regression techniques to obtain internally consistent estimates.[27] Obtaining accurate estimates of illegal drug use prevalence remains a major challenge because of the associated stigma and difficulties with accessing marginalized populations. As a result, indirect estimates of prevalence, based on methods such as the multiplier methods, capture–recapture and back-projection estimates, were preferred over direct sources such as surveys.[28] The modelled High Income North America (i.e. Canada, USA and Greenland) estimates are based on 27 prevalence studies and two studies on remission.[18]

To provide a more global sample, the GBD study developed disability weights using community-based surveys conducted in five countries and open-access Internet-based surveys.[29,30] Epidemiological data from a US national study were used to adjust each disability weight by severity,[31] and microsimulation methods were used to account for comorbidity.[16] After all corrections, the disability weight for opioid use disorder was set by the GBD study at 0.50 (95% uncertainty interval [UI]: 0.33–0.69) on a scale from 0 (no disability) to 1.0 (severe disability).[18] Final prevalence estimates were multiplied by their corresponding disability weights to obtain YLD, described as the number of years that individuals lived with disability.

Disability-adjusted life years

DALYs were calculated as the sum of YLL and YLD, representing the overall burden of opioid-related mortality and disability from opioid use disorder.

Age-standardized rates for DALY were calculated using the GBD, time-invariant, world standard population. Crude (all-age) and age-standardized analyses are presented, and trend analyses use age-standardized estimates. Analyses were conducted for both sexes together and by sex. YLL and DALY are also presented for the USA and each of the seven GBD super-regions.

Uncertainty intervals

Uncertainty intervals (UIs) were established by running 1000 draws and identifying the 2.5th and 97.5th percentiles for each estimate. The level of uncertainty is related to the quality of the available data and the data coverage. Narrow UIs indicate high certainty in the estimate, whereas wide UIs indicate low certainty in the estimate.

Results

General results and international comparisons

In 2014, there were 131 057.8 (95% UI: 104 713.8–159 793.1) crude DALYs from opioid-related mortality and disability from opioid use disorder. Of these, 80 893.3 (63 579.9–100 891.3) were among males and 50 164.5 (37 340.4–62 727.8) among females (data not shown).

The age-standardized DALY rate for Canadian males and females combined was 355.5 per 100 000 population (95% UI: 280.8–436.3), a burden associated with opioid-related mortality and disability from opioid use disorder that was significantly higher than the global rate of 193.2 (147.5–232.5; Table 1). The burden of opioid-related mortality and disability from opioid use disorder in 2014 was concentrated in the High Income region (which includes Canada and the USA); North Africa and the Middle East; and the Central Europe, Eastern Europe and Central Asia regions (see Figure 1). The USA demonstrates the largest rates of opioid burden for both males (968.6 DALYs per 100 000; 95% UI: 746.6–1167.2) and females (565.7 DALYs per 100 000; 95% UI: 435.2–684.3), more than double the burden estimated in Canada in 2014.

Age-standardized opioid-related mortality rates increased substantially among males, from 1.3 per 100 000 (95% UI: 1.0–1.7) in 1990 to 3.1 (2.3–4.1) in 2014, whereas rates among females rose from 0.5 (0.4–0.7) to 1.3 (1.0–1.8) between 1990 and 2014 (Figure 2). The crude opioid-related mortality count increased from 201.1 per 100 000 (157.0–271.9) in 1990 to 606.6 (454.3–805.6) in 2014 among males, and from 76.7 (59.9–105.6) in 1990 to 279.2 (210.9–361.7) in 2014 among females. For the most part, observed Canadian data from vital statistics fall within the GBD estimates of 95% UIs. However, in 2011, the observed data for males surpassed the GBD modelled estimates, and this trend continued through the rest of the time series.

The age-standardized YLL rate for Canadians (both sexes combined) was 103.1 per 100 000 (95% UI: 83.5–129.9) (Table 2). This rate was much higher among males (146.3; 109.6–195.9) than among females (59.8; 45.1–79.4). Figure 2 highlights the increasing trends in YLL and YLD for both males and females, which together demonstrate a slow but steady increase from 1990 to 2014, resulting in large overall percentage increases. The increase is greater in YLL, reflecting the impact of an increasing number of deaths at younger ages. For both sexes, the YLL rate in Canada increased by 142.2% between 1990 and 2014, with a 28.2% increase between 2004 and 2014. In contrast, the global YLL rate decreased by 10.1% from 1990 to 2014, with an 8.6% decrease between 2004 and 2014 (Table 2).

Figure 3 shows the age distribution of DALYs as the sum of YLL and YLD, for males and females, as rates per 100 000 population and counts. The DALY rate among infants is low because of the small number of deaths contributing a relatively higher number of YLL in this age group. This is consistent with vital statistics data for this age group, which show a small

TABLE 1
Age-standardized DALY rates for opioid-related mortality and disability from opioid use disorder, 2014, and per cent change of these age-standardized DALY rates, 1990–2014 and 2004–2014, total and by sex, for Canada, the USA, worldwide and by Global Burden of Disease super-regions

Region	Total				Females				Males			
	DALY rate per 100 000 population	95% UI	Per cent change in age-standardized rates 1990–2014 (%)	Per cent change in age-standardized rates 2004–2014 (%)	DALY rate per 100 000 population	95% UI	Per cent change age-standardized rates 1990–2014 (%)	Per cent change age-standardized rates 2004–2014 (%)	DALY rate per 100 000 population	95% UI	Per cent change in age-standardized rates 1990–2014 (%)	Per cent change in age-standardized rates 2004–2014 (%)
Canada	355.5	280.8–436.3	54.7	14.8	270.5	202.0–343.5	42.8	15.1	440.7	342.1–554.7	63.0	14.8
USA	767.9	612.3–915.7	47.5	18.1	565.7	435.2–684.3	41.8	18.2	968.6	746.6–1167.2	50.1	17.9
Global	193.2	147.5–232.5	−4.4	−0.9	136.5	102.7–166.1	−7.2	−0.9	249.2	192.0–299.4	−3.0	−1.9
Southeast Asia, East Asia and Oceania	145.0	111.5–176.1	−27.9	−8.0	108.4	83.2–133.1	−33.0	−6.6	181.2	138.4–217.3	−24.5	−8.9
Central Europe, Eastern Europe and Central Asia	298.6	254.8–344.5	−8.9	−18.2	151.4	119.9–179.2	−10.9	−16.3	452.0	385.7–522.4	−8.9	−19.1
High Income[a]	346.6	274.9–417.1	36.3	14.4	252.3	193.6–304.2	34.9	15.6	440.1	347.8–530.3	36.6	13.5
Latin America and Caribbean	116.3	86.8–145.7	13.6	3.8	88.9	64.7–113.1	10.0	4.5	144.6	109.9–179.2	15.9	3.2
North Africa and Middle East	330.7	234.1–414.0	13.5	−0.0	216.8	153.2–288.8	8.4	3.2	438.0	310.5–534.9	15.3	−1.8
South Asia	147.8	107.6–185.6	13.0	10.2	111.8	80.4–141.6	13.4	9.1	182.2	133.4–230.1	13.4	11.1
Sub-Saharan Africa	136.5	102.3–168.2	−7.9	−5.6	93.2	67.3–120.8	−10.5	−8.6	180.8	139.6–218.2	−6.6	−3.9

Abbreviations: DALY, disability-adjusted life years; UI, uncertainty interval.

[a] High Income super-region: High Income North America, Australasia, High Income Asia Pacific, Western Europe, Southern Latin America.

and variable number of deaths due to accidental narcotic poisoning each year.[24] The highest number of DALY total counts and highest DALY age-standardized rates are among males in their 20s, whereas those aged 65 years and over contribute a relatively small number of opioid-related DALY overall. YLD contribute the greatest proportion of DALY in all age categories except the neonatal period; however, this proportion varies by age group. There is a relatively higher contribution of YLD to DALY among those aged 70 years and over, compared to younger age groups, and YLD contribute a relatively higher proportion to DALY among younger females, compared to younger men.

Discussion

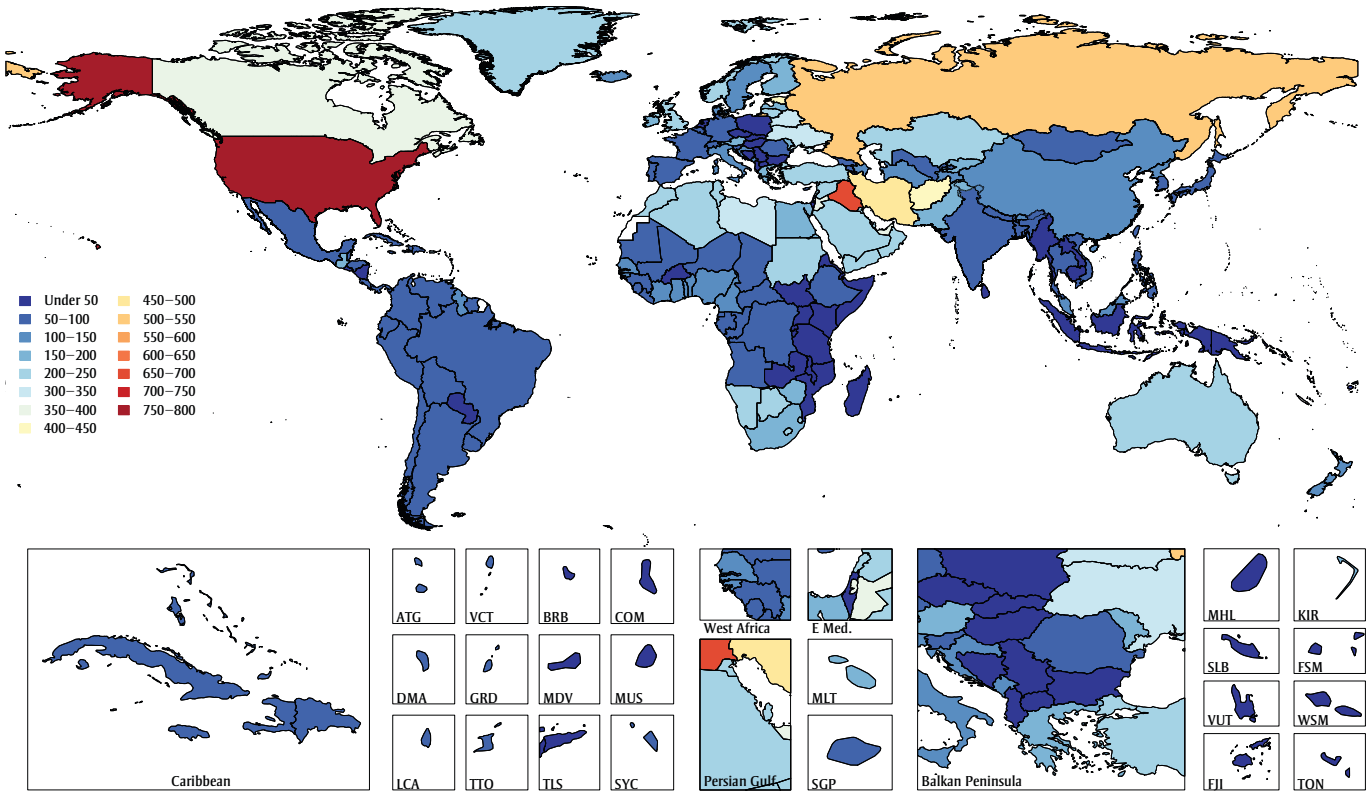
Estimates from the GBD study demonstrate that the health burden associated with opioid-related mortality and disability from opioid use disorder in Canada is significant and has increased from 1990 to 2014. The 142% increase in YLLs and 63% increase in DALYs from 1990 to 2014 demonstrate a slowly developing epidemic of opioid-related harms over a quarter of a century.

The Special Advisory Committee on the Epidemic of Opioid Overdose reported 2861 apparent opioid-related deaths in 2016 in Canada.[2] While not directly comparable because of the differences in case definitions, this nevertheless indicates a recent, rapid acceleration of this public health problem. Patterns observed in the USA may foreshadow what is to come for Canada, as the vital statistics data used to model estimates in the USA are current to 2015. Early patterns of opioid-related mortality seen in the USA have been observed in Canada, albeit later.

The burden of opioid-related health loss in Canada disproportionately affects males. The estimated prevalence of opioid use disorder and the DALY rate in males is 1.6 times that in females; their death rate, 2.3 times; their YLD rate, 1.3 times; and their YLL rate, almost 2.5 times. There is a need to understand what drives these sex differences and how interventions can address health inequity. Similarly, opioid-related harms are disproportionately higher among young adults, which could have lasting repercussions throughout the life course. The nature of opioid-related disability and mortality varies according to age group.[32] While deaths in younger age groups likely reflect a higher proportion of non-prescription opioid use, mortality in the older age groups may reflect a significant proportion of opioid toxicity.[33]

It is important to note that while the trends from 1990 to 2014 show large increases in opioid-related mortality and disability from opioid use disorder, these estimates are almost certainly conservative and underestimate the true burden of opioid use in Canada. When calculating prevalence, used to estimate YLD and DALY, only opioid use disorder is captured. Not all opioid use in the population meets the criteria for opioid use disorder,

FIGURE 1
Disability-adjusted life year rate per 100 000 population for opioid-related mortality and disability from opioid use disorder, both sexes combined, 2014, by country



Abbreviations: ATG, Antigua and Barbuda; BRB, Barbados; COM, Comoros; DMA, Dominica; E Med., Eastern Mediterranean; FJI, Fiji; FSM, Micronesia; GRD, Grenada; KIR, Kiribati; LCA, Saint Lucia; MDV, Maldives; MHL, Marshall Islands; MLT, Malta; MUS, Mauritius; SGP, Singapore; SLB, Solomon Islands; SYC, Seychelles; TLS, Timor-Leste; TON, Tonga; TTO, Trinidad and Tobago; VCT, Saint Vincent and the Grenadines; VUT, Vanuatu; WSM, Samoa.

yet all levels of non-prescription opioid use have the potential to cause harm and disability. Including use that does not meet the criteria for disorder would provide a more comprehensive picture of the true burden of opioid use in Canada. As noted in the methods section of this paper, the 2016 iteration of the GBD calculated estimates using 2012 Canadian vital statistics data. Given that vital statistics data for 2013 and 2014 show an increasing trend in opioid-related mortality, based on public health surveillance, we anticipate that the number of opioid-related deaths will be significantly higher in 2016 and 2017 in Canada.[2] When the GBD process is able to capture this increase, deaths, YLD, YLL and DALY will be higher than the estimates for 2014, which are the focus of this paper.

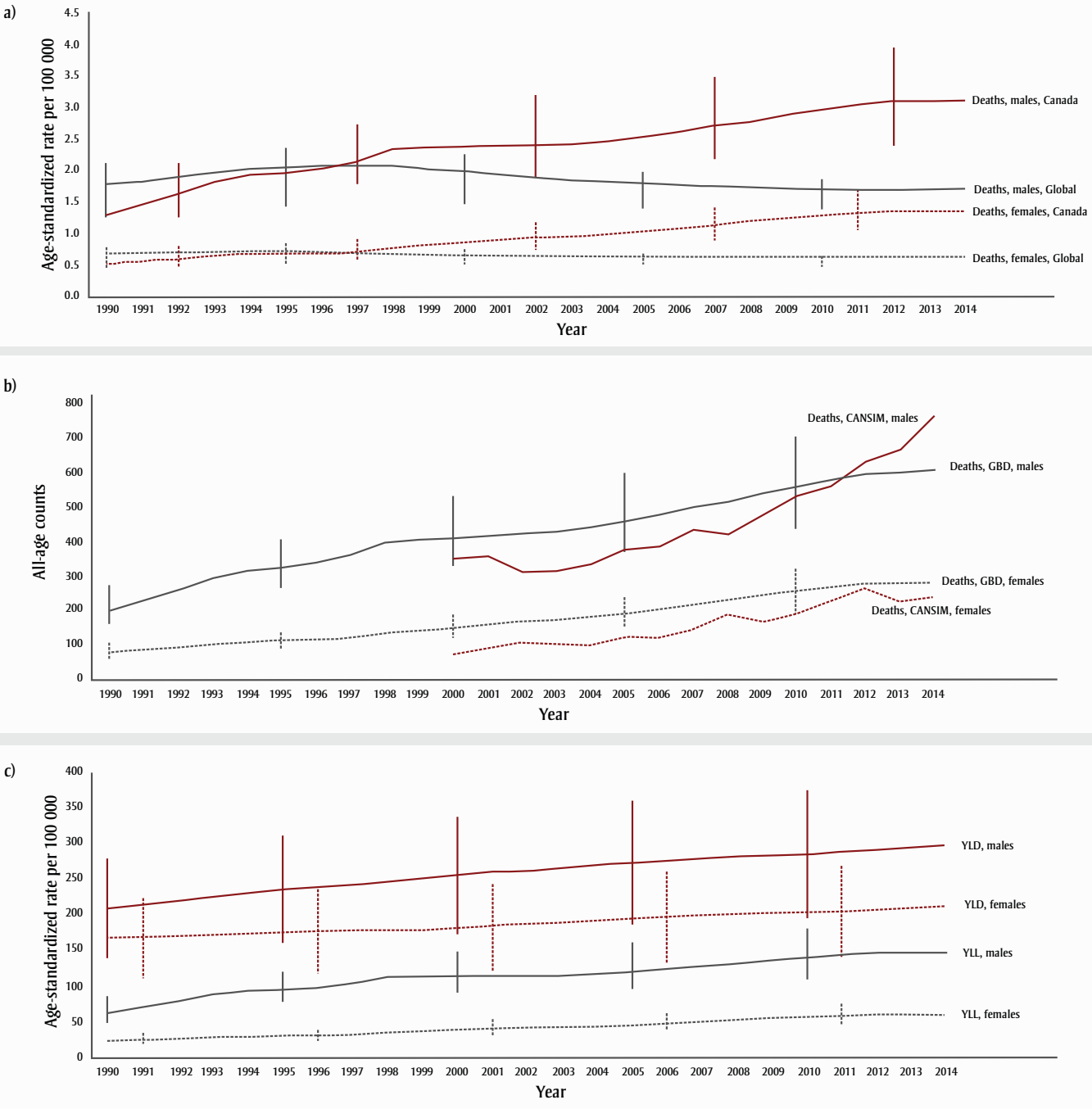
Strengths and limitations

The strengths of this study include the rigorous approach to modelling estimates used to quantify health loss associated with opioid use in a manner that is comparable across time, across causes and between countries. This paper provides a more comprehensive account of the health burden associated with opioid-related mortality and disability from opioid use disorder in Canada than previously published results.[3,6,34]

However, along with this comparability come limitations. The data presented here have been truncated at 2014 in order to align with the date range of the estimates we report from the GBD, as explained in the previous section. The GBD produces estimates through a modelling process that includes standardizing across countries and recoding some causes of death that are known to be unreliable. As such, some GBD estimates may not be fully aligned with the observed data for Canada. Nonetheless, these estimates provide a more robust picture of health loss due to opioid use in Canada, including temporal trends. Comparison of the GBD estimates and observed data from 2000 to 2014 indicate high concordance once categories of deaths are collapsed in a consistent fashion. Deaths due to opioid use disorder, which are relatively rare in Canada (observed deaths between 2000 and 2014 ranged from 1 to 13), were combined with deaths due to accidental poisoning by narcotics and other hallucinogens to create total deaths due to opioid use. This approach may overestimate deaths related to opioid use due to the inclusion of "other hallucinogens" in ICD code X42. However, this is likely to be small because of the low toxicity of hallucinogens.[35] Furthermore, some deaths recorded as accidental poisoning may, in fact, have been intentional poisonings, thus representing deaths by suicide.[36] The full picture of deaths related to opioid use needs to be considered when understanding patterns of opioid-related harms, including those attributed to opioid use disorder and unintentional and intentional poisonings.

