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Commentary

Broadening our understanding of Canada's epidemics of pharmaceutical and contaminated street drug opioid-related overdoses

Robert Strang, MD, MHSc, FRCPC

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It is my privilege to introduce this second special issue of *Health Promotion and Chronic Disease Prevention in Canada: Research, Policy and Practice* focussed on Canada's current opioid crisis. As Nova Scotia's Chief Medical Officer of Health, I deal with a broad range of public health issues. The opioid crisis is one of the most challenging, given its magnitude, reach and complex nature. The death toll is sobering: in 2017 alone, almost 4000 persons lost their lives to apparent opioid-related overdoses in Canada, and this figure may rise as more data become available.[1] Every part of the country and all sectors of Canadian society are affected. The majority of these deaths are occurring in men (78%) and among individuals aged 30 to 39 years (28%).[1] The evidence suggests that apparent opioid-related overdoses may now be the leading cause of death among men aged 30 to 39.[2] One of the reasons this opioid crisis is so complex is that it is actually made up of two linked epidemics: an epidemic of harms, including overdoses, from pharmaceutical opioids, and an epidemic of overdoses from contaminated street drugs.

When federal, provincial and territorial governments established the Special Advisory Committee on the Epidemic of Opioid Overdoses (SAC), which I co-chair with my federal counterpart, Dr. Theresa Tam, Canada's Chief Public Health Officer, we did not even know how many Canadians were dying every year from opioid overdoses. Setting up a national surveillance system to monitor apparent opioid-related deaths was itself a significant accomplishment, requiring close cooperation between the sectors of justice, public/community safety and health in all 13 provinces and territories, as well as the federal government. While this new national cross-sector collaboration was imperative to allow us to quantify the critical outcome of opioid-related overdose deaths, it is just one of many partnerships required to effectively address this crisis. An effective and coordinated response depends on a wide range of timely evidence, which has necessitated collaboration between the public health sector and non-traditional government counterparts in justice, public/community safety and border security, as well as first responders, primary care providers, harm reductions agencies and persons with lived experiences, among others. While we now have data on and some understanding of proximate determinants—for example, we know that in 2017 three-quarters (72%) of apparent opioid-related deaths involved fentanyl or fentanyl analogues, and that the majority (71%) of accidental deaths also involved one or more non-opioid substances[1]—there is a tremendous amount to be done to describe and quantify the complex web of upstream causes of the linked epidemics of pharmaceutical opioid and contaminated street drug overdoses.

The articles in this issue must be understood in this larger context: we know more than we did in December 2016, when the SAC was established, but we need to know much more still to significantly reduce the number of Canadians dying from pharmaceutical and street drug opioid-related overdoses. Collectively, these articles increase our understanding of Canada's opioid crisis and help to inform our public health interventions.

The first three articles examine several current surveillance initiatives that provide insight on different facets of the crisis from a national perspective. Abdesselam[3] highlights initiatives undertaken by the Government of Canada and other national and provincial and territorial partners to monitor the opioid crisis, and makes the case for novel surveillance approaches to improve the collection, analysis and harmonization of drug-related data, such as the development of a national drug observatory. Do and colleagues[4] use national data on opioid toxicity-related emergency department visits, from the Canadian Injury Reporting and Prevention Program (eCHIRPP), a network of 6 general and 11 pediatric hospitals from across the country, to examine associated context and circumstances surrounding these visits. Their study provides preliminary insights into the influence of proximal and distal/upstream factors associated with opioid use, highlighting the importance of mental health as an apparent contributing factor. Do[5] also teamed up with the City of Ottawa Paramedic Service to provide a "proof of concept" for national surveillance of Emergency Medical Services (EMS) data on suspected overdoses occurring prior to admission to a health care service. Their proof of concept demonstrates that, when available, paramedic data can serve as a rich, timely source of information.