Because only disability associated with opioid use disorder was estimated, these

FIGURE 2
(a) Age-standardized opioid-related mortality rates per 100 000 population, males and females, 1990–2014, global and Canada; (b) crude mortality counts, modelled Global Burden of Disease and Vital Statistics data, males and females, 1990–2014, Canada; and (c) age-standardized YLL and YLD rates, males and females, 1990–2014, Canada



Abbreviations: CANSIM, Canadian Socio-Economic Information Management System; GBD, Global Burden of Disease; YLD, years lived with disability; YLL, years of life lost.
Note: Vertical bars represent the 95% uncertainty intervals.

TABLE 2
Age-standardized YLL rates for opioid-related deaths and prevalence of opioid dependence, 2014, and per cent change of age-standardized YLL rates from 1990–2014 and 2004–2014, total and by sex, for Canada, the USA, globally and by Global Burden of Disease super-region

Region	Total				Females				Males				Per cent change in (total) age-standardized YLL rates (%)	
	YLL rate per 100 000	95% UI	Prevalence	95% UI	YLL rate per 100 000	95% UI	Prevalence	95% UI	YLL rate per 100 000	95% UI	Prevalence	95% UI	1990–2014	2004–2014
Canada	103.1	83.5–129.9	0.7	0.6–0.8	59.8	45.1–79.4	0.5	0.5–0.7	146.3	109.6–195.9	0.8	0.7–0.9	142.2	28.2
USA	265.0	123.2–294.5	1.3	1.2–1.5	164.2	67.0–185.0	1.1	0.9–1.2	364.6	145.3–409.7	1.7	1.5–1.8	343.2	48.6
Global	47.6	39.8–51.0	0.4	0.3–0.4	23.6	18.9–25.6	0.3	0.2–0.3	71.2	57.8–79.5	0.4	0.4–0.5	−10.1	−8.6
Southeast Asia, East Asia and Oceania	35.9	30.5–48.6	0.3	0.2–0.3	20.7	15.5–24.8	0.2	0.2–0.3	50.8	40.4–76.2	0.3	0.3–0.4	−43.9	−12.2
Central Europe, Eastern Europe and Central Asia	150.8	129.7–179.1	0.4	0.3–0.4	48.4	40.9–62.4	0.3	0.2–0.3	257.3	215.0–309.4	0.5	0.5–0.6	−8.3	−25.7
High Income[a]	107.5	60.0–116.5	0.6	0.6–0.7	61.6	31.7–67.7	0.5	0.4–0.5	152.8	77.7–167.1	0.8	0.7–0.8	147.8	32.5
Latin America and Caribbean	19.9	17.8–24.6	0.2	0.2–0.3	9.1	8.2–11.2	0.2	0.2–0.2	30.8	27.0–39.7	0.3	0.2–0.3	43.3	6.2
North Africa and Middle East	41.3	30.1–49.5	0.7	0.6–0.9	13.0	9.2–16.2	0.5	0.4–0.6	68.0	46.9–82.4	0.9	0.8–1.1	18.5	−11.9
South Asia	20.3	17.2–24.2	0.3	0.3–0.4	11.1	8.8–13.7	0.2	0.2–0.3	29.1	22.7–36.9	0.4	0.3–0.4	6.0	−3.9
Sub-Saharan Africa	30.5	24.2–37.7	0.3	0.2–0.3	10.6	8.9–13.7	0.2	0.2–0.3	50.7	36.2–65.1	0.3	0.3–0.4	−21.1	−16.6

Abbreviations: YLL, years of life lost; UI, uncertainty interval.

[a] High Income super-region: High Income North America, Australasia, High Income Asia Pacific, Western Europe, Southern Latin America.

analyses do not take into account disability associated with other forms of use, such as acute opioid intoxication or harmful use that does not meet the criteria for disorder. Other studies may include ICD codes not referenced in the present study.[37] The actual burden of disability associated with a broader range of opioid use is likely to be higher than the estimates reported here. Disability weights derived from surveys in a limited number of countries may not be entirely applicable to the Canadian context, and the underlying level of disability for opioid use disorder may vary significantly over time and between contexts.[1]

Finally, the GBD method does not account for indirect effects of opioid use and losses that are not health-related. Opioid use may impact negatively on other facets of life, such as relationships, educational attainment and work life, thus having indirect health effects through these social determinants.[38]

Further refinement of analyses by characteristics other than sex and age was not possible with the GBD data. Opioid-related health loss is likely not evenly distributed across the Canadian population, and further analyses of inordinately affected subgroups should be conducted. Examples of these subgroups include those who have other mental health problems, low school involvement, a prior history of substance use disorder, chronic homelessness, a history of abuse and neglect and substance use during adolescence.[39] The relationship of medical opioid-prescribing patterns due to patterns of health loss due to opioid use should also be further elucidated. Subnational estimates were not provided, but may be available in future iterations of the GBD study, in a manner similar to those for the USA and the United Kingdom.[40,41]

Conclusion

Health loss due to opioid use is significant and has increased dramatically in Canada from 1990 to 2014. When the GBD study produces estimates with updated vital registration data on opioid-related deaths for 2013 and later, we expect estimates for the period 2014 to 2016 to be even greater than those reported here. Furthermore, they will more accurately reflect the health loss associated with opioid use in Canada. Even then, these estimates will not fully account for the burden of disease associated with opioid use. Canada has a higher level of health loss associated with opioid use than all other high-income countries except for the USA. Well-coordinated public health action to prevent problematic opioid use and related harms is indicated to mitigate the unnecessary death and disability associated with this problem in Canada.

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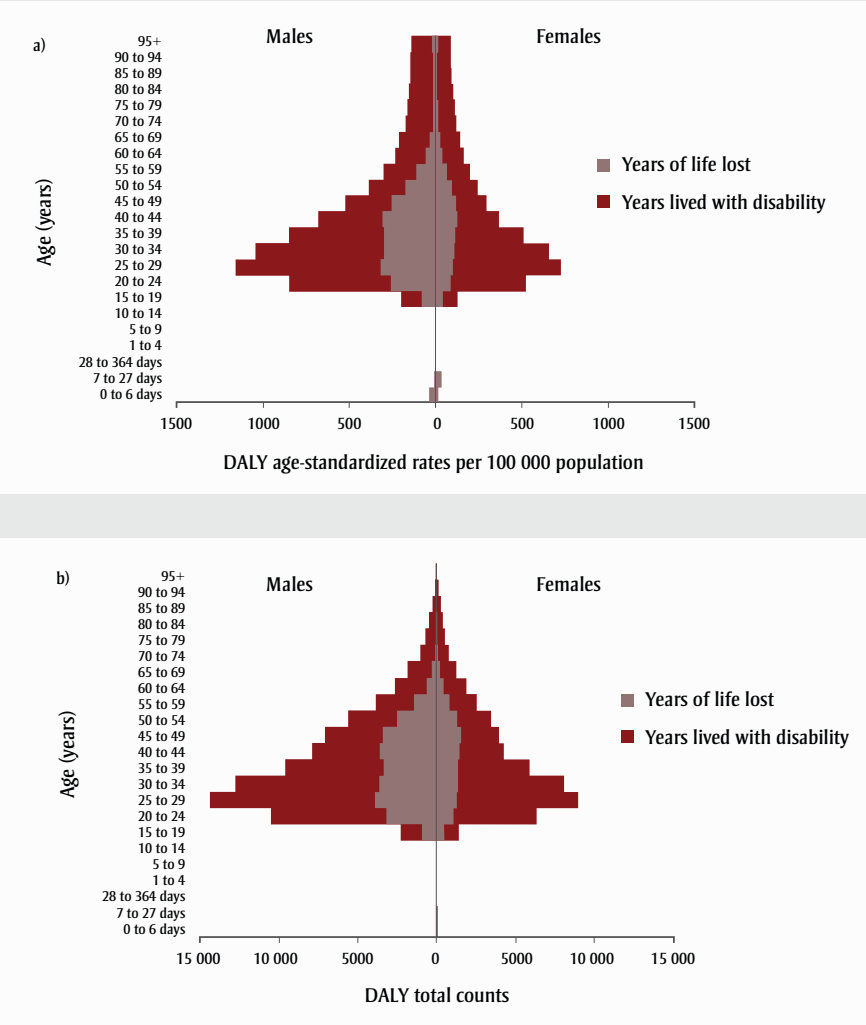
FIGURE 3
Age-specific DALY (a) rates and (b) counts, comprising YLLs and YLDs, males and females, 2014, Canada



Abbreviations: DALY, disability-adjusted life year; YLD, years lived with disability; YLL, years of life lost

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Authors' contributions and statement

HMO and JJL conceived the research questions and objectives for this study. HMO and JJL led the synthesis and interpretation of results. HMO, JJL and MB drafted the manuscript. All co-authors contributed to interpreting data and reviewing and revising the manuscript for intellectual content. All authors read and approved the final manuscript.

The content and views expressed in this article are those of the authors and do not necessarily reflect those of the Government of Canada.

References

1. Health Canada. Government of Canada actions on opioids: 2016 and 2017. Ottawa (ON): Government of Canada; 2017 [Catalogue No.: H14-236/2017E-PDF].
2. Special Advisory Committee on the Epidemic of Opioid Overdoses. National report: apparent opioid-related deaths in Canada (January 2016 to June 2017) [Internet]. Ottawa (ON): Government of Canada; 2017 [cited 2018 Jan 1]. Available from: https://www.canada.ca/en/public-health/services/publications/healthy-living/apparent-opioid-related-deaths-report-2016-2017-december.html
3. Klar SA, Brodkin E, Gibson E, et al. Furanyl-fentanyl overdose events caused by smoking contaminated crack cocaine – British Columbia, Canada, July 15-18, 2016. Health Promot Chronic Dis Prev Can. 2016;36(9):200-1. doi: 10.24095/hpcdp.36.9.05.
4. Baldini A, Von Korff M, Lin EH. A review of potential adverse effects of long-term opioid therapy: a practitioner's guide. Prim Care Companion CNS Disord. 2012;14(3):PCC.11m01326. doi: 10.4088/PCC.11m01326.
5. U.S. Department of Health & Human Services (HHS), Office of the Surgeon General. Facing addiction in America: the Surgeon General's report on alcohol, drugs, and health. Washington (DC): HHS; 2016.
6. Canadian Institute for Health Information. Pan-Canadian trends in the prescribing of opioids, 2012 to 2016. Ottawa (ON): CIHI; 2017.
7. Statistics Canada. CANSIM database: Table 102-0540: Deaths, by cause, Chapter XX: External causes of morbidity and mortality (V01 to Y89), age group and sex, Canada, annual (number), Canada [Internet]. Ottawa (ON): Statistics Canada; [cited 2018 Jan 1]. Available from: http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=1020540
8. Statistics Canada. Canadian Tobacco, Alcohol and Drugs (CTADS): 2015 summary [Internet]. Ottawa (ON): Government of Canada; [updated 2017 Mar; cited 2018 Jan 9]. Available from: https://www.canada.ca/en/health-canada/services/canadian-tobacco-alcohol-drugs-survey/2015-summary.html
9. Tourangeau R, Yan T. Sensitive questions in surveys. Psychol Bull. 2007; 133(5):859-83. doi: 10.1037/0033-2909.133.5.859.

10. Bonevski B, Randell M, Paul C, et al. Reaching the hard-to-reach: a systematic review of strategies for improving health and medical research with socially disadvantaged groups. BMC Med Res Methodol. 2014;14(1):42.

11. Substance Abuse and Mental Health Services Administration. Substance use and suicide: A nexus requiring a public health approach. Washington (DC): US Department of Health and Human Services; 2016. [HHS Publication No. SMA-16-4935].

12. Gakidou E, Afshin A, Abajobir AA, et al.; GBD 2016 Risk Factors Collaborators. Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet. 2017;390(10100): 1345-422. doi: 10.1016/S0140-6736 (17)32366-8.

13. Wall R, Rehm J, Fischer B, et al. Social costs of untreated opioid dependence. J Urban Health. 2000; 77(4):688-722. doi: 10.1007 /BF02344032.

14. GBD 2016 Causes of Death Collaborators. Global, regional, and national age-specific mortality for 264 causes of death, 1980–2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet. 2017; 390(10100):1151-210. doi: 10.1016/ S0140-6736(17)32152-9.

15. Stevens GA, Alkema L, Black RE, et al. Guidelines for accurate and transparent health estimates reporting: the GATHER statement. PLoS Med. 2016; 13(6):e1002056. doi: 10.1371/journal .pmed.1002056.

16. Vos T, Abajobir AA, Abate KH, et al.; GBD 2016 Disease and Injury Incidence and Prevalence Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet. 2017;390(10100):1211-59. doi: 10.1016/S0140-6736(17)32154-2.

17. Hay SI, Abajobir AA, Abate KH, et al.; GBD 2016 DALYs and HALE Collaborators. Global, regional, and national disability-adjusted life-years (DALYs) for 333 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet. 2017;390(10100):1260-344. doi: 10.1016/S0140-6736(17) 32130-X.

18. Degenhardt L, Charlson F, Mathers B, et al. The global epidemiology and burden of opioid dependence: results from the global burden of disease 2010 study. Addiction. 2014;109(8): 1320-33. doi: 10.1111/add.12551.

19. Calabria B, Degenhardt L, Briegleb C, et al. Systematic review of prospective studies investigating "remission" from amphetamine, cannabis, cocaine and opioid dependence. Addict Behav. 2010;35(8):741-49. doi: 10.1016/j .addbeh.2010.03.019.

20. Degenhardt L, Bucello C, Calabria B, et al.; GBD illicit drug use writing group. What data are available on the extent of illicit drug use and dependence globally? Results of four systematic reviews. Drug Alcohol Depend. 2011;117(2–3):85-101. doi: 10.1016/j .drugalcdep.2010.11.032.

21. Nelson P, McLaren J, Degenhardt L, et al. What do we know about the extent of heroin and other opioid use and dependence? Results of a global systematic review. Sydney (AU): National Drug and Alcohol Research Centre, University of New South Wales; 2010 [NDARCTechnical Report no. 309].

22. Degenhardt L, Bucello C, Mathers B, et al. Mortality among regular or dependent users of heroin and other opioids: a systematic review and meta-analysis of cohort studies. Addiction. 2011;106(1):32–51. doi: 10.1111/j.1360-0443.2010.03140.x.

23. Foreman KJ, Lozano R, Lopez AD, Murray CJ. Modeling causes of death: an integrated approach using CODEm. Popul Health Metr. 2012;10(1):1. doi: 10.1186/1478-7954-10-1.

24. Statistics Canada. CANSIM database: Table 102-0525: Deaths, by cause, Chapter V: Mental and behavioural disorders (F00 to F99), age group and sex, Canada, annual (number), Canada [Internet]. Ottawa (ON): Statistics Canada; [cited 2018 Jan 1]. Available from: http://www5.statcan.gc.ca /cansim/a26?lang = eng&id = 1020525

25. Diagnostic and Statistical Manual of Mental Disorders, 4th ed., text revision (DSM-IV-TR). Washington (DC): American Psychiatric Association; 2000.

26. World Health Organization. The ICD-10 classification of mental and behavioural disorders – diagnostic criteria for research. Geneva: World Health Organization; 1993.

27. Barendregt JJ, van Oortmarssen GJ, Vos T, Murray CJ. A generic model for the assessment of disease epidemiology: the computational basis of DisMod II. Popul Health Metr. 2003; 1(1):4. doi: 10.1186/1478-7954-1-4.

28. Hickman M, Taylor C, Chatterjee A, et al. Estimating the prevalence of problematic drug use: a review of methods and their application. Bull Narc. 2002;54:15-32.

29. Salomon JA, Vos T, Hogan DR, et al. Common values in assessing health outcomes from disease and injury: disability weights measurement study for the Global Burden of Disease Study 2010. Lancet. 2012; 380(9859): 2129-43.

30. Salomon JA. New disability weights for the global burden of disease. Bull World Health Organ. 2010;88:879-79.

31. Grant BF, Moore T, Kaplan K. Source and Accuracy Statement: Wave 1 National Epidemiologic Survey on Alcohol and Related Conditions (NESARC). Bethesda (MD): National Institute on Alcohol Abuse and Alcoholism; 2003.

32. Paulozzi LJ, Jones CM, Mack KA, et al. Vital signs: overdoses of prescription opioid pain relievers – United States, 1999-2008. MMWR. 2011;60(43): 1487-92.

33. Centers for Disease Control and Prevention (CDC). Vital signs: overdoses of prescription opioid pain relievers and other drugs among women--United States, 1999–2010. MMWR Morb Mortal Wkly Rep. 2013 Jul 5;62(26):537-42.

34. Canadian Institute for Health Information. Opioid-related harms in Canada. Ottawa (ON): CIHI; 2017.

35. MacLean KA, Johnson MW, Griffiths RR. Hallucinogens and club drugs. Textbook of Substance Abuse Treatment, Fifth Edition. Galanter M, Kleber HD, Brady KT eds. American Psychiatric Association, Arlington, VA. 2015 Apr 1.

36. Rockett IR, Kapusta ND, Bhandari R. Suicide misclassification in an international context: revisitation and update. Suicidol Online. 2011;2:48-61.

37. O'Connor S, Grywacheski V, Louie K. At-a-glance – Hospitalizations and emergency department visits due to opioid poisoning in Canada. Health Promot Chronic Dis Prev Can. 2018;38(6):244-7.

38. Degenhardt L, Whiteford H, Hall WD. The Global Burden of Disease projects: what have we learned about illicit drug use and dependence and their contribution to the global burden of disease? Drug Alcohol Rev. 2014;33(1):4-12.

39. Stone AL, Becker LG, Huber AM, et al. Review of risk and protective factors of substance use and problem use in emerging adulthood. Addict Behav. 2012;37(7):747-75.

40. Newton JN, Briggs AD, Murray CJ, et al. Changes in health in England, with analysis by English regions and areas of deprivation, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet. 2015;386(10010):2257-74.

41. Coles E, Mensah GA. The burden of heart, lung, and blood diseases in the United States, 1990 to 2016: Perspectives from the National Heart, Lung, and Blood Institute. Glob Heart. 2017; 12(4):349-58.

https://doi.org/10.24095/hpcdp.38.6.04

At-a-glance

Hospitalizations and emergency department visits due to opioid poisoning in Canada

Shannon O'Connor, MA; Vera Grywacheski, MPH; Krista Louie, MSc

Abstract

The rise in opioid-related harms is an issue of increasing public health importance in Canada. This analysis used data from the Hospital Morbidity Database and the National Ambulatory Care Reporting System to determine the number of opioid poisoning hospitalizations and emergency department visits in Canada. Opioid poisoning hospitalizations have increased over the past 10 years, reaching 15.6 per 100 000 population in 2016/17. Emergency department visits due to opioid poisoning have also increased in Alberta and Ontario, the two provinces that collect emergency department data at the level of detail required for this analysis. These findings highlight the importance of pan-Canadian surveillance of opioid-related harms, as well as the need for evidence-based policies to help reduce these harms.

Keywords: *analgesics, opioid, public health, hospitalization, emergency service, hospital*

Highlights

- Opioid poisonings result in an average of 16 hospitalizations a day in Canada, as well as 11 emergency department visits a day in Alberta and 13 emergency department visits a day in Ontario.
- Over the past 10 years, seniors aged 65 and older and adults aged 45 to 64 have had the highest rates of opioid poisoning hospitalizations, while youth aged 15 to 24 and adults aged 25 to 44 had the fastest growing hospitalization rates.
- While opioid poisoning hospitalization rates have increased in most jurisdictions, the highest rates are in northern and western Canada.
- Most of the increases in both hospitalizations and emergency department visits due to opioid poisoning have occurred over the past three years.

Introduction

Canada is having a serious public health crisis due to the harms associated with opioids. Recent data from the Public Health Agency of Canada indicate that there were 2861 apparent opioid-related deaths in Canada in 2016 and at least 1460 deaths from January to June 2017.[1] Despite the urgent nature of this crisis, there is very little information regarding the number of Canadians who experience nonfatal opioid-related harms. Therefore, pan-Canadian measures that provide a better understanding of the harms associated with opioids, including hospitalizations and emergency department visits, are a high priority.

Methods

This analysis identified hospitalizations and emergency department visits due to opioid poisoning using ICD-10-CA (the International Statistical Classification of Diseases and Related Health Problems, 10th Revision) codes (T40.0, T40.1, T40.2, T40.3, T40.4 and T40.6). The analysis included 10 years (2007/08 to 2016/17) of hospitalization data from the Canadian Institute for Health Information's (CIHI) Hospital Morbidity Database for all Canadian provinces and territories (except Quebec and Nunavut, where the most recent data available was from 2015/16). The hospitalization analysis was limited to "significant opioid poisoning" cases, defined as cases in which opioid poisoning was considered influential to the time that the patient spent in hospital and to the treatment that they received while they were there. To identify significant opioid poisoning hospitalizations, the analysis included diagnosis types M (most responsible diagnosis), 1 (pre-admit comorbidity), 2 (post-admit comorbidity), 6 (proxy most-responsible diagnosis), W, X, Y (service transfer diagnoses) and C (CIHI-assigned value for Quebec).

The analysis also included five years (2012/13 to 2016/17) of emergency department (ED) data from CIHI's National Ambulatory Care Reporting System for Alberta and Ontario, the two provinces that require mandatory coding of full ICD-10-CA codes. While Yukon also collects ED data at this level of detail, it was excluded from the analysis due to the small number of counts. The analysis of ED data included any documented diagnosis of an opioid poisoning.

The direct standardization process was used to calculate standardized rates, with the 2011 Canadian population being used as the reference year.

Results

Hospitalizations due to opioid poisoning

In 2016/17, there were 5670 hospitalizations due to opioid poisoning in Canada,

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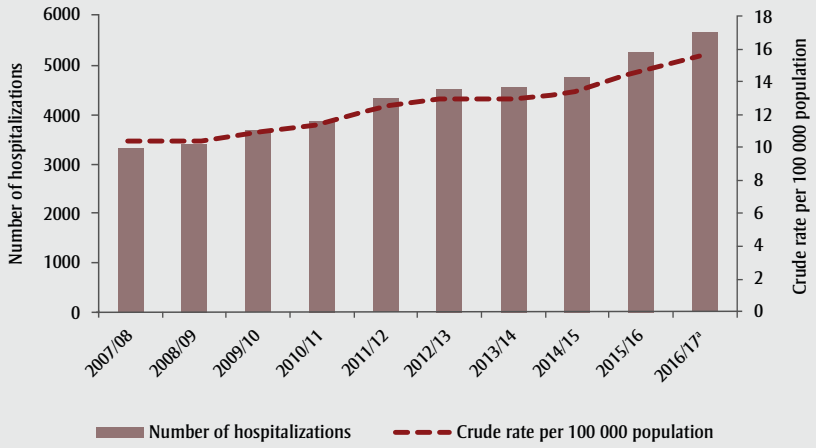
an average of 16 hospitalizations each day. Over the past 10 years, the rate of hospitalizations due to opioid poisoning increased by 53%, to 15.6 per 100 000 population (Figure 1). Nearly half of this increase occurred over the last three years. Hospitalization rates due to opioid poisoning have increased across all age groups, with seniors aged 65 and older and adults aged 45 to 64 consistently having the highest rates (Figure 2). The fastest growing hospitalization rates, however, were observed in youth aged 15 to 24 and in adults aged 25 to 44. While opioid poisoning hospitalization rates have historically been higher among females, 2016/17 was the first year in which the hospitalization rate was slightly higher for males (15.8 per 100 000 population) than it was for females (15.5 per 100 000 population) (Table 1).

The analysis also revealed that while opioid poisoning hospitalization rates vary across Canada, they are increasing in almost all jurisdictions. In 2016/17, hospitalization rates were highest in northern and western Canada, with the territories, British Columbia and Alberta having the highest rates (Figure 3).

Emergency department visits due to opioid poisoning

In 2016/17, there were 3894 ED visits in Alberta and 4831 ED visits in Ontario due to opioid poisoning, an average of 11 ED visits in Alberta and 13 in Ontario each day. Over the past five years, the age-adjusted rate of ED visits due to opioid poisoning has more than doubled in Alberta, from 37.6 per 100 000 population in 2012/13 to 88.6 per 100 000 population in 2016/17 (Figure 4). In Ontario, the age-adjusted rate of ED visits due to opioid poisoning has increased by 47%, from 23.5 per 100 000 population in 2012/13 to 34.6 per 100 000 population in 2016/17. Like hospitalizations, most of the increases in both provinces occurred over the last three years.

FIGURE 1
Opioid poisoning hospitalizations, Canada, 2007/08 to 2016/17



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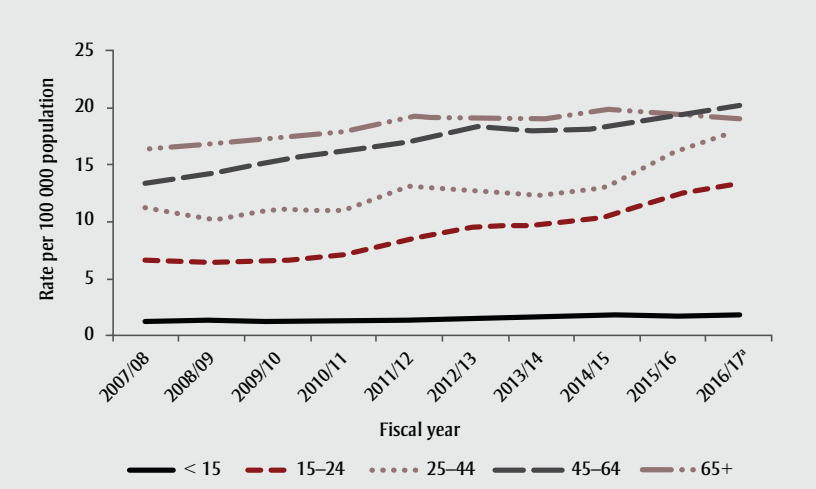
[a] Quebec and Nunavut data are from 2015/16 (the most recent year of data available).

FIGURE 2
Opioid poisoning hospitalizations by age (in years), Canada, 2007/08 to 2016/17



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[a] Quebec and Nunavut data are from 2015/16 (the most recent year of data available).

TABLE 1
Crude rate per 100 000 population of significant opioid poisoning hospitalizations by sex and fiscal year, Canada, 2007/08 to 2016/17

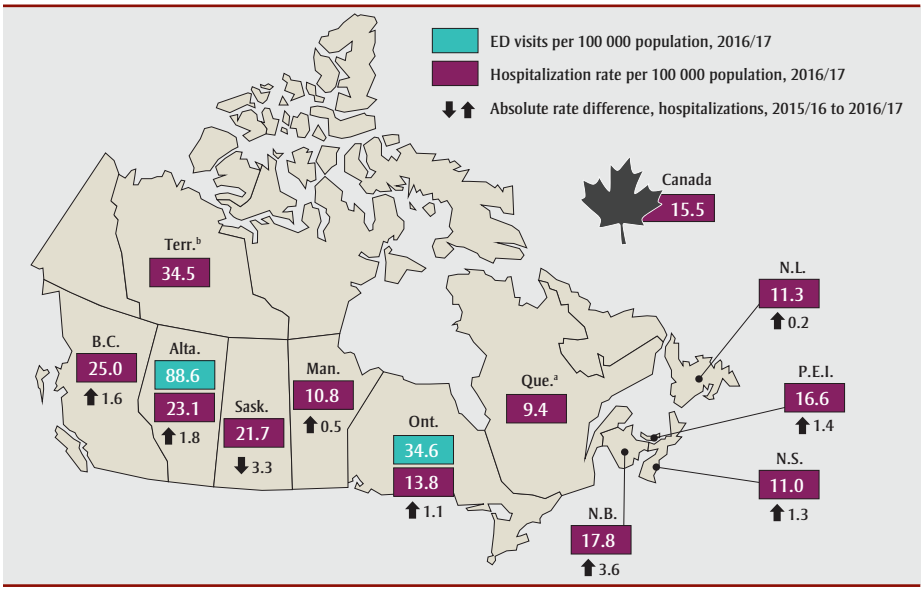
Sex	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17[a]
Female	11.2	11.3	11.8	12.3	13.5	13.7	13.8	14.1	14.8	15.5
Male	9.1	9.1	10.0	10.4	11.5	12.3	12.0	12.7	14.6	15.8

Source: Reprinted with permission from Canadian Institute for Health Information. Opioid-related harms in Canada: data tables, September 2017. Ottawa (ON): CIHI; 2017. Available from: https://www.cihi.ca/sites/default/files/document/opioid-harms-data-tables-en.xlsx

Note: Records with unknown/other sex are not reported.

[a] Quebec and Nunavut data are from 2015/16 (the most recent year of data available).

FIGURE 3
Hospitalizations and ED visits due to opioid poisoning, age-adjusted rates per 100 000 population, Canada, 2016/17



Source: Adapted with permission from Canadian Institute for Health Information. Opioid-related harms in Canada: chartbook, September 2017. Ottawa (ON): CIHI; 2017. Available from: https://www.cihi.ca/sites/default/files/document/opioid-harms-chart-book-en.pdf

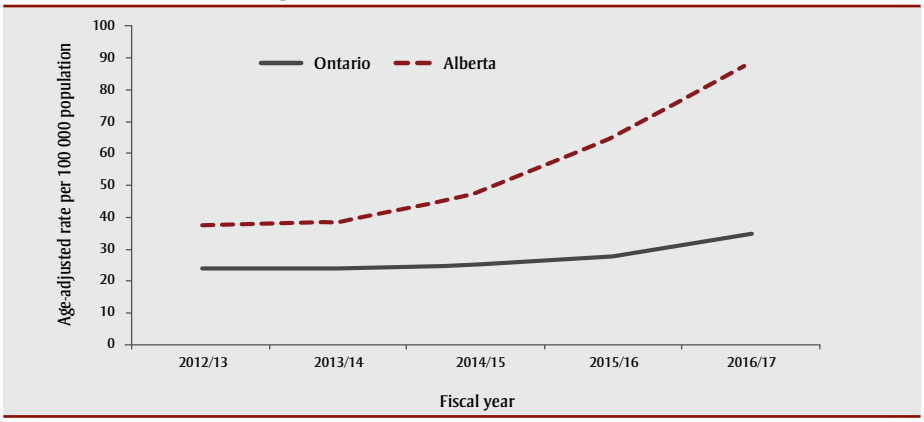
Abbreviations: Alta., Alberta; B.C., British Columbia; ED, emergency department; Man., Manitoba; N.B., New Brunswick; N.L., Newfoundland and Labrador; N.S., Nova Scotia; Ont., Ontario; P.E.I., Prince Edward Island; Que., Quebec; Sask., Saskatchewan; Terr., Territories (Yukon, Northwest Territories and Nunavut).

[a] Quebec hospitalization data are from 2015/16 (the most recent year of data available); therefore, there is no absolute rate difference shown.

[b] Yukon, Northwest Territories and Nunavut hospitalization data are grouped together due to low volumes. These data should be interpreted with caution. Nunavut data are from 2015/16 (the most recent year of data available); therefore, there is no absolute rate difference shown.

In Alberta, youth aged 15 to 24 and adults aged 25 to 44 had the highest and fastest growing rates of ED visits due to opioid poisoning, tripling over the past five years (Table 2). In Ontario, adults aged 25 to 44 had the highest and fastest growing rates, increasing by 85% over the past five years. In both provinces, rates of ED visits due to opioid poisoning were higher among males than females (Table 3). This difference was particularly striking in Alberta, where the rate of opioid poisoning ED visits was 110.0 per 100 000 population for males and 72.6 per 100 000 population for females in 2016/17.

FIGURE 4
Opioid poisoning ED visits, Ontario and Alberta, 2012/13 to 2016/17



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Abbreviation: ED, emergency department.

Discussion

This analysis found that hospitalizations and emergency department visits due to opioid poisoning have increased in recent years, with the greatest increases in rates over the past three years.

Strengths and limitations

This study provides the most up-to-date analysis of pan-Canadian trends in opioid poisoning hospitalizations and emergency department visits. However, the analysis included only opioid poisonings that received treatment in a hospital or emergency department setting, and does not capture individuals who received treatment in other environments (e.g. supervised consumption sites). The results, therefore, likely underestimate the number of Canadians who have experienced harms related to opioids. In addition, the analysis relied on administrative data sources which are based on patients' chart documentation. Deficiencies in chart documentation and/or failure to provide hospital coders with appropriate documents can affect data quality and lead to underreporting.

Conclusion

The rise in opioid-related harms highlights the importance of establishing comparable data to support public health surveillance at local, provincial and federal levels. The results of this analysis also underscore the importance of evidence-based strategies to help reduce opioid-related harms, including access to opioid agonist treatment, improved prescribing practices, prescription monitoring programs and increased access to naloxone. Moving forward, CIHI intends to update this analysis on a regular basis as more data becomes available, including ED data for additional jurisdictions.

Acknowledgements

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Conflicts of interest

CIHI has received five years of funding from Health Canada for work related to

TABLE 2
Crude rate per 100 000 population of opioid poisoning ED visits by age group and fiscal year, Ontario and Alberta, 2012/13 to 2016/17

	Ontario					Alberta				
Age group (years)	2012/13	2013/14	2014/15	2015/16	2016/17	2012/13	2013/14	2014/15	2015/16	2016/17
<15	3.2	3.4	3.1	3.9	3.8	6.2	8.5	6.9	6.0	4.8
15–24	30.1	29.7	32.4	32.2	41.8	50.9	57.9	72.5	115.2	162.1
25–44	30.8	29.8	33.6	40.9	56.9	49.8	49.6	68.6	100.0	151.0
45–64	27.1	27.5	27.8	30.3	34.5	41.3	41.1	46.3	58.9	72.5
65+	19.2	19.5	20.6	21.9	22.1	30.7	29.7	32.3	36.3	35.1

Source: Reprinted with permission from Canadian Institute for Health Information. Opioid-related harms in Canada: data tables, September 2017. Ottawa (ON): CIHI; 2017. Available from: https://www.cihi.ca/sites/default/files/document/opioid-harms-data-tables-en.xlsx

Abbreviation: ED, emergency department.