The following three articles provide insights on opportunities for interventions, from addressing upstream factors such as access to supply and mental health, to engaging downstream health systems to monitor opioid-related harms

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and health outcomes. In British Columbia, Otterstatter[6] describes patterns of health care utilization among people who overdosed from illegal street drugs, using the BC provincial overdose cohort.[6] His finding, that overdose cases have higher rates of health service use, suggests that there are opportunities within the health care system, missed and otherwise, to provide interventions and to take preventative action. In Nova Scotia, Schleihauf[7] and team describe the impact of changes to opioid prescribing practices on opioid-related death rates. They found that while opioid-related mortality rates remained more or less constant between 2011 and 2017, the number of prescription opioid morphine units distributed by pharmacists decreased, while the proportion of deaths attributed to nonpharmaceutical opioids increased following recent changes to prescribing guidelines. This finding highlights the importance of monitoring both prescriptions and the supply of street drugs, in order to determine the impact of changes in prescribing practices on substance use patterns. In Alberta, Chan[8] and colleagues examined opioid toxicity suicide trends from 2000 to 2016, and their burden relative to other means of suicide. They did not observe similar trends between opioid-related intentional overdoses (suicide) and illegal fentanyl-driven unintentional overdoses (accidental), suggesting that individuals who die by opioid toxicity suicide are different from those who die from an accidental overdose, and that public health interventions must therefore be tailored to each group.

Over the past two years, governments at the federal, provincial and territorial levels have mobilized technical and financial resources to respond to this crisis. In line with the federal government's four-pillared approach to the opioid crisis[9] (prevention, treatment, harm reduction and enforcement), many provinces and territories have put in place coordinated action plans and strategies to respond to the crisis. Public health surveillance has been, and will continue to be, critical to informing effective, coordinated responses. However, it will need to expand beyond monitoring and tracking health outcomes and pharmaceutical and street drug supply and use, to exploring the deeper social and structural determinants of health, i.e., the "causes of the causes."[10] Understanding upstream causative factors will require engaging a broader range of sectors to be more proactive in developing and targeting interventions and prevention strategies.

The work that has been done in the area of surveillance continues to provide evidence needed to inform this crisis and the move further upstream is groundbreaking. The lessons learned will serve us well as we look at substance use more broadly, including the impact of the upcoming cannabis legislation.

I would like to take this opportunity to commend all those working in public health and across the partnering disciplines for your collaborative and determined work collecting and analyzing the evidence, informing and supporting the work to address these linked epidemics.

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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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At-a-glance

Opioid surveillance: monitoring and responding to the evolving crisis

Kahina Abdesselam, MSc; Matthew James Dann, MSc; Ramona Alwis, MSc; Julie Laroche, PhD; Samuel Ileka-Priouzeau, MSc

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Abstract

The incidence of opioid-related overdoses is increasing at an alarming pace, largely driven by the increased use of fentanyl and its analogues. The need for sound and reliable sources of data on opioid use is crucial in order to make decisions on implementing efficient interventions, and develop appropriate policies and guidelines to mitigate the burden of opioid use.

This article highlights initiatives undertaken by federal partners to address the opioid crisis in Canada. The need for novel surveillance approaches that improve the collection and harmonization of drug-related data is also discussed.

Keywords: *opioid, fentanyl, surveillance, national trends, drug misuse*

Highlights

- The number of opioid prescriptions and morphine milligram equivalents (MMEs) prescribed sharply declined in all provinces in 2016 and 2017.
- Federal partners undertook several initiatives to better understand Canada's opioid crisis.
- Current surveys of the general population should be complemented by newer innovative surveillance approaches that are better able to target people who use drugs.

Background

The incidence of opioid-related overdoses continues to increase at an alarming pace, largely driven by the increased use of fentanyl and its analogues. There were 2800 opioid-related deaths in Canada in 2016, and preliminary data suggest that the number of deaths surpassed 4000 in 2017.[1] From a public health standpoint, this is a major crisis, as the number of deaths in 2016 exceeded the number at the height of the HIV epidemic in Canada in 1995.[2] The sheer number of overdoses related to fentanyl and its analogues suggests that opioid misuse affects all Canadians, not only people living on the fringes of society.[3]