Note: Records with unknown age are not reported.

TABLE 3
Crude rate per 100 000 population of opioid poisoning ED visits by sex and fiscal year, Ontario and Alberta, 2012/13 to 2016/17

	Ontario					Alberta				
Sex	2012/13	2013/14	2014/15	2015/16	2016/17	2012/13	2013/14	2014/15	2015/16	2016/17
Female	22.6	22.4	22.7	26.5	29.1	41.0	41.2	45.7	59.0	72.6
Male	24.4	24.2	27.1	29.2	40.1	34.4	36.4	50.3	74.3	110.0

Source: Reprinted with permission from Canadian Institute for Health Information. Opioid-related harms in Canada: data tables, September 2017. Ottawa (ON): CIHI; 2017. Available from: https://www.cihi.ca/sites/default/files/document/opioid-harms-data-tables-en.xlsx

Abbreviation: ED, emergency department.

Note: Records with unknown/other sex are not reported.

the monitoring and surveillance of prescription drug abuse in Canada. The authors have no other conflicts of interest to disclose.

Authors' contributions and statement

SO, KL and VG were involved in the design and conceptualization of the work, as well as in the analysis and interpretation of the data. SO and KL were involved in drafting and revising the paper. All authors have approved the final manuscript for publication.

The content and views expressed in this article are those of the authors and do not necessarily reflect those of the Government of Canada.

Reference

1. Government of Canada. Apparent opioid-related deaths. Ottawa (ON): Government of Canada; [cited 2018 Jan 3]. Available from: https://www.canada.ca/en/health-canada/services/substance-abuse/prescription-drug-abuse/opioids/apparent-opioid-related-deaths.html

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At-a-glance

Impact of drug overdose-related deaths on life expectancy at birth in British Columbia

Xibiao Ye, PhD (1); Jenny Sutherland, MSc (1); Bonnie Henry, MD (1); Mark Tyndall, MD (2); Perry Robert William Kendall, MD (1)

Abstract

We quantified the contributions of leading causes of death and drug overdose to changes in life expectancy at birth over time and inequalities by sex and socioeconomic status in British Columbia. From 2014 to 2016, life expectancy at birth declined by 0.38 years and drug overdose deaths (mainly opioid-involved) contributed a loss of 0.12 years of the decrease. The analysis also demonstrated that the higher drug overdose mortality among males and among those in lower socioeconomic status communities contributed to a differential decrease in life expectancy at birth for males and for those in the latter category.

Keywords: *opioid overdose death, life expectancy at birth, inequality*

Highlights

- Life expectancy at birth (LE_0) in BC decreased by 0.38 years from 2014 to 2016, and fatal drug overdoses (the majority involving opioids) accounted for 32% of the decrease.
- In 2016, LE_0 for males was 4.59 years lower than that for females, and drug overdose mortality accounted for 9% of this gap.
- In 2016, LE_0 for those in communities with the highest deprivation index (quintile 5 or lowest socio-economic status) was 5.58 years lower compared to people who live in communities with the lowest deprivation index (quintile 1 or highest socio-economic status), and drug overdose mortality accounted for 7% of this gap.

Introduction

The number of illicit drug overdose deaths has dramatically increased in British Columbia (BC) since 2014, from 369 deaths in 2014 to 1208 deaths (including suspected cases) as of October 31, 2017.[1] Fentanyl or its analogues, in combination with other drugs, accounted for the majority of illicit drug overdose deaths.[2] In response to the increasing drug overdose crisis, a public health emergency was declared on April 14, 2016 in BC.[3]

The contribution of drug overdose deaths to life expectancy change has rarely been quantified. Between 2000 and 2014, unintentional poisonings (mostly drug and alcohol overdoses) contributed a loss of 0.338 years in life expectancy at birth (LE_0) for the non-Hispanic white population in the United States of America (USA), the greatest negative impact by cause of death.[4] Specifically, opioid-involved overdose deaths contributed to a loss of 0.21 years in LE_0 for the entire USA population between 2000 and 2015.[5] In this article, we sought to adapt the analysis to the BC setting and to further expand the analysis by quantifying the contribution of opioid and other drug overdose deaths to life expectancy inequalities by sex and socioeconomic status (SES).

Methods

We obtained data on deaths recorded by the BC Vital Statistics Agency during 2001–2016. We used the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10) to classify causes of deaths. We identified deaths involved opioids (T40.0, T40.1, T40.2, T40.3, T40.4, T40.6), cocaine (T40.5) and other drugs (T40.7, T40.8, T40.9). Those classified as unintentional injuries (X40–X44) or undetermined intent (Y10–Y14) were included in the analysis. We calculated mortality using the insured population in the province and used the 2001 population as the reference to standardize mortality rates.

We used the Chiang method[6] to construct period life tables and calculated LE_0 gaps between 2001 and 2016 and between 2014 and 2016. We examined LE_0 inequalities by sex and by deprivation index. Deprivation index, an area-based SES measurement including material deprivation (a composite of household income, unemployment and high school graduation) and social deprivation (a composite of marital status, living alone and residential stability), was constructed using the 2011 Canadian Census according to the method described by Pampalon et al.[7] A lower score for this index indicates a better SES (less deprivation). We partitioned the gaps into age and leading cause of death including drug overdose using Arriaga's decomposition method.[8] Analyses

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were undertaken using SAS version 9.3 (SAS Institute Inc., Cary, NC, USA).

Results

LE_0 in BC increased from 80.27 years (95% confidence interval [CI] 80.12–80.42) in 2001 to 83.02 years (95% CI 82.88–83.16) in 2014. However, from 2014 to 2016, LE_0 decreased by 0.38 years to 82.64 years (95% CI 82.50–82.77) (Table 1). Reduced mortality rates for cancers, heart diseases, cerebrovascular diseases and accidents contributed to the majority of the 2.37-year increase in LE_0 during 2001 and 2016. However, deaths involving any type of drugs caused a loss of 0.15 years to LE_0 during this period. Opioid-involved deaths accounted for nearly 80% of overall drug overdose deaths in 2001, but this increased to 90% in 2016. The increase in opioid-involved deaths contributed a loss of 0.16 years to LE_0 in 2016, compared to 2001. Drug overdose deaths contributed a loss of 0.12 years in 2016 compared to 2014, accounting for 32% of the total decline during this period.

In 2001, LE_0 for males was 5.01 years lower than that for females (Table 2). The higher drug overdose mortality in males contributed 0.20 years to the gap, but the majority were attributed to cancer, heart disease and injury (accidents and suicide) deaths. While the sex difference in LE_0 declined to 4.59 years in 2016, the contribution by drug overdose deaths doubled to 0.42 years (accounting for 9% of the gap). Drug overdose mortality rates were inversely associated with both material and social deprivation index. In 2011, LE_0 for the population living in the highest total deprivation level (quintile 5 or the lowest SES) communities was 5.50 years lower than that for the population living in the lowest total deprivation level

TABLE 1
Contributions of leading causes of death and drug overdose to the changes in life expectancy at birth in BC

	Year 2001		Year 2014		Year 2016		Change and contributions (in years) by selected causes of death to the life expectancy at birth change in 2016			
							Change from 2001	Contribution[a]	Change from 2014	Contribution[a]
Life expectancy (in years)	80.27		83.02		82.64		2.37		−0.38	
Number of deaths and age-standardized mortality rate (per 100 000 population) by cause of death	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**				
Cancer	7799	196.4	9948	170.2	10 170	162.8	−17.1%	0.66	−4.3%	0.15
Heart diseases	6875	173.2	6121	95.2	6456	93.5	−46.0%	1.27	−1.8%	0.02
Cerebrovascular disease	2297	57.9	2175	34.1	2320	33.7	−41.8%	0.36	−1.2%	0.01
Chronic lower respiratory diseases	1299	32.7	1590	26.1	1801	27.5	−16.1%	0.08	5.1%	−0.03
Diabetes	707	17.8	1595	26.2	1670	25.8	45.1%	−0.13	−1.3%	0.01
Unintentional injuries	1018	25.6	1088	19.6	816	13.7	−46.7%	0.39	−30.4%	0.17
Influenza, pneumonia	1181	29.7	1091	16.5	1261	17.9	−40.0%	0.17	8.4%	−0.03
Alzheimer's disease and other dementia	1041	26.2	2487	36.3	2726	37.2	41.8%	−0.15	2.5%	−0.02
Chronic liver disease and cirrhosis	269	6.8	463	8.1	480	8.1	20.2%	−0.03	0.7%	0.00
Suicide	459	11.6	604	12.4	427	8.7	−24.7%	0.07	−29.9%	0.10
Parkinson's disease	204	5.1	322	5.4	357	5.6	8.2%	0.00	2.8%	0.00
Primary hypertension and renal diseases	110	2.8	279	4.3	301	4.2	51.6%	−0.02	−1.2%	0.00
Drug overdose	272	6.9	369	8.1	528	11.7	70.7%	−0.15	43.9%	−0.12
Opioid and cocaine	64	1.6	128	2.9	192	4.3	166.3%	−0.08	48.0%	−0.04
Opioid w/o other drugs except cocaine	153	3.9	194	4.2	277	6.1	58.9%	−0.08	45.2%	−0.07
Cocaine w/o other drugs except opioid	55	1.4	47	1.0	58	1.3	−9.4%	0.01	23.9%	−0.01
Other drugs without opioid or cocaine	0		0		S					0.00
Other diseases (including undetermined causes)	4716	118.8	5486	92.5	7095	116.7	−1.7%	−0.14	26.2%	−0.63

Abbreviation: S, suppressed due to the number of death is less than 5.

[a] Contributing value is negative when mortality rate for a cause increased overtime and thus decreased the life expectancy at birth.

TABLE 2
Contributions of drug overdose to the life expectancy at birth inequalities (in years), by sex and deprivation level, British Columbia

Factor	2001 or 2011[a]		2016	
	Life expectancy difference	Contribution by drug overdose	Life expectancy difference	Contribution by drug overdose
Sex (male vs. female)[b]	−5.01	−0.20	−4.59	−0.42
Deprivation level (quintiles 5 vs. 1)[c]				
Material deprivation	−1.65	−0.16	−1.88	−0.16
Social deprivation	−5.62	−0.26	−5.43	−0.33
Total deprivation	−5.50	−0.31	−5.58	−0.39

[a] 2001 for the sex analysis and 2011 for the deprivation index analysis.
[b] Negative contribution represents a life expectancy at birth loss in males due to the higher drug overdose mortality.
[c] Negative contribution represents a life expectancy at birth loss in the population with the lowest socioeconomic status due to the higher drug overdose mortality. A low deprivation level value indicates a better socioeconomic situation (i.e. a lower level of deprivation).

(quintile 1 or the highest SES). Of this, 0.31 years were attributed to drug overdose deaths. The contribution by drug overdose increased to 0.39 years in 2016 (accounting for 7% of the gap). The inequalities by social deprivation were greater than that by material deprivation in both years.

Discussion

In this analysis, we found a 2.37-year increase in LE_0 from 2001 and 2016, but a 0.38-year decline from 2014 to 2016 (with 0.12 years attributed to drug overdose deaths). While the sex difference in LE_0 slightly narrowed between 2001 and 2016, the contribution by drug overdose deaths to the inequality doubled. During 2011 and 2016, LE_0 inequalities by deprivation level (between quintiles 1 and 5) were relatively stable, but the contribution by drug overdose deaths increased.

Between 2000 and 2015, drug overdoses contributed to 0.28 years lost in LE_0 in the USA. Of this, 0.21 years were attributed to opioid-involved overdose deaths.[5] In this analysis, we demonstrated that drug overdose deaths, specifically opioid overdose deaths, contributed to a considerable loss to LE_0 in BC. However, the contribution was smaller than in the USA due to the lower age-standardized morality rates (e.g. opioid overdose mortality rate in both sexes was 16.3 per 100 000 in the USA in 2015[5] and 11.9 per 100 000 in BC in 2016). LE_0 has improved over past decades in the USA, reaching the highest at 78.9 years in 2014, but slightly declined to 78.8 years in 2015 and to 78.6 years in 2016. The decline was largely due to the increased deaths in younger ages and deaths from unintentional injuries including drug overdose.[4,9] Similarly, we have found a LE_0 decline since 2014 in BC and the decline was partially attributed to increased drug overdose deaths, in particular in males. Other provinces have also experienced increasing drug overdose deaths,[10-12] but it is unclear how this will impact life expectancy at the national level.

Sex and socioeconomic inequalities in life expectancy at birth have been reported at different geographic levels.[13-16] While studies clearly showed the differences in life expectancy, little is known about the contributions of cause of death and risk factors associated with sex and SES. In this analysis, we showed that drug overdose deaths alone explained approximately 9% of LE_0 loss in males in 2016, compared to females. The contribution has doubled during the last 15 years due to the significantly increased drug overdose deaths in males. Drug overdose mortality rate for those in the lowest SES communities was 3 times higher than that in the highest SES communities (data not shown), accounting for 7% of LE_0 loss. These findings show the important impact that drug overdose deaths have had on the entire population of BC, and in particular, the differential negative impact on males and those who live in the most socioeconomically deprived areas of the province. This should further our resolve to address this largely preventable cause of death.

The contribution by drug overdose deaths may have been underestimated as only confirmed cases were included and coroners' cause of death can take up to two years or longer to determine. For 2016, BC Coroners Service reported 985 drug overdose deaths,[1] but by using vital statistics data, we identified 528 drug overdose deaths and over 1200 cases with undetermined causes of deaths. A significant proportion of these unspecified cases will likely be determined as opioid related, driving the contribution of opioid overdose deaths higher (likely greater than 50%). A recent study showed that 30% of drug-related deaths registered in the forensic toxicology registry in Sweden had not been recorded in the country's vital statistics database, resulting in an approximately 20% underreporting of drug-related mortality.[17] Including other data sources, e.g. forensic toxicological registry to identify additional drug-related deaths would further improve the estimation.

Conclusion

The life expectancy at birth for people in BC increased by 3 years between 2001 and 2014, but decreased by 0.38 years from 2014 to 2016. The opioid overdose crisis was an important contributor to this loss. The higher death rate from opioid overdoses was also a major contributor to a shorter life expectancy among males compared to females and to a shorter life expectancy for people from the most socioeconomically disadvantaged communities compared to those from the least disadvantaged communities.

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Conflicts of interest

The authors have no conflicts of interest to disclose.

Authors' contributions and statement

XY conceptualized the design of the study and wrote the initial draft. JS led data analysis. PK, BH and MT provided input to study design, analysis and interpretation of the data, and drafting and revising the paper. All authors have seen and approved the final manuscript.

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References

1. Office of the Chief Coroner, BC Ministry of Public Safety and Solicitor General. Illicit Drug Overdose Deaths in BC [Internet]. 2017 [cited 2017 Dec 29]. Available from: https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/death-investigation/statistical/illicit-drug.pdf

2. Office of the Chief Coroner, BC Ministry of Public Safety and Solicitor General. Fentanyl-Detected Illicit Drug Overdose Deaths [Internet]. 2017 [cited 2017 Dec 29]. Available from: https://www2.gov.bc.ca/assets/gov/public-safety-and-emergency-services/death-investigation/statistical/fentanyl-detected-overdose.pdf

3. BC Gov News. Provincial health officer declares public health emergency [Internet]. 2016 [cited 2017 Dec 29]. Available from: https://news.gov.bc.ca/releases/2016HLTH0026-000568

4. Kochanek KD, Murphy SL, Xu J, Arias E. Mortality in the United States, 2016 Key findings Data from the National Vital Statistics System. NCHS Data Brief. 2016;293:1-8. Available from: https://www.cdc.gov/nchs/data/databriefs/db293.pdf

5. Dowell D, Arias E, Kochanek K, Anderson R, Guy GP, Losby JL, et al. Contribution of opioid-involved poisoning to the change in life expectancy in the United States, 2000-2015. JAMA. 2017;318(11):1065-1067. doi: 10.1001/jama.2017.9308.

6. Chiang CL. On constructing current life tables. J Am Stat Assoc. 1972; 67(339):538–41.

7. Pampalon R, Hamel D, Gamache P, Philibert MD, Raymond G, Simpson A. An area-based material and social deprivation index for public health in Québec and Canada. Can J Public Health. 2012;103(8):17–22. Available from: http://journal.cpha.ca/index.php/cjph/article/view/3156

8. Arriaga EE. Measuring and explaining the change in life expectancies. Demography. 1984;21(1):83-96.

9. Xu J, Murphy SL, Kochanek KD, Arias E. Mortality in the United States, 2015 Key findings Data from the National Vital Statistics System, Mortality. NCHS Data Brief. 2016;267: 3-8. Available from: https://www.cdc.gov/nchs/data/databriefs/db267.pdf

10. Public Health Ontario. Opioid-related morbidity and mortality in Ontario [Internet]. [cited 2018 Jan 7]. Available from: http://www.publichealthontario.ca/en/dataandanalytics/pages/opioid.aspx

11. Alberta Health Analytics and Performance Reporting Branch. Alberta Health Opioids and Substances of Misuse Alberta Report, 2017 Q3. 2017 [cited 2018 Jan 7]; Available from: https://open.alberta.ca/dataset/1cfed7da-2690-42e7-97e9-da175d36f3d5/resource/e69ffcb0-6d34-4e2b-bf35-7d13ec35de59/download/Opioids-Substances-Misuse-Report-2017-Q3.pdf

12. Public Health Agency of Canada. National report: Apparent opioid-related deaths in Canada (January 2016 to March 2017) [Internet]. [cited 2018 Jan 7]. Available from: https://www.canada.ca/en/public-health/services/publications/healthy-living/apparent-opioid-related-deaths-report-2016.html

13. Wang H, Naghavi M, Allen C, Barber RM, Bhutta ZA, Carter A, et al. Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet. 2016; 388(10053):1459–544. doi : 10.1016/S0140-6736(16)31012-1.

14. Dwyer-Lindgren L, Stubbs RW, Bertozzi-Villa A, Morozoff C, Callender C, Finegold SB, et al. Variation in life expectancy and mortality by cause among neighbourhoods in King County, WA, USA, 1990–2014: a census tract-level analysis for the Global Burden of Disease Study 2015. Lancet Public Health. 2017;2(9):e400–10. doi: 10.1016/S2468-2667(17)30165-2.

15. Zhang LR, Rasali D. Life expectancy ranking of Canadians among the populations in selected OECD countries and its disparities among British Columbians. Arch Public Health. 2015;73(1):17. doi: 10.1186/s13690-015-0065-0.

16. Public Health Agency of Canada. Health Inequalities Data Tool, 2017 Edition. A joint initiative of the Public Health Agency of Canada, the Pan-Canadian Public Health Network, Statistics Canada, and the Canadian Institute of Health Information. [Internet]. Ottawa (ON): PHAC; 2017 [cited 2018 Jan 5]. Available from: https://infobase.phac-aspc.gc.ca/health-inequalities/

17. Fugelstad A, Ramstedt M, Thiblin I, Johansson LA. Drug-related deaths: Statistics based on death certificates miss one-third of cases. Scand J Public Health. 2017;1-9. doi: 10.1177/1403494817745187.

https://doi.org/10.24095/hpcdp.38.6.06

At-a-glance

Lessons learned from launching the Manitoba Take-Home Naloxone Program

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Abstract

The Government of Manitoba launched the provincial Take-Home Naloxone Program in January 2017. By the end of September 2017, there were over 60 sites operating in Manitoba. These sites distributed 765 kits to people at risk of opioid overdose, and 93 of these kits were replacement kits used in overdose events. Most of these events occurred among males (60.2%) and in a private residence (72.0%). Fentanyl and carfentanil were the most common substances reported during overdose events. Take-Home Naloxone Program data provide important information about the unique context of the opioid crisis in Manitoba.

Keywords: *naloxone distribution, opioid, overdose response*

Highlights

- Take-Home Naloxone Programs should be designed to minimize the human resource burden involved with distribution, thereby facilitating access.
- Take-Home Naloxone Program indicators can provide important information about drug market dynamics and drug-related harms.

Introduction

Harms associated with opioid overdose and misuse are a growing public health concern in Manitoba and in the other Canadian provinces. In Manitoba alone, the number of apparent opioid-related deaths increased by 87.5% from the first quarter of 2016 (n = 16) to the same period in 2017 (n = 30).[1] Significant shifts have been noted in fentanyl-related deaths in 2017. Specifically, 40% of deaths (n = 12) were found to have the carfentanil analogue present. This provincial trend is of concern as carfentanil is considered 50 to 100 times stronger than fentanyl, with doses as small as one microgram causing toxic effects in humans.[2]

As a response to the emerging opioid crisis, the Street Connections program of the Winnipeg Regional Health Authority launched the first Take-Home Naloxone Program in Manitoba in January 2016. The key program components were adapted from the British Columbia Centre for Disease Control, Take-Home Naloxone Program,[3] and further shaped by lessons learned through a qualitative consultation with people who use opioids in Winnipeg and other key stakeholders.

Manitoba Health, Seniors and Active Living (MHSAL) refined Winnipeg's pilot program and launched it as a provincial initiative in January 2017 as part of a public health opioid response plan. As part of the program, MHSAL provided take-home naloxone kits free of charge to persons at risk of opioid overdose, accompanied by training on overdose prevention, recognition and response, including the administration of naloxone. A summary of take-home naloxone kit components, distribution site criteria and a training manual are available online at www.gov.mb.ca/fentanyl/. An up-to-date list of take-home naloxone distribution sites in Manitoba is available at www.streetconnections.ca.

In this article, we present the key findings from the evaluation of the Manitoba Take-Home Naloxone Program from January 1 to September 30, 2017, as well as some of the key programmatic features that enabled the program's rapid expansion.

Methods

The Manitoba Take-Home Naloxone Program evaluation draws from three key sources of data. First, registered take-home naloxone distribution sites were opened into the inventory system created in Panorama (an electronic public health management system), providing information on the number of distribution sites and take-home naloxone kits delivered to sites from the provincial naloxone warehouse. Second, the Public Health Branch of MHSAL requires distribution sites to submit collated numbers on kits distributed to people at risk of opioid overdose (form available online at https://www.gov.mb.ca/health/publichealth/surveillance/docs/mhsu_6259_20171115.pdf).

Finally, when a lay responder uses a kit in an overdose event, the staff person replacing the kit completes and submits an overdose response form (available online at https://www.gov.mb.ca/health/publichealth/surveillance/docs/mhsu_6836_20161215.pdf) as a requirement of program monitoring and evaluation. We conducted the

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data analysis using these three data sources for the period of January 1 to September 30, 2017.

Results

In Manitoba, there were nine distribution sites operating at the time of the launch of the provincial Take-Home Naloxone Program, and over 60 distribution sites operating by the end of September 2017, including in 24 First Nations communities. Between January 1 and September 30, 2017, the provincial naloxone warehouse delivered 1360 take-home naloxone kits to distribution sites in Manitoba. Take-home naloxone distribution sites provided 765 of these kits to people at risk of an opioid overdose. Of these 765 kits, 93 were replaced due to reported use during suspected opioid overdose events in the community. This suggests that for every eight kits distributed, one kit is used in relation to a suspected opioid overdose event.

A large proportion of the 93 suspected opioid overdose events (where take-home naloxone kits were used and replaced) occurred among people between the ages of 12 and 30 (48.3%) (Table 1). In addition, 56 were male, 30 were female and seven were of sex unknown/prefer not to say. Most of these overdose events occurred in the Winnipeg Health Region (79.6%) and in a private residence (72.0%). Blotter tabs of bootleg fentanyl (36.6%) and carfentanil (23.7%) were the most commonly reported drugs involved in suspected opioid overdose events where take-home naloxone kits were used.

In 49 of 93 reported overdose events (52.6%), the lay responder did not call 911 (Table 2). The main reasons that 911 was not called included: "thought the person would get better on their own" (22.5%), "worried police would come" (20.4%) and "no phone" (14.3%). Main actions taken by the lay responder in response to the overdose events included: "checked the person's breathing" (60.2%) and "provided artificial respirations" (41.9%). Furthermore, half of the females who overdosed received one dose (0.4 mg) of naloxone, while males who overdosed most commonly received two doses (0.8 mg) of naloxone (53.6%) (data not shown).

TABLE 1
Characteristics of suspected opioid overdose events where a take-home naloxone kit was reportedly used, Manitoba, January 1 to September 30, 2017, N = 93

Characteristics	Categories	n (%)
Sex	Female	30 (32.3)
	Male	56 (60.2)
	Unknown/Prefer not to say	7 (7.5)
Age group (years)	12–30	45 (48.3)
	31–40	23 (24.7)
	41 or over	12 (13.0)
	Unknown/Prefer not to say	13 (14.0)
Location of overdose event	Private residence	67 (72.0)
	Street	7 (7.5)
	Other[a]/Unknown/Prefer not to say	19 (20.5)
Health region of overdose event	Winnipeg	74 (79.6)
	Other health regions	13 (13.9)
	Out of province/Unknown/Prefer not to say	6 (6.5)
Substance type[b]	Fentanyl	34 (36.6)
	Carfentanil	22 (23.7)
	Crystal meth	13 (14.0)
	Morphine	9 (9.7)
	Other substances[c]	15 (16.0)

[a] Other locations include public washroom, hotel, shelter and in-vehicle.
[b] Results are not mutually exclusive.
[c] Other substances include benzodiazepine, cocaine/crack, alcohol, codeine, methadone, heroin and dilaudid.

Discussion

Manitoba successfully implemented the Take-Home Naloxone Program in a relatively short period. The rapid expansion of Manitoba's Take-Home Naloxone Program is evident in the growth of distribution site numbers and reach, with sites in most health regions and over 24 First Nations communities within the first nine months of operation.

This success is attributable to several contextual and programmatic factors. First, pioneer take-home naloxone programs in other provinces, programs and regions have demonstrated the effectiveness of this intervention.[4] This body of evidence has supported the expansion of take-home naloxone distribution in other jurisdictions, including Manitoba.

Second, the rescheduling of naloxone as a nonprescription medication by Health Canada[5] in 2016 enabled the Manitoba program to launch in 2017 with less restrictive distribution site criteria, as a prescribing practitioner was not required. Furthermore, the program offers overdose response training to anyone who wishes to become a trainer for lay overdose responders, which reduces the human resource burden on health care providers at distribution sites.

Finally, MHSAL established key partnerships before distribution site criteria were solidified to ensure that the program would be flexible enough to operate in various urban and remote settings. Consultations with the First Nations Inuit Health Branch and regional tribal councils were key in establishing a cost recovery agreement scheme. This has enabled First Nations and non–First Nations communities to gain similar access to take-home naloxone kits, promote standardized training across the province and establish the ability to collate and share naloxone distribution data consistent with the principles of First Nations ownership, control, access and possession.[6]

Our data highlight a continued reluctance of lay responders to call 911 in overdose events because of the fear of arrest or harm from police attendance. The Good Samaritan Drug Overdose Act was enacted into law in May 2017, providing immunity to arrest for simple drug possession to a person who

TABLE 2
Characteristics of emergency response to suspected opioid overdose events where a take-home naloxone kit was reportedly used, Manitoba, January 1 to September 30, 2017, N = 93

Characteristics	Categories	n (%)
Was 911 called?	Yes	34 (36.6)
	No	49 (52.6)
	Unknown/Prefer not to say	10 (10.8)
Reason(s) for NOT calling 911[a]	No phone	7 (14.3)
	Worried police would come	10 (20.4)
	Thought the person would get better on their own	11 (22.5)
	Other reasons[b]	6 (12.2)
	Unknown/Prefer not to say	15 (30.6)
Action(s) taken during overdose[a]	Stayed with the person until (s)he came around	54 (58.1)
	Checked the person's breathing	56 (60.2)
	Provided artificial respiration	39 (41.9)
	Slapped or shook the person *(not recommended)*	34 (36.6)
	Put the person in the recovery position	25 (26.9)
	Checked the person's pulse	32 (34.4)
	Yelled at the person	39 (41.9)
	Provided chest compressions	20 (21.5)
	Stayed with the person until first responders arrived	28 (30.1)
	Checked the person's airway for obstruction	20 (21.5)
	Gave the person a sternal rub	30 (32.3)
	Other actions taken[c]	—
	Unknown	17 (18.3)
Number of naloxone doses[d] given	One	30 (32.3)
	Two	40 (43.0)
	Three	12 (12.9)
	Unknown	11 (11.8)

[a] Results are not mutually exclusive.

[b] Other reasons include the person overdosed requesting not to call 911, taking the person to the emergency room themselves, and the person recovering quickly.

[c] Other actions taken during the overdose include putting the person in a cold shower and stimulating with ice.

[d] One naloxone dose = 0.4 mg (i.e. 0.4 mg/mL).

—: Suppressed due to small sample size (i.e. n = 1–5).

calls 911 in an overdose emergency. Naloxone program data may be used to evaluate the impact of this policy change on the willingness of lay responders to call 911 during overdose events.

We found that blotter tabs of illicit fentanyl and carfentanil were the most commonly reported drugs involved in overdose events where take-home naloxone kits were reported to be used. To the best of our knowledge, the other urban centres in Canada have not reported this form of marketing/trafficking bootleg fentanyl and carfentanil. The fact that these products were reported detected or involved suggests that people are intentionally seeking and consuming these drugs, but not titrating them safely. This information reflects subjective reports on the drugs the naloxone kit owner suspected were involved in the overdose. Although these responses are not and cannot be validated with drug checking or toxicology, they comprise a very useful source of information about local drug markets.

Conclusion

Manitoba has successfully implemented the provincial Take-Home Naloxone Program in a relatively short period, providing opportunities to prevent opioid overdoses and reduce harms in emergency conditions. Data derived from the Take-Home Naloxone Program provide important information about the unique context of opioid use and related harms in Manitoba, enhance opioid surveillance reports and can inform other public health interventions. Naloxone distribution programs ultimately rely on the expertise of people with lived experiences and provide opportunities for meaningful engagement between health service providers and people at risk of an opioid overdose.

Conflicts of interest

The authors have no conflict of interest to declare.

Authors' contributions and statement

SBE interpreted the data, drafted and revised the paper; SM designed and conceptualized the work, analyzed and interpreted the data and drafted and revised the paper; CZ analyzed the data and revised the paper; and JR conceptualized the work and revised the paper.

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References

1. Government of Manitoba, Manitoba Health, Seniors and Active Living, Public Health and Primary Care Division, Epidemiology and Surveillance. Surveillance of opioid misuse and overdose in Manitoba: April 1 – June 30, 2017. Winnipeg (MB): Government of Manitoba; 2017. Available from: http://www.gov.mb.ca/health/publichealth/surveillance/docs/q2_opioid.pdf

2. Raffa RB, Pergolizzi JV, LeQuang JA, Taylor R, Colucci S, Annabi MH. The fentanyl family: a distinguished medical history tainted by abuse. J Clin Pharm Ther. 2018;43(1):154-8.

3. BC Centre for Disease Control. BC's Take Home Naloxone Program [Internet]. Vancouver (BC): BCCDC; 2012 [accessed 2017 Jan 12]. Available from: http://towardtheheart.com/ezine/3/take-home-naloxone-program

4. Clark AK, Wilder CM, Winstanley EL. A systematic review of community opioid overdose prevention and naloxone distribution programs. J Addict Med. 2014;8(3):153-63.

5. Health Canada. Notice: Prescription Drug List (PDL): Naloxone [Internet]. Ottawa (ON): Health Canada; [modified 2016 Mar 22, accessed 2017 Jan 12]. Available from: https://www.canada.ca/en/health-canada/services/drugs-health-products/drug-products/prescription-drug-list/notice-naloxone.html

6. First Nations Information Governance Centre. The First Nations Principles of OCAP® [Internet]. Akwesasne (ON): FNIGC; [updated 2018; accessed 2017 Jan 12]. Available from: http://fnigc.ca/ocapr.html

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Original quantitative research

Evaluating the early impacts of delisting high-strength opioids on patterns of prescribing in Ontario

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This article has been peer reviewed.

Abstract

Introduction: Ontario delisted high-strength fentanyl, hydromorphone and morphine from the public drug formulary for non-palliative care prescribers on 31 January, 2017. Our aim is to assess the early impact of this policy on prescribing patterns and to examine whether this impact varied by prescriber type, opioid type and opioid strength.

Methods: We conducted a population-based, cross-sectional study on palliative and non-palliative care patients dispensed fentanyl, hydromorphone or morphine through the Ontario public drug program between 1 January, 2014, and 31 July, 2017. For each month during the study period, we reported the total number of high-strength opioid recipients stratified by prescriber type, and the total volume of each drug dispensed, stratified by strength. We used interventional autoregressive integrated moving average (ARIMA) models to assess the policy's impact on prescribing patterns.

Results: We observed a 98% decrease in the total number of publicly funded recipients of high-strength opioids between December 2016 and July 2017 (5930 to 133 recipients) for all prescribers. The policy led to a significant decline in the total volume of all three opioids dispensed: hydromorphone from 20 374 621 to 16 952 097 mg ($p < .01$); morphine from 40 644 190 to 33 555 480 mg ($p < .03$); and fentanyl from 9 604 913 to 5 842 405 mcg/h ($p < .01$). For both fentanyl and hydromorphone, this reduction generally corresponded to an increase in the number of low-strength opioids dispensed.

Conclusion: Delisting high-strength opioids substantially reduced the number of high-strength opioid recipients and reduced the overall volume of long-acting opioids dispensed in Ontario through the public drug program. Future studies should examine its impact on patient outcomes.

Keywords: *fentanyl, morphine, hydromorphone, opioids, policy change, delisting, Ontario, palliative care*

Highlights

- Delisting of high-strength formulations of fentanyl, hydromorphone and morphine led to reductions in dispensing of these products among all prescribers, despite allowances in the policy for prescribing among palliative care prescribers.
- The majority of these changes in dispensing patterns occurred in the months of January and February 2017, while little change occurred between the policy's announcement in July 2016 and implementation in January 2017.
- Despite an increase in dispensing of lower-strength opioid formulations following the policy's implementation, there was still an overall reduction in the total volume of fentanyl, hydromorphone and morphine dispensed.

Introduction

The use of prescription opioids has increased dramatically over the past 20 years in North America, and recent trends in other countries suggest that overprescribing of opioids is becoming an international phenomenon.[1-8] In particular, high doses of opioids are commonly prescribed despite evidence for the risks associated with such practices, including fatal overdoses, motor vehicle collisions and falls and fractures among elderly adults.[1,2,9,10] Opioid-prescribing guidelines for chronic non-cancer pain in Canada previously characterized a daily opioid dose above 200 mg morphine equivalents (MME) as a "watchful dose," whereas recent 2017 guidelines recommend that clinicians avoid doses exceeding 90 MME.[11] With the increasing focus on avoiding high daily opioid doses, the broad availability of high-strength formulations that lead to daily doses above 200 MME has been questioned.[12] In August 2017, several groups in the United States, including the Physicians for Responsible

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Opioid Prescribing, the National Safety Council, the Association of State and Territorial Health Officials and the American College of Medical Toxicology, submitted a joint petition to the U.S. Food and Drug Administration to remove high-strength opioids from the commercial market, citing concerns surrounding their safety.[13]

As part of Ontario's Strategy to Prevent Opioid Addiction and Overdose, the Ontario Public Drug Programs (OPDP) announced the delisting of high-strength opioids on 20 July, 2016.[14,15] These changes eliminated the Ontario Drug Benefit (ODB) reimbursement for high-strength, long-acting opioids, specifically 75 and 100 mcg/h fentanyl patches, 24 and 30 mg hydromorphone controlled-release (CR) capsules, and 200 mg morphine sustained release (SR) tablets. An exception was made for those on the Palliative Care Facilitated Access (PCFA) prescribers list. With the implementation of this policy, eligible recipients of the ODB program (i.e. patients who are ≥ 65 years of age, receive social assistance or home care services, reside in a long-term care home or have high drug costs relative to household income) could no longer have these products reimbursed by the public drug program unless they were receiving palliative care services from a PCFA physician. However, it is still possible to access these high-strength opioids through out-of-pocket or private-payer payments. The policy was implemented on 31 January, 2017, and its impact on publicly funded opioid-prescribing patterns remains unknown.