Per capita, Canada is the second largest consumer of opioids.[4] A recent opinion poll from the Angus Reid Institute revealed that 1 in 5 adult Canadians have been prescribed opioids.[5] In addition, 1 in 8 adult Canadians say they have close friends or family members who have become dependent on opioids in the last 5 years.[5] Although the number of opioid prescriptions dispensed across the provinces increased slightly (2.7%, population-adjusted) from 2012 to 2016, there was a sharp reduction (34.2%, population-adjusted) from 2016 to 2017. Similarly, the total morphine milligram equivalents (MME) dispensed between 2012 and 2016 declined slightly. The sharp reduction between 2016 and 2017 (15.9%) could indicate a change in opioid-prescription practices by physicians.[6]

Prescription trends across Canada paint a heterogeneous picture of the type, quantity and strength of opioids dispensed across the country (Figure 1). Moreover, an upward trend in emergency department visits and hospitalizations due to opioid overdoses (30% increase between 2007/2008 and 2014/2015[7]) suggests that opioid misuse is an issue of growing concern and that people who use these substances may be increasingly turning to the illicit market.

While national-level surveys of the general population are usually well-developed, data on subpopulations susceptible to substance misuse are lacking. This hampers the ability to develop targeted, timely and appropriate evidence-based drug policies and interventions aimed at tackling the current crisis. For example, the Canadian Tobacco, Alcohol and Drugs Survey (CTADS) and similar surveys (see Table 1) offer some insight on the opioid burden at a national level. However, general population surveys provide limited information on key indicators, such as the reasons for fluctuations in prevalence of opioid use; the types of opioids being used; where opioids are being used; and many sociodemographic characteristics, such as socioeconomic status, age, sex, ethnicity, housing, etc. Thus, the behavioural and risk patterns of individuals susceptible to opioid misuse may be significantly underrepresented due to the sampling methodology used in these population surveys.[8]

Enhanced surveillance systems and studies specifically tailored to gather information on hard-to-reach populations are required to better understand the underlying mechanisms associated with opioid misuse. These can also help highlight

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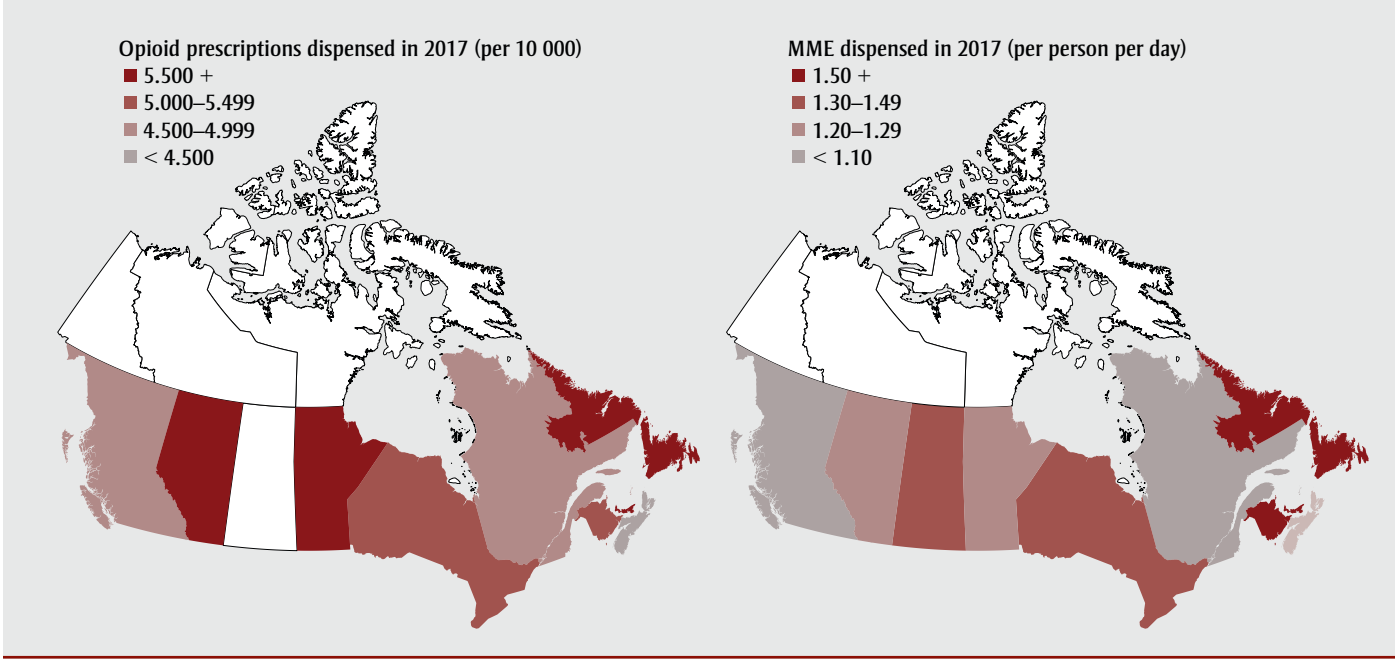
FIGURE 1
Overall opioids[a] dispensed by pharmacies (per 10 000 population), along with their morphine milligram equivalents (MME) per person per day, provinces,[b] Canada, 2017[c7]