This paper describes the early impact of delisting high-strength opioid formulations in Ontario. The objective of this study was to quantify the impact of this policy on patterns of opioid prescribing, and to evaluate how this impact differed by prescriber type, opioid type and opioid strength in the first six months following policy implementation.

Methods

Setting

We conducted a population-based, cross-sectional study of all individuals who received a prescription for long-acting fentanyl, hydromorphone or morphine that was reimbursed by the OPDP between 1 January, 2014, and 31 July, 2017. This study was approved by the Research Ethics Board of Sunnybrook Health Sciences Centre in Toronto, Ontario.

Data sources

We used administrative health care data from the Institute for Clinical Evaluative Sciences (ICES) in Toronto, Ontario, to conduct this analysis. Specifically, we used the ODB claims database, which captures all opioids dispensed to patients eligible for the ODB programs with an error rate of < 1%.[16] In Ontario, physicians registered as PCFA prescribers regularly treat palliative patients and are allowed to prescribe publicly funded prescription medications that are otherwise limited for most physicians practising in Ontario.[17] We defined a cohort of physicians registered as PCFA prescribers according to their prescribing history between 2007 (when PCFA was launched) and the end of the study period. Each physician's PCFA eligibility period was defined as the time between their first and last prescription for a drug claim billed using a specific PIN from the PCFA drug list. We added a 365-day grace period to the date of their last prescription to avoid misclassifying PCFA prescribers as intermittent prescribers of medications on this list. All analyses were performed at the ICES in Toronto, Ontario, using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA) and a type 1 error rate of .05 as the threshold for statistical significance.

Outcomes

We reported the total number of people dispensed at least one high-strength opioid, stratified by prescriber type (palliative vs. non-palliative care) in each month between 1 January, 2014, and 31 July, 2017. We also reported the total monthly volume of study opioids (morphine, hydromorphone and fentanyl) dispensed by calculating the sum of the quantity of patches (fentanyl) or tablets (hydromorphone or morphine) multiplied by the strength of each formulation for each month of the study period. We included all publicly funded doses of fentanyl patches (25 mcg/h, 50 mcg/h, 75 mcg/h and 100 mcg/h), as well as oral and sustained release formulations of hydromorphone (3 mg, 4.5 mg, 6 mg, 9 mg, 12 mg, 18 mg, 24 mg and 30 mg) and morphine (10 mg, 15 mg, 20 mg, 30 mg, 50 mg, 60 mg, 100 mg and 200 mg). This monthly volume was calculated and reported separately for each drug for the purpose of describing the changes in drug volume dispensed over time. No comparisons were conducted between opioid type, therefore opioid volume was not converted into morphine equivalents. For fentanyl, the volume dispensed reflects the hourly patch strength (i.e. 25 mcg/h) multiplied by the number of patches dispensed. Finally, we reported the total monthly quantity of fentanyl, hydromorphone and morphine dispensed, stratified by opioid strength.

Statistical analysis

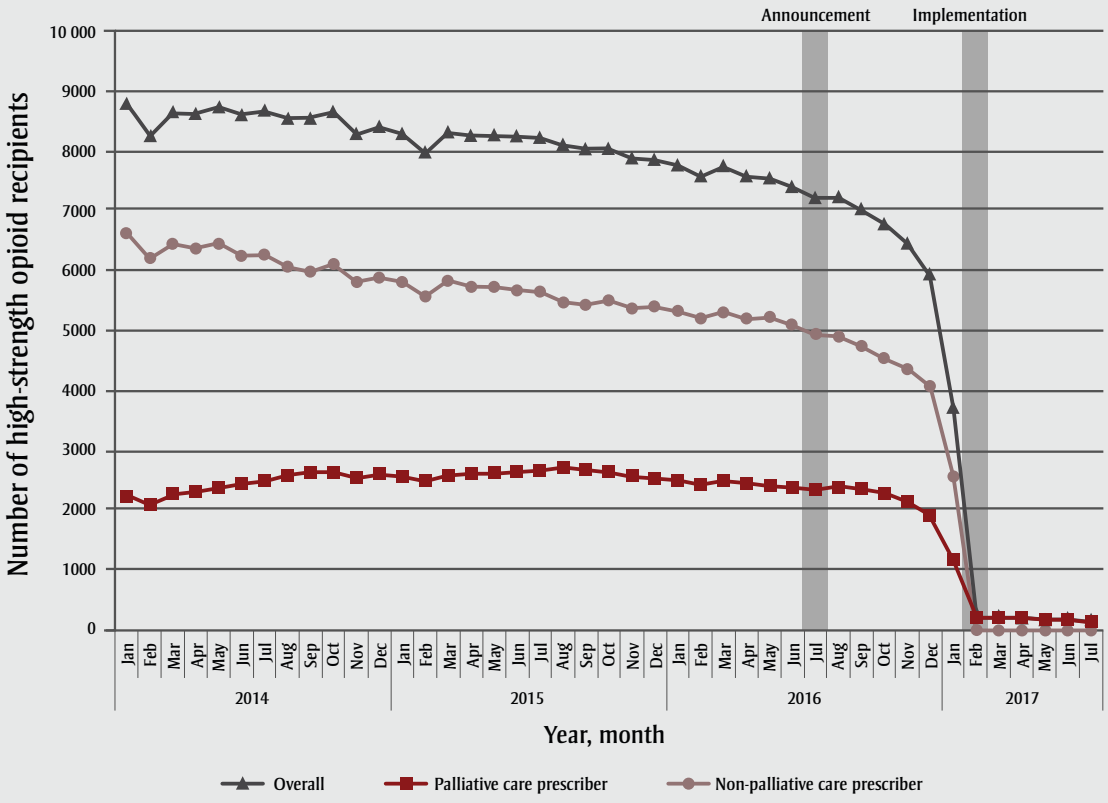
We used interventional autoregressive integrated moving average (ARIMA) models to determine the impact of the OPDP's policy to delist high-strength opioids on the total volume of fentanyl, hydromorphone and morphine prescribed. Our hypothesis was that the policy announcement (20 July, 2016) would lead to a gradual reduction in opioid volumes after the policy announcement as prescribers attempted to taper their patients' doses, which would continue to accelerate following the policy implementation (31 January, 2017). Therefore, we tested a change in slope from after the announcement until implementation (using a ramp intervention function) and an immediate sustained change after implementation (using a step intervention function). We used augmented Dickey–Fuller tests to assess stationarity of the time series and differenced the time series at the appropriate lags in order to produce stationary time series. We examined autocorrelation function (ACF), partial autocorrelation function (PACF) and inverse correlation function (IACF) plots to determine the appropriate moving average or autoregressive terms for the models. We then assessed the fit of the models using residual ACF, PACF and IACF plots; Ljung–Box chi-square tests to test for white noise; and residual normality diagnostic plots.

Results

Recipients of all high-strength opioids, by prescriber type

We observed an 18% decrease in the number of recipients of publicly funded, high-strength opioids between July 2016 (the policy announcement) and December 2016 (from 7209 to 5930 recipients) (Figure 1). By the end of February 2017, one month after the policy's implementation, there were only 197 ODB-eligible recipients of high-strength opioids, all of which were prescribed by palliative care physicians (a 97% reduction from December

FIGURE 1
Ontario Drug Benefit–eligible recipients of high-strength opioids, by prescriber type in Ontario, between January 2014 and July 2017



2016). This value was generally sustained (range: 133 to 201 recipients monthly) until the end of the study period (there was a 98% reduction between December 2016 and July 2017).

Volume of opioids dispensed, by opioid type

There was no impact of the July 2016 policy announcement on the total volume of fentanyl ($p = .17$), hydromorphone ($p = .71$) or morphine ($p = .74$) dispensed and reimbursed by the ODB program; however, after the implementation of the policy in January 2017, we observed a statistically significant reduction in the total volume of all three opioids dispensed (Figure 2). Specifically, between December 2016 and July 2017, we observed a 17% reduction in the volume of both hydromorphone (from 20 374 621 to 16 952 097 mg; $p = .008$) and morphine (from 40 644 190 to 33 555 480 mg; $p = .028$) dispensed, and a 39% reduction in the volume of fentanyl patches dispensed (from 9 604 913 to 5 842 405 mcg/h; $p = .007$).

Opioid type, by strength

Prior to the announcement of the delisting of high-strength opioids, the most commonly prescribed strength of fentanyl patch was 100 mcg/h, with 54 823 patches dispensed in June 2016. The 75 mcg/h strength was the least commonly prescribed, with 30 616 patches dispensed during the same month (Figure 3). Following the policy's announcement and subsequent implementation, the number of high-strength fentanyl patches declined dramatically; however, the number of low-strength fentanyl patches prescribed increased in parallel. Specifically, the dispensing of 50 mcg/h fentanyl patches almost doubled (from 50 884 to 89 364 patches—a 75.6% increase) while that of the 25 mcg/h patches increased by 10% (from 45 229 to 49 652 patches) between December 2016 and July 2017.

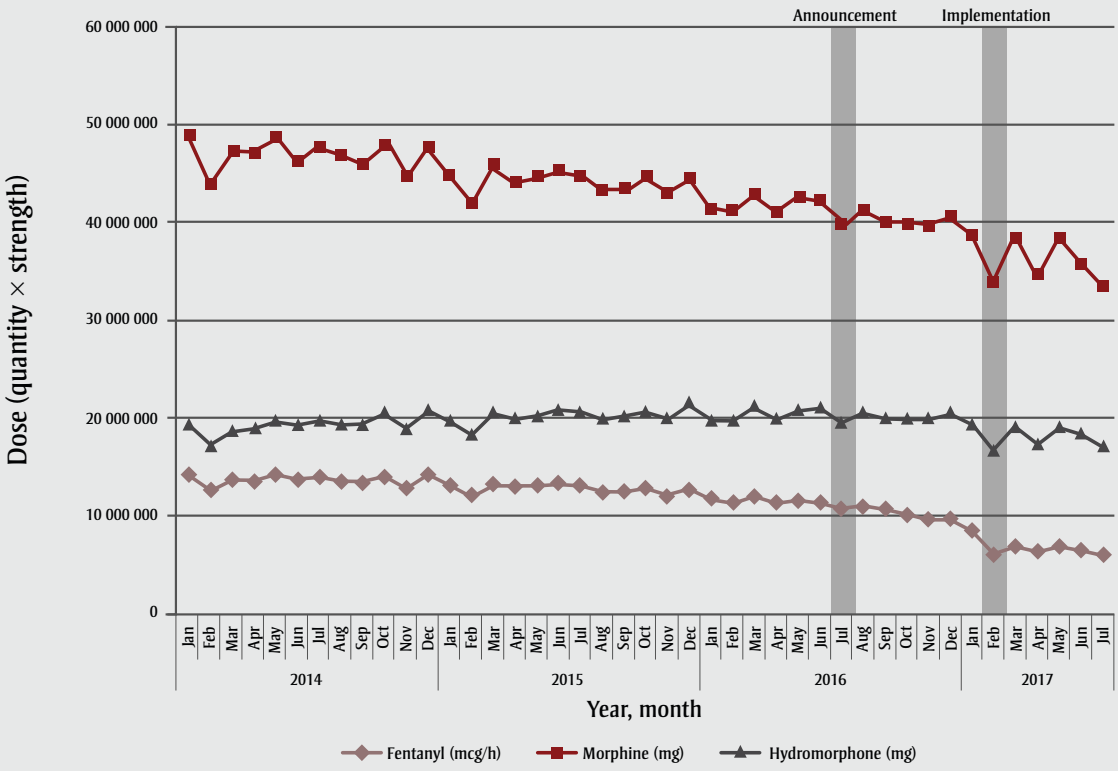
We observed a similar trend in hydromorphone dispensing: high-strength formulations remained stable after the policy's announcement, and then decreased dramatically in January when the delisting came into effect (Figure 4). By the end of the study period (July 2017), only 5272 tablets for high-strength hydromorphone were dispensed during the month, a decrease of 97% from the 203 012 tablets dispensed in December 2016. Concurrently, there was an increase in 12 mg (30% increase, from 345 742 to 449 584 tablets) and 18 mg (34% increase, from 156 422 to 209 282 tablets) hydromorphone formulations dispensed between December 2016 and July 2017.

High-strength morphine tablets were among the least commonly dispensed strengths of morphine during the course of the study period (Figure 5). As in the case of the other delisted opioids, we observed no change in high-strength morphine dispensing after the policy announcement, but did observe a reduction immediately after policy implementation (a 100% reduction, from 16 944 units in December 2016 to zero units in July 2017). We also observed a general destabilization in the dispensing trends for many lower-strength morphine formulations, but no consistent pattern of increased dispensing of any of these products.

Discussion

In this population-based, cross-sectional study we found that delisting high-strength opioid formulations led to a

FIGURE 2
Volume of opioids dispensed from the Ontario Drug Benefit program, by opioid type, between January 2014 and July 2017



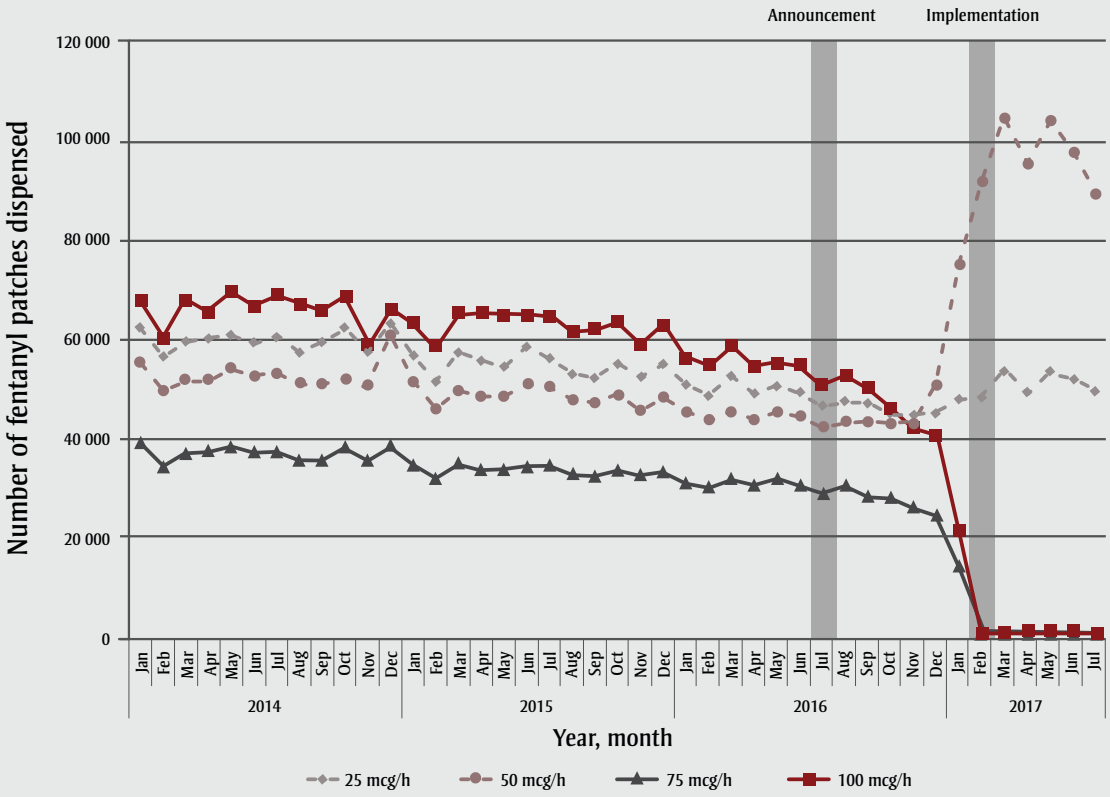
Note: These doses are not converted into morphine equivalents and are therefore not comparable between drug types. Fentanyl volume reflects its total hourly patch strength in mcg/h while morphine and hydromorphone volume represents total amount of drug dispensed, in mg.

reduction in the dispensing of these products among all prescribers. Our observation that the reduction happened among all prescribers is particularly important because policy makers in Ontario specifically amended the delisting policy to exclude palliative care patients, recognizing the management of pain in palliative care as an important priority.[18] Therefore, the degree of reduced prescribing of high-strength opioids in this sector is unexpected. This finding may suggest a lack of awareness on the part of palliative care prescribers and pharmacists of this exception to the policy, or a broader impact of the policy on physician decision-making related to the role of high-strength forms of opioids in clinical practice more generally. However, since physicians on the PCFA list may also prescribe medications to non-palliative care patients, it is also possible that these observations are reflective of a reduction in high-strength opioid prescribing to such patients.

We observed an increase in the dispensing of lower-strength opioid formulations following the policy's implementation, which replaced, to a large degree, the reductions in high-strength opioid dispensing. This result aligns with the notice of the Ontario Ministry of Health and Long-Term Care (MOHLTC) related to the policy, which stated that low-strength, long-acting opioids would remain available through the public drug program and may be combined to form higher doses for patients with a higher opioid tolerance.[19] Therefore, it is likely that many patients were transitioned to lower-strength fentanyl, hydromorphone or morphine following the policy implementation. While this increases pill burden for patients who continue on a high daily dose of opioids, the overall reduction in the number of high-strength opioids available in the community may subsequently aid in the prevention of opioid-related adverse events such as accidental overdose and fatality.[2,20] Furthermore, despite the increase in the dispensing of low-strength, long-acting opioids, we observed a slight reduction in the overall volume of long-acting opioids dispensed following the policy's implementation. Therefore, the delisting of high-strength opioids may have encouraged some prescribers to reconsider their patients' high-dose opioid therapy and begin the process of tapering. Future work is needed to understand how any observed reductions in opioid dose–impacted pain management at the individual level. Given that the population affected by this policy may not have the means to pay for alternative, nonpharmaceutical pain treatment (e.g. physiotherapy, cognitive behavioural therapy), policies considering novel funding mechanisms for these nonpharmaceutical treatment options may be warranted.