Source: IQVIA. Compuscript. 2017.
[a] Types of opioids for prescriptions trends: codeine, fentanyl, hydromorphone, morphine, oxycodone and tramadol. For MME, tramadol was excluded as there is no reliable way to calculate MME.
[b] Rates for Prince Edward Island and Newfoundland and Labrador are combined.
[c] January to November 2017 only, as December 2017 data had not been added to the database at the time of extraction.

TABLE 1
Overview of the existing and new federal surveillance initiatives that contribute to an understanding of the opioid crisis in Canada

Surveillance projects by organization	Description	New
Health Canada		
General population surveys[12]	Canadian Tobacco, Alcohol and Drugs Survey (CTADS), a telephone-based biennial survey to capture data on tobacco, alcohol and drug use. In 2015, CTADS used a sampling frame for household surveys that included cell-phone-only households for the first time. Samples include Canadians 15 years and older. The CTADS replaced the Canadian Tobacco Use Monitoring Survey (CTUMS) and Canadian Alcohol and Drug Use Monitoring Survey (CADUMS). Health Canada also uses the Canadian Student Tobacco Alcohol and Drug Survey (CSTAD) to target student populations from Grade 7 to 12 across Canada.	
Laboratory Information Management System (LIMS); Health Canada's Drug Analysis Service (DAS)[13]	The DAS is responsible for testing suspected controlled substances seized by law enforcement agencies that submit exhibits for testing. The test results are entered into LIMS, along with information on when the exhibit was submitted to the laboratory. This allows for regular surveillance of substances including NPS and pharmaceutical drugs.	
New Psychoactive Substance (NPS) Online Survey	The NPS Online Survey is currently being piloted. Canadians 15 years and older who report having used an NPS at least once in their life are recruited through a thread posted on Bluelight, websites on illicit drugs and an innovative online survey that uses a broad random intercept method. The questions are designed to provide insight on the new substances and on substance use patterns in Canada.	✔
Canadian Post-Secondary Education and Drug Use Survey (CPADS)	CPADS started as a pilot study in March 2018. CPADS will collect information via online surveys distributed to students aged 17–25 enrolled in participating postsecondary institutions. The surveys are distributed via school-affiliated emails.	✔
Canada Compuscript (CS) – Quintiles IMS[7]	The CS is obtained from purchased data from Quintiles IMS, in which dispensed prescriptions of pharmaceutical products in Canadian drug stores are available.	
Canadian Surveillance System for Poison Information (CSSPI)[14]	CSSPI consists of 5 poison control centres across Canada that medical professionals and the public can contact to seek treatment advice. Health Canada is currently collaborating with CSSPI to obtain standardized cases and uniform data elements across the poison control centres. Poison centres control calls will allow for an estimated baseline data on opioid use and harm across the country, which could be helpful in the establishing a toxico-vigilance system.	✔

Continued on the following page

TABLE 1 (continued)
Overview of the existing and new federal surveillance initiatives that contribute to an understanding of the opioid crisis in Canada

Surveillance projects by organization	Description	New
Health Canada (continued)		
Internet monitoring	Internet monitoring of new synthetic opioids can help capture information on drugs categorized "not for human consumption." Systematic online searches can identify Canada-based websites that are selling NPS, in order to help Canada better meet international reporting obligations, inform risk assessment and scheduling of NPS, and inform potential health warnings and prevention initiatives. Law enforcement would also be kept apprised of new substances they can expect to find in clandestine laboratories. Currently, monitoring involves a manual search of Canadian websites.	
Losses and thefts[15]	This database collects information on the reported number of controlled substances that are missing (because they were stolen or have been lost) from a pharmacy, hospital, health care practitioner or licensed/registered dealer. This database could be an indicator of diversion of substances.	
Canada Vigilance Program (CVP)[16]	The CVP collects information on adverse reactions from marketed products, including prescription opioids. Reports containing illicit drugs as suspect products are only captured in the database if a marketed health product is also mentioned as a co-suspect product.	
Non-Insured Health Benefits (NIHB) Program[17]	NIHB is a national, medical health benefits program providing coverage for benefit claims for specified drugs and other medical items for eligible First Nations peoples.	
Public Health Agency of Canada (PHAC)		
Canadian Hospitals Injury Reporting and Prevention Program (CHIRRP)[18]	The CHIRRP collects information for harms associated with opioid use using data from emergency department visits in 11 sentinel pediatric and 6 general hospitals across the provinces and territories (excluding PEI, Saskatchewan, Northwest Territories and Yukon).	
Track[19]	Track is an enhanced surveillance system that monitors the prevalence of HIV, HCV and other infections as well as the associated risk behaviours (including opioid-related indicators) among injection drug users and men who have sex with men via venue-based sampling at a number of sites (most recently, 11) across Canada.	
Opioid-related deaths and harms surveillance[20]	PHAC works closely with provinces and territories to collect data on apparent opioid-related deaths from their respective offices of chief coroners/medical examiners.	
Canadian Institute for Health Information (CIHI)		
National Prescription Drug Utilization Information System (NPDUIS)[21]	The NPDUIS collects prescription claims–level data, formulary data and drug product information related to publicly financed drug benefit programs from across the provinces and territories (excluding Quebec, Northwest Territories and Nunavut).	
Hospital Morbidity Database (HMDB)[22]	The HMDB collects discharge data from acute care facilities across Canada and day surgery facilities in Quebec. It captures national administrative, clinical and demographic information on hospital inpatient events. Opioid-related admissions are limited to the detail provided by ICD-10-CA codes.	
National Ambulatory Care Reporting System (NACRS)[23]	The NACRS collects data for all hospital- and community-based ambulatory care outpatients. Opioid-related admissions are limited to the detail provided by ICD-10-CA codes.	
Canadian Centre on Substance Use and Addiction (CCSA)		
National Treatment Indicators (NTI)[24]	The NTI project was established in 2009 to collect information on admissions to treatment centres, relying on a common set of treatment indicators on publicly funded programs across participating provinces and territories in Canada.	

Abbreviation: NPS, new psychoactive substance.

changes, and identify patterns in risk factors that could be targeted by public health interventions.

Surveillance: existing and new initiatives

The Government of Canada recently established an Opioid Action Plan (OAP)[9] for the implementation of immediate measures that will reduce largely preventable harms. As decisions and policies are to be based on sound, reliable information, there is an urgent need for robust, quality opioid-related data.

To address this gap, Health Canada recently implemented targeted surveillance initiatives that complement existing general population surveys. For instance, the New Psychoactive Substances (NPS) Online Survey is currently being piloted to determine if the presence, demand for and use of new psychoactive substance (NPS; including new synthetic opioids) could be accurately documented by reaching out to online communities of people interested in experimenting with psychoactive substances. The use of the term "new" does not necessarily indicate that these substances have been newly discovered or synthesized, but rather that they are newly available or have recently emerged as substances of misuse. During the pilot phase of the NPS Online Survey, Health Canada worked with administrators from a pre-existing online forum specifically

designed for people with an interest in experimenting with psychoactive substances. This forum provides a platform where people who use drugs can exchange information and describe experiences, and discuss the psychoactive effects of substances they have tried. Forum participants are contacted and recruited through two methods: Canadians who report using an NPS at least once through a thread posted on Bluelight; and by casting an extremely broad, random intercept method using an innovative online survey.