It is important to note that the greatest change in dispensing patterns occurred at the end of January 2017, when the policy was implemented. We observed little change in prescribing practice between the policy's announcement in July 2016 and December of that year, which suggests that clinicians did not use this period to gradually implement prescribing changes.[14] This hypothesis is supported by our observation of an increase in lower-strength opioid dispensing following the policy's implementation. Thus, future studies should explore the impact of this policy

FIGURE 3
Volume of fentanyl dispensed from the Ontario Drug Benefit program, by strength, between January 2014 and July 2017



on patient-level outcomes including total dose prescribed, changes in payment (e.g. moving to other payers), abrupt dose changes and clinical outcomes such as fatal and nonfatal overdoses.

Strengths and limitations

A major strength of this study is its use of population-based data. Specifically, using records from ICES, we were able to capture prescription records of all patients whose high-strength opioids were reimbursed through the public drug program.

This study has some limitations that merit discussion. First, we studied all high-strength opioid recipients whose prescription opioids were reimbursed by Ontario's public drug program. However, this excludes those who receive their prescription medications through private insurance or out-of-pocket payments. Therefore, we are unable to draw conclusions about the impact of this policy on broader prescribing patterns to the general public in Ontario. Second, we are only able to capture instances of medication dispensing using administrative claims and are unable to determine whether the recipient used the medication after dispensing. Therefore, it is possible that some of the prescriptions captured may have been unused or diverted to the illicit market. Third, we did not capture sociodemographic information, and therefore could not investigate whether the policy had differential impact on palliative care patients by sex, age or location of residence. Future work could explore these subpopulations. Finally, we categorized physicians as palliative care prescribers if they prescribed medications from the PCFA list. Since these physicians may also treat non-palliative care patients, it is possible that some opioids categorized as "palliative care" in our study may be used by non-palliative care patients.

Conclusion

The delisting of high-strength opioids dramatically reduced the overall number of opioid recipients prescribed these products by both palliative and non-palliative care physicians. This reduction corresponded to an increase in lower-strength opioid dispensing that occurred promptly after the policy's implementation. We found that this policy led to a small but significant reduction in the volume of long-acting morphine, hydromorphone and fentanyl reimbursed by the public drug program in Ontario. This outcome may indicate that restrictions on high-strength opioid reimbursement created an opportunity for physicians to consider slow, safe tapering of opioids in their patients who are at risk of adverse events from high-dose opioid use. Future research is needed to assess whether this is the case, to confirm these findings over a longer follow-up time and to ensure that this policy did not lead to abrupt cessation of opioids in some patients.

Acknowledgements

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FIGURE 4
Volume of hydromorphone dispensed from the Ontario Drug Benefit program, by strength, between January 2014 and July 2017

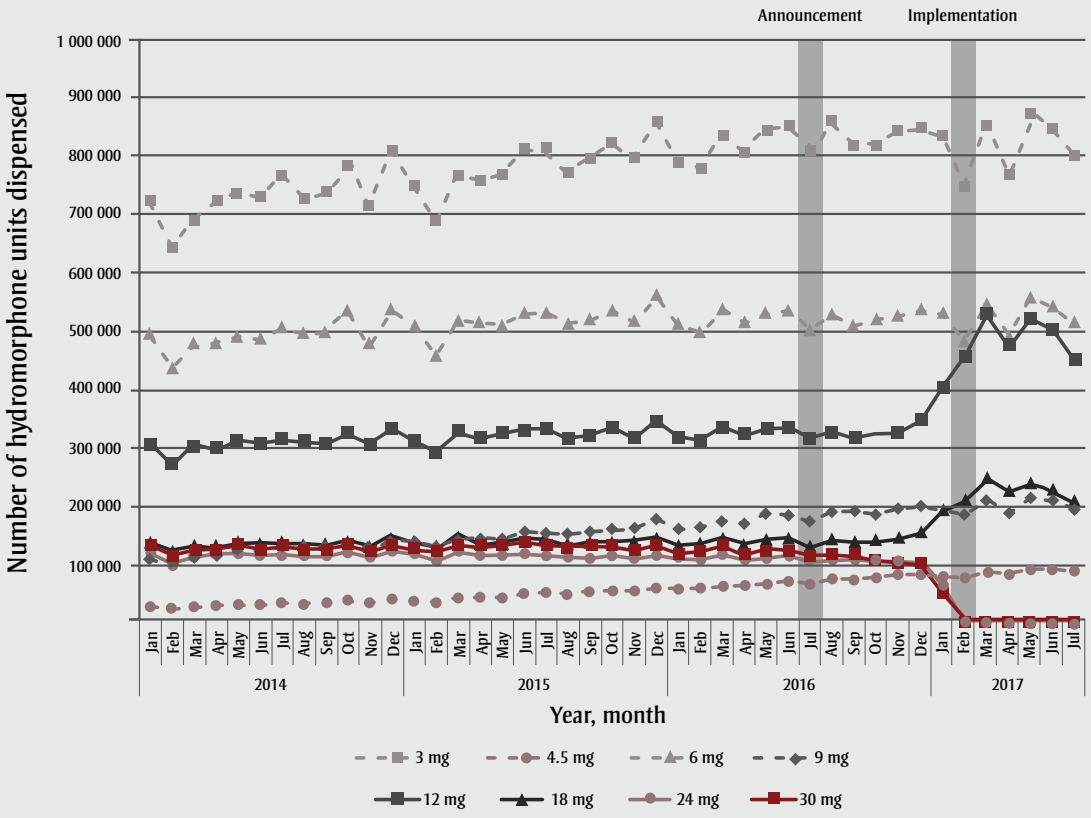
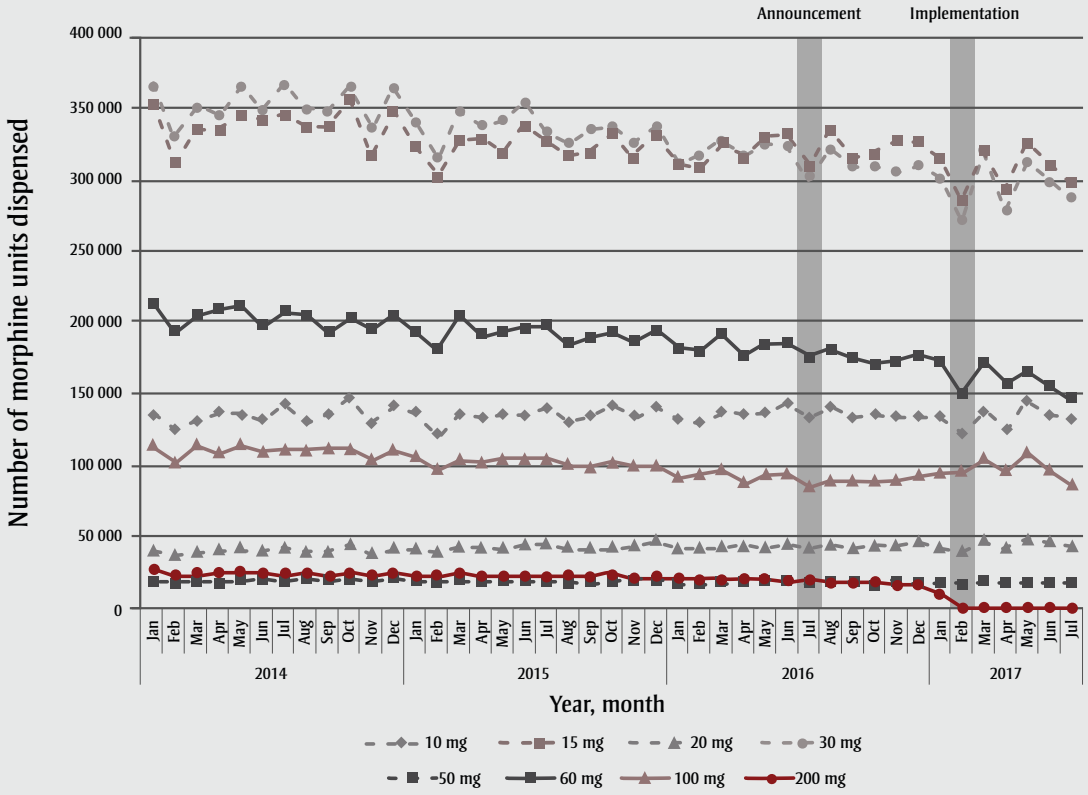


FIGURE 5
Volume of morphine dispensed from the Ontario Drug Benefit program, by strength, between January 2014 and July 2017



was also supported by the Institute for Clinical Evaluative Sciences (ICES), which is funded by an annual grant from the Ontario MOHLTC. The opinions, results and conclusions reported in this paper are those of the authors and are independent from the funding sources. No endorsement by ICES, the Ontario SPOR Support Unit or the Ontario MOHLTC is intended or should be inferred.

Conflicts of interest

The authors declare no conflicts of interest with respect to the publication of this article.

Authors' contributions and statement

TG, DM, MT and WK contributed to the study concept, research design, data collection and analysis. QG interpreted the findings and wrote the manuscript, with guidance from co-authors. All authors assisted in manuscript revision and have approved the final version.

The content and views expressed in this article are those of the authors and do not necessarily reflect those of the Government of Canada.

References

1. Gomes T, Mamdani MM, Dhalla IA, Paterson JM, Juurlink DN. Opioid dose and drug-related mortality in patients with nonmalignant pain. Arch Intern Med. 2011;171(7):686-91. doi: 10.1001/archinternmed.2011.117.

2. Spooner L, Fernandes K, Martins D, et al. High-dose opioid prescribing and opioid-related hospitalization: a population-based study. PLOS ONE [Internet]. 2016 Dec 14 [cited 2017 Nov 19];11(12):e0167479. doi: 10.1371/journal.pone.0167479.

3. Wright AP, Becker WC, Schiff GD. Strategies for flipping the script on opioid overprescribing. JAMA Intern Med. 2016;176(1):7-8. doi: 10.1001/jamainternmed.2015.5946.

4. Clark DJ, Schumacher MA. America's opioid epidemic: supply and demand considerations. Anesth Analg. 2017; 125(5):1667-74. doi: 10.1213/ANE.0000000000002388.

5. Makary MA, Overton HN, Wang P. Overprescribing is major contributor to opioid crisis. BMJ. 2017;359:j4792. doi: 10.1136/bmj.j4792.

6. Tran T, Taylor SE, Hardidge A, Findakly D, Aminian P, Elliott RA. Impact of pharmacists assisting with prescribing and undertaking medication review on oxycodone prescribing and supply for patients discharged from surgical wards. J Clin Pharm Ther. 2017;42(5):567-72. doi: 10.1111/jcpt.12540.

7. Toth AR, Possidente CJ, Sawyer LM, DiParlo MA, Fanciullo GJ. National and northern New England opioid prescribing patterns, 2013–2014. Pain Med. 2017;18(9):1706-14. doi: 10.1093/pm/pnw231.

8. Blake H, Leighton P, van der Walt G, Ravenscroft A. Prescribing opioid analgesics for chronic non-malignant pain in general practice – a survey of attitudes and practice. Br J Pain. 2015;9(4):225–32. doi: 10.1177/2049463715579284.

9. Bohnert ASB, Valenstein M, Bair MJ, et al. Association between opioid prescribing patterns and opioid overdose-related deaths. JAMA. 2011; 305(13):1315-21. doi: 10.1001/jama.2011.370.

10. Gomes T, Redelmeier DA, Juurlink DN, Dhalla IA, Camacho X, Mamdani MM. Opioid dose and risk of road trauma in Canada: a population-based study. JAMA Intern Med. 2013; 173(3):196-201. doi: 10.1001/2013.jamainternmed.733.

11. Busse JW, Craigie S, Juurlink DN, et al. Guideline for opioid therapy and chronic noncancer pain. CMAJ. 2017; 189(18):E659–E666. doi: 10.1503/cmaj.170363.

12. Els C, Jackson TD, Hagtvedt R, et al. High-dose opioids for chronic noncancer pain: an overview of Cochrane Reviews. Cochrane Database Syst Rev [Internet]. 2017 Oct 30 [cited 2017 Nov 17]. doi: 10.1002/14651858.CD012299.pub2.

13. Butler J, Hersman DA, Kolodny A, McKay C, Rummler J. Citizen petition [Internet]. 2017 Aug 30 [cited 2017 Nov 19]. Available from: http://i2.cdn.turner.com/cnn/2017/images/08/31/citizen.petition.uhdu.opioids.8.30.17.final.pdf

14. Ontario Public Drug Programs, Ministry of Health and Long-Term Care. Notice from the Executive Officer: changes to the Ontario Drug Benefit (ODB) program funding of opioid medications [Internet]. 2016 Jul 20 [cited 2017 Nov 4]. Available from: http://www.health.gov.on.ca/en/pro/programs/drugs/opdp_eo/notices/exec_office_20160720.pdf

15. Ministry of Health and Long-Term Care. Taking action to prevent opioid addiction and overdose [Internet]. 2017 Oct 4 [cited 2017 Nov 11]. Available from: https://news.ontario.ca/mohltc/en/2017/10/taking-action-to-prevent-opioid-addiction-and-overdose.html

16. Levy AR, O'Brien BJ, Sellors C, Grootendorst P, Willison D. Coding accuracy of administrative drug claims in the Ontario Drug Benefit database. Can J Clin Pharmacol. 2003;10(2): 67-71.

17. Ontario Medical Association. Palliative Care Facilitated Access frequently asked questions [Internet]. 2017 Apr [cited 2017 Nov 11]. Available from: http://www.wwpalliativecare.ca/Uploads/ContentDocuments/PCFA%20FrequentlyAskedQuestions%202017-04-5.pdf

18. Ontario Medical Association. Changes to the Palliative Care Facilitated Access program [Internet]. 2017 Apr [cited 2017 Nov 8]. Available from: http://wwpalliativecare.ca/Uploads/ContentDocuments/PCFABackgrounder2017-04-05.pdf

19. Ministry of Health and Long-Term Care. Reminder regarding delisting of high-strength long-acting opioids under the Ontario Drug Benefit (ODB) program [Internet]. 2017 Jan 27 [cited 2017 Nov 5]. Available from: http://www.health.gov.on.ca/en/pro/programs/drugs/opdp_eo/notices/exec_office_20170127.pdf

20. Von Korff M, Kolodny A, Deyo RA, Chou R. Long-term opioid therapy reconsidered. Ann Intern Med. 2011; 155(5):325-8. doi: 10.7326/0003-4819-155-5-201109060-00011.

https://doi.org/10.24095/hpcdp.38.6.08

At-a-glance

What can social media tell us about the opioid crisis in Canada?

Semra Tibebu, BSc (1,2); Vicky C. Chang, MPH (1,2); Charles-Antoine Drouin, BA (3); Wendy Thompson, MSc (2); Minh T. Do, PhD (1,2,4)

Abstract

We explored social media as a potential data source for acquiring realtime information on opioid use and perceptions in Canada. Twitter messages were collected through a social media analytics platform between June 15, 2017, and July 13, 2017, and analyzed to identify recurring topics mentioned in the messages. Messages concerning the medical use of opioids as well as commentary on the Canadian government's current response efforts to the opioid crisis were common. The findings of this study may help to inform public health practice and community stakeholders in their efforts to address the opioid crisis.

Keywords: *opioids, Twitter, use and perceptions, Canada*

Highlights

- Messages concerning personal medical use of opioids were predominant, with morphine, oxycodone and codeine the most referenced opioids; recreational or illegal use was not frequently mentioned.
- Community impacts such as seeing opioids being used and stray needles in public, as well as personal connections to overdoses, were discussed.
- Many messages expressed sentiments about the government's lack of action in addressing the opioid crisis.
- Twitter may be a useful tool for gauging public opinion on the opioid crisis and the medical use of opioids.

Introduction

Across North America, the number of opioid-related deaths, hospitalizations and overdoses has increased in recent years.[1,2] In Canada, the rate of hospitalizations, cumulative of all age groups, due to opioid poisoning increased more than 30% between 2007 and 2016 to just below 16 hospitalizations per 100 000 persons.[3] In 2016, there were 2861 opioid-related deaths in Canada.[4] By 2017, all the provinces continued to see large increases in the number of opioid-related deaths.[5-7] Timely data on opioid-related overdoses would be invaluable in monitoring trends and supporting effective responses to the crisis.

Traditional methods of surveying opioid use across Canada include nationwide surveys and administrative databases documenting opioid-related deaths and overdoses.[3,6] Although informative, limitations to these sources include delay in the access to data or in the publication of results, response bias affecting survey results, and the lack of detailed information on the context surrounding opioid use.

Social media has been previously used as a tool to provide data on urgent public health issues.[9-12] Previous studies have utilized social media for the epidemiological monitoring of diseases and to gauge public reactions to health promotion efforts.[6-8] In recent years, the use of Twitter in research has increased, compared with other social media, due to the high volume of tweets and ease in accessing and searching Twitter data.[9]

With the current opioid crisis, the public perceptions and documented use of opioids by the Canadian Twitter user population (or "twitterati") could inform responses to the crisis and identify Twitter users' reactions towards current efforts. This study examines Twitter data to do with opioid use and perceptions in Canada.

Methods

Twitter data were collected by the social analytics company Nexalogy (Montréal, Quebec) between June 15, 2017, and July 13, 2017. This period was selected because of the growing number of opioid-related deaths across the country in the preceding months.[5,6,7] To create a search strategy, common generic terms, brand names and slang terms to do with opioid drugs were identified from the literature and through Google (https://www.google.ca/) and the Urban Dictionary (https://www.urbandictionary.com/).[13,14] We conducted preliminary searches of the opioid terms on Twitter using Nexalogy; terms yielding five or more tweets related to opioid use or perceptions about opioid use were included in the final search strategy (Box 1).

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BOX 1
Search terms used to collect Twitter data

- fentanyl
- oxycontin
- opioid
- oxycodone
- oxy
- vicodin
- hydromorphone
- hydrocodone
- morphine
- methadone
- percocet
- codeine
- heroin
- "Tylenol 3"
- vikes
- percs
- "codeine cough syrup"
- "drinking lean"

Included tweets were geotagged in Canada or were tweeted by users whose profile indicated they were located in Canada. Since it is difficult to attribute with certainty the context of a retweet, all retweets were excluded.

Once the messages were downloaded, we excluded irrelevant messages pertaining to: news stories shared by news corporations or health organizations, messages with opioid terms in the user's name but not their messages, duplicate messages, and messages comprising numbers and characters instead of text. When the source or intent of the message was unclear, we reviewed links to the original tweets (which were provided along with the Twitter messages) to determine the relevance of the tweet.

A broad coding scheme from the literature, based on recurring words, phrases and themes found in the messages, was devised. The two main themes, "use" and "perception," were mutually exclusive; this scheme was utilized in a previous qualitative opioid-related Twitter study.[14] As Twitter messages were re-read multiple times, the coding scheme was redefined into subcategories under each of the two main themes and modified until all messages could be accurately categorized; subcategories were mutually exclusive.[15] All messages were coded accordingly. Two researchers reviewed all the messages, and any discrepancies were resolved through discussion and/or with the help of a third researcher. The frequencies of each theme were calculated.

Results

A total of 2602 tweets matching the search strategy were extracted. Of these, 1776 tweets were excluded after a manual review determined that they were irrelevant. The final dataset included 826 messages: 148 were related to opioid use and 678 were related to perceptions about opioids.

Opioid use messages

Of all the messages related to opioid use, morphine was referenced in 37 (25%), oxycodone in 29 (20%), codeine in 30 (20%) and opioid-acetaminophen products in 33 (22%). Overdoses were discussed in 10 messages, with 8 of these commenting on another individual's use.

Medical use of opioids was commonly referenced (n = 70; 67%), with negative sentiments slightly more common (n = 15; 42%) than positive ones (n = 13; 36%) (Table 1). Morphine was mentioned in 27 (39%) medical use messages.

Of the messages commenting on the use of opioids by others, the number of messages that focussed on the impact of opioid use on friends and family (n = 23; 52%) approximately equaled the number that focussed on interactions with drug use in public spaces (n = 21; 48%). For example, two messages mentioned finding needles in the neighbourhood (Table 1).

Opioid perception messages

Of the messages to do with perceptions about opioids, "heroin" was the term used the most often (n = 203; 30%), followed by "fentanyl" (n = 184; 27%) and "opioids" (n = 150; 22%).

Commentary on the opioid crisis accounted for 318 (47%) messages related to perceptions of opioids. Of those, 173 (54%) messages stated opinions and facts about the crisis, while 129 (41%) detailed specific sentiments to do with the crisis (Table 2).

The majority of sentiments were directed at officials and their efforts in the opioid epidemic; 20 (15%) messages were directed at the Canadian government or police officials and 35 (27%) at the United States of America government and police officials; 18 (14%) blamed or expressed anger with pharmaceutical companies and doctors (Table 2).

Harm reduction accounted for 48 (15%) messages; 22 (46%) of these were specific to legalizing prescription heroin for opioid dependency treatment programs, while marijuana legalization accounted for 13 (27%) (Table 2).

Commentary on opioids and opioid users accounted for 122 (18%) perception messages (Table 2). A majority of opioid commentary messages (n = 62; 50%) were opinions and facts, such as discussions about research focused on opioids. Positive sentiments about opioids, or their effectiveness, accounted for 31 (25%) messages while negative sentiments accounted for 30 (25%) messages. There was no association between the type of opioid referenced and the associated sentiment.

Discussion

Our study demonstrated that Twitter provides context on the use of medical opioids and insight on the attitudes of the Canadian public regarding opioids.

The high prevalence of morphine, oxycodone and codeine mentioned in tweets about opioid use is consistent with reports stating that these are the most commonly prescribed opioids.[16-18] Surprisingly, recreational use of opioids was not frequently mentioned. Although Twitter provides users with the option to remain anonymous, other social media sites (e.g. Instagram) are more popular for sharing stigmatized and illegal behaviours, such as underage drinking and marijuana use, especially within the younger populations.[19,20]

Messages that discussed opioid use by others provided insight into community-level impacts of the opioid crisis, for example, evidence of opioid use in public and seeing needles on the ground. Similarly, in perception-related messages,

TABLE 1
Messages about opioid use (N = 148) among Canadian Twitter users, June–July 2017

Theme	Frequency n (%)	Example of a message
Own use	**104 (70)**	
Medical	70 (67)	Had a migraine from hell, now I'm a limp noodle on the couch, thanks percocet!
		I think that codeine is finally kicking in, headache is retreating
		[twitter handle] I'm on codeine for it but it's making me so sick that I'm just taking the pain like a man
Recreational	10 (10)	
		Fentanyl and chill
		Secret [you] haven't told many; I did heroin and wanted to get addicted
		Gassing up on lean and good percs
Unknown	24 (23)	I'm high on life and codeine. Can't forget that
		[twitter handle] Funny story I overdosed on codeine once and now I can't get a prescription anymore lol (not actually…
		Found my codeine pills, time [to] down the bottle
Use by others	**44 (30)**	
People they know	23 (52)	He said he was aware of risks of #Fentanyl but figured that odds were it wouldn't be him, he was wrong and almost died
		I know people who "took as directed" and medicated themselves into an opioid coma
		[twitter handle] I had a friend pass away taking a [fentanyl] pill pressed to look like oxy 80, thank you for telling this story
Drug use in public spaces	21 (48)	Some kid just walked up to me and asked if I had any percs…
		You know it's a [bad] day when an obvious heroin addict accidentally gives you a used bloody needle cap when he hands you his change
		There's heroin needles on the bus #sudburyprobs #sudbury-buses

Twitter users provided details, through statistics or personal opinion, on how the opioid crisis has affected their city. An interesting finding was the discontent expressed about the Canadian government, police and pharmaceutical companies. A majority of the messages either blamed these institutions and organizations for causing the opioid crisis or expressed disappointment in their efforts to combat the crisis. Such commentary on community impacts and opinions concerning the opioid crisis may help to inform community stakeholders and municipal governments on the public response to current efforts addressing the opioid crisis.

Strengths and limitations

This is the first study to explore opioid-related attitudes and behaviours through social media in the Canadian context. It provides relevant details about Canadian experiences of the opioid epidemic. This study benefitted from full access to Twitter data by utilizing Nexalogy, thereby ensuring all relevant posts were collected. As well, the use of detailed themes provided an in-depth exploration into both the sentiment and the context of the Twitter messages.

A major limitation is the absence of demographic and geographical characteristics of those posting at the time of the study. Future studies will look at extracting a user's location, age and sex/gender. Understanding the distribution of opioid-related use and perceptions by sex/gender, age and location could help to inform future educational and use-prevention strategies, to ensure the populations engaging in risky behaviours are correctly educated about opioids. In addition, the brief data collection period limited the number of messages collected, as well as the number of news stories about the opioid crisis to which Twitter users could react. Future studies should have a longer recording period in order to examine trends in use and perception.

Twitter as a data source presents additional limitations. Since only a subset of the Canadian population utilizes Twitter, the data are not from a random sample, which reduces the generalizability of these results. Furthermore, because we could not obtain the total number of tweets posted during the data collection period, we were unable to calculate the prevalence of messages about opioids posted by the Canadian Twitter user population. Finally, the thematic analysis methodology was tedious. If Twitter data are to be utilized for public health practice, thematic analysis software, such as NVivo, should be applied to improve timeliness of data analysis, thereby improving the timeliness of a public health response.[21]

Conclusion

Although further validation is needed, overall our analysis of the Twitter data appears to be a useful tool for gauging public opinion on the opioid crisis and the medical use of opioids in a timely manner.

Conflicts of interest

The authors of this study had no conflicts of interest.

Authors' contributions and statement

ST contributed to study conceptualization, data collection, analysis and interpretation, and manuscript drafting; VC contributed to data analysis and interpretation, and manuscript revision; MD, WT and CD contributed to study conceptualization and manuscript revision.

TABLE 2
Messages about opioid perception (N = 678) among Canadian Twitter users, June–July 2017

Theme	Frequency n (%)	Example of a message
Commentary on opioid crisis	**318 (47)**	
Questions	16 (5)	[twitter handle] they can't just buy fentanyl on the street?
Opinions/Facts	173 (54)	Those under 15 yrs and those over 65 yrs experience the highest accidental opioid poisonings.
Statistics on overdoses/deaths	18 (10)	Multi overdoses at [correctional centre] in the last 10 days... #fentanyl #crisisin-corrections
Sentiments	129 (41)	
Cautionary	32 (25)	If you party, you can never be on what you get. Watch your friends.
Directed at Canadian government/police	20 (15)	[twitter handle] You flooded #Canada with #OxyContin…
Directed at US government/police	35 (27)	Very telling...Shows U.S. world where [US politician's twitter handle] priorities lie…
Blame/angry with doctors/pharmaceutical companies	18 (14)	…I understand that the vast majority of opioid usage comes from legal prescription sources
Sad/scared about crisis	22 (17)	This is so scary! #pei #drugs #fentanyl
Other themes		
US-related messages	97 (31)	[twitter handle] Well all except West Virginia. They're a heroin addict.
Positive sentiment for effort of Canadian government/police	17 (5)	So thankful for our police officers. Can't begin to imagine what they face every day.
Fentanyl has affected home town	15 (5)	Some neighbours say #fentanyl is a big problem in the area. #hamont
Importation of fentanyl from China	11 (3)	[twitter handle] Fentanyl shipped from China as part of the economic genocide plan
Harm reduction	48 (15)	[twitter handle] The fentanyl patch return program is ineffective and hazardous
Legalize/Prescription heroin discussion	22 (46)	And, to think that Vancouver, B.C. officials are aiming to legislate 'Free Heroin'
Legalize weed discussion	13 (27)	[twitter handle] legalized pot will lead to a drop in opioid dependency
Commentary on opioids in general	**122 (18)**	
Positive	31 (25)	Morphine makes the holy known
Negative	30 (25)	If you drug someone with fentanyl you should be SHOT
Opinions/Facts/Questions	62 (50)	TIL that in Switzerland there is a program that gives a heroin addict heroin with prescription!
Questions	9 (15)	[twitter handle] wait is dope pot or heroin, I get confused
Research	7 (11)	Fascinating study found CBD had no analgesic or antiemetic effects alone
Medical discussion	8 (13)	[twitter handle] Specific to ACS chest pain. Do you find any significant difference in response to morphine or fentanyl?
Opioids are not the main topic	**238 (35)**	
General conversations/jokes	159 (67)	I fell asleep and they injected heroin into me, haha good joke guys
Reference to entertainment	59 (25)	She's morphine, queen of my vaccine my love, my love
Celebrity use	20 (8)	In 1986, Culture Club singer Boy George was charged in London with heroin possession.

The content and views expressed in this article are those of the authors and do not necessarily reflect those of the Government of Canada.

References

1. Ciccarone D. Fentanyl in the US heroin supply: a rapidly changing risk environment. Inter J Drug Policy. 2017; 46:107-11. doi: 10.1016.j.drugp0.2017 .06.010.
2. Fischer B, Russell C, Murphy Y, Kurdyak P. Prescription opioids, abuse and public health in Canada: is fentanyl the new centre of the opioid crisis? Pharmacoepidemiol Drug Saf. 2015;24:1334-6. doi:10.1002/pds.3901.
3. Canadian Institute for Health Information (CIHI). Opioid-related harms in Canada: chartbook September 2017. Ottawa (ON): CIHI; 2017.
4. National report: apparent opioid-related deaths (2016). Ottawa (ON): Government of Canada; 2017.
5. Ontario Agency for Health Protection and Promotion. Opioid-related morbidity and mortality in Ontario. Toronto (ON): Public Health Ontario; 2017 [cited 2017 Aug 20]. Available from: http://www.publichealthontario.ca /en/dataandanalytics/pages/opioid .aspx

6. Alberta Health. Opioids and substances of misuse: Alberta report. 2017 Q2. Edmonton (AB): Government of Alberta; 2017.

7. British Columbia Coroners Service. Illicit drug overdose deaths in BC: January 1, 2007 – October 31, 2017. Burnaby (BC): Ministry of Public Safety; 2017.

8. Health behaviour in school-aged children: trends report 1990-2010. Ottawa (ON): Public Health Agency of Canada; 2014 [cited 2017 Aug 20]. Available from: https://www.canada.ca/en/public-health/services/health-promotion/childhood-adolescence/programs-initiatives/school-health/health-behaviour-school-aged-children/trends-report-1990-2010.html

9. Capurro D, Cole K, Echavarria MI, Joe J, Neogi T, Turner AM. The use of social networking sites for public health practice and research: a systematic review. J Med Internet Res. 2014;16(3):e79. doi: 10.2196/jmir.2679.

10. Fung IC, Tse ZT, Fu KW. The use of social media in public health surveillance. Western Pac Surveill Response J. 2015;6(2):3-6. doi: 10.5365/wpsar.2015.6.1.019.

11. Charles-Smith LE, Reynolds TL, Cameron MA, et al. Using social media for actionable disease surveillance and outbreak management: a systematic literature review. PLoS One. 2015;10(10):e0139701. doi: 10.1371/journal.pone.0139701.

12. Sinnenburg L, Buttenheim AM, Padrez K, Mancheno C, Ungar L, Merchant RM. Twitter as a tool for health research: a systematic review. Am J Public Health. 2017;107(1):e1-8. doi: 10.2105/AJPH.2016.303512.

13. Cavazos PA, Krauss M, Fisher SL, Salyer P, Grucza RA, Bierut LJ. Twitter chatter about marijuana. J Adolesc Health. 2015;56(2):139-45. doi: 10.1016/j.jadohealth.2014.10.270.

14. Chan B, Lopez A, Sarkar U. The canary in the coal mine tweets: social media reveals public perceptions of non-medical use of opioids. PLoS One. 2015;10(8):e0135072. doi: 10.1371/journal.pone.0135072.

15. Hamad EO, Savundranayagam MY, Holmes JD, Kinsells EA, Johnson AM. Toward a mixed-methods research approach to content analysis in the digital age: the combined content-analysis model and its applications to health care twitter feeds. J Med Internet Res. 2016;18(3):e60. doi: 10.2196/jmir.5391.

16. Health Quality Ontario. 9 Million prescriptions: what we know about the growing use of prescription opioids in Ontario. Toronto (ON): Queen's Printer for Ontario; 2017.

17. Dhalla IA, Mamdami MM, Sivilotti ML, Kopp A, Qureshi O, Juurlink DN. Prescribing of opioid analgesics and related mortality before and after the introduction of long-acting oxycodone. CMAJ. 2009;181(12):891-6. doi: 10.1503/cmaj.090784.

18. Gomes T, Mamdani MM, Paterson JM, Dhalla IA, Juurlink DN. Trends in high-dose prescribing in Canada. Can Fam Physician. 2014;60:826-32.

19. Cavazos-Rehg PA, Krauss MJ, Sowles SJ, Bierut LJ. Marijuana-related posts on Instagram. Prev Sci. 2016;17(6):710-20. doi: 10.1007/s11121-016-0669-9.

20. Boyle SC, Earle AM, LaBrie JW, Ballou K. Facebook dethroned: revealing the more likely social media destinations for college students' depictions of underage drinking. Addict Behav. 2017;65:63-7. doi: 10.1016/j.addbeh.2016.10.004.

21. Zimmer M, Proferes NJ. A topology of Twitter research: disciplines, methods, and ethics. Aslib J Inform Manag. 2014;66(3):250-61. doi: 10.1108/AJIM-09-2013-0083.

Other PHAC publications

Researchers from the Public Health Agency of Canada also contribute to work published in other journals. Look for the following articles published in 2017 and 2018:

Cumming E, Kosatsky T. Calls to BC poison control on 4/20: a case-only analysis. Br Columbia Med J. 2018;60(1):62-3.

Ford JD, Sherman M, Berrang-Ford L, […] **Edge V.** Preparing for the health impacts of climate change in Indigenous communities: the role of community-based adaptation. Global Environ Change. 2018;49:129-39. doi: 10.1016/j.gloenvcha.2018.02.006.

Gonzalez A, MacMillan H, Tanaka M, Jack SM, **Tonmyr L.** Child welfare responses linked to subtypes of exposure to intimate partner violence: evidence from the Canadian Incidence Study of Reported Child Abuse and Neglect. J Interpers Violence. 2017: 886260517705661. doi: 10.1177/0886260517705661.

Lavigne É, Bélair M.-A., Duque DR, **Do MT,** et al. Effect modification of perinatal exposure to air pollution and childhood asthma incidence. Eur Respir J. 2018;51(3):1701884. doi: 10.1183/13993003.01884-2017.

Rhodes AE, Boyle MH, Bridge JA, […] **Tonmyr L, Skinner R,** et al. Les soins médicaux de jeunes hommes et de jeunes femmes qui décèdent par suicide. Can J Psychiatry. 2018;63(3):161-9. doi: 10.1177/0706743717741060.

Steensma C, **Choi BCK,** Loukine L, **Schanzer D.** Period life tables for calculating life expectancy: options to assess and minimize the potential for bias. Am J Public Health. 2018;108(3):e14. doi: 10.2105/AJPH.2017.304268.

Sun W, **Liu S,** He F, et al. Impact of relaxation of the one-child policy on maternal mortality in Guangzhou, China. Int J Gynecol Obstet. 2018. doi: 10.1002/ijgo.12445.