The NPS Online Survey, which relies on voluntary participation to provide information on drug practices, is intended to contribute as an early-warning system about NPS in Canada—helping to document the presence, demand for and use of NPS in order to help meet international reporting requirements[10] and to identify new substances of concern to inform control and regulatory processes.

In addition to novel surveillance approaches, the Opioid Data Working Group (ODWG) at Health Canada undertook a comprehensive review of existing opioid data holdings and surveillance activities in order to identify potential gaps and limitations. As the rise of harms associated with this public health crisis continues, the need to capture harmonized, national-level, in-depth data on risk factors will continue to grow. For example, in order to capture the current state of the opioid crisis in Canada, the Office of Drug Research and Surveillance (ODRS) is working with the Canadian Surveillance System for Poison Information (CSSPI) on harmonizing call data collected by poison control centres to capture details on drug-related harms, including due to opioid-related overdoses. The ODRS is also collaborating with its federal and provincial/territorial partners to determine how to best collate opioid- and other drug-related data from across Canada. Obtaining these data at a national level for Canada would be best achieved through the development and implementation of a Canadian Drugs Observatory, which is a best-practice model[11] for ongoing national-level drug data collection, analysis and dissemination on drug use, harms and treatment. To this end, Health Canada is currently assessing the feasibility of implementing national drug observatory models.

Table 1 summarizes the existing and new federal initiatives that could efficiently provide useful information on behavioural and demographic risks, geographical patterns, harms and treatment.

Conclusion

Canadian public health stakeholders need better access to accurate and timely data to guide their response to the opioid crisis. A strong evidence base would enable public health actors to initiate an early warning system, identify trends, target interventions, monitor impacts and support decisions. While some measures of drug use, such as national-level surveys of the general population, are well-developed, other key data sources are not necessarily used in a way that makes a national roll-up possible or to help inform and support the identification of risk factors for opioid misuse and associated harms. As such, novel approaches for collecting, analyzing and disseminating drug use data from surveillance activities will enhance the understanding of the availability, the associated patterns of use and the harms related to opioid use.

Finally, while several federal and/or provincial/territorial departments, along with non-governmental organizations, currently perform some of the functions typically associated with a drugs observatory, Canada lacks a dedicated national drugs observatory. Adopting this best-practice model for ongoing national-level drug data monitoring would help Canada respond efficiently to the opioid crisis and other emerging drug-related issues.

Conflicts of interest

All authors are employees of Health Canada. No author has any other conflict of interest to disclose.

Authors' contributions and statement

RA researched the information on federal programs. MJD conducted the IQVIA analysis. KA wrote this paper. SIP revised the paper. JL approved the final manuscript.

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https://doi.org/10.24095/hpcdp.38.9.03

Original quantitative research

Sentinel surveillance of suspected opioid-related poisonings and injuries: trends and context derived from the electronic Canadian Hospitals Injury Reporting and Prevention Program, March 2011 to June 2017

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This article has been peer reviewed.

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Abstract

Introduction: The opioid epidemic is currently a major public health problem in Canada. As such, knowledge of upstream risk factors associated with opioid use is needed to inform injury prevention, health promotion and harm reduction efforts.

Methods: We analyzed data extracted from 11 pediatric and 6 general hospital emergency departments (EDs) as part of the electronic Canadian Hospitals Injury Reporting and Prevention Program (eCHIRPP) from March 2011 to June 2017. We identified suspected opioid-related injuries using search strings and manually verified them. We computed age-adjusted and sex-stratified proportionate injury ratios (PIRs) and 95% confidence intervals (CIs) to compare opioid-related injuries to all injuries in eCHIRPP. Negative binomial regression was used to determine trends over time. We conducted qualitative analyses of narratives to identify common themes across life stages.

Results: Between March 2011 and June 2017, 583 suspected opioid-related poisoning/injury cases were identified from eCHIRPP. Most of the cases were females (55%). Many of the injuries occurred in patients' own homes (51%). Forty-five percent of the injuries were intentional self-harm. Among children (aged 1–9 years), most injuries were caused by inadvertent consumption of opioids left unattended. Among youth (aged 10–19 years) and adults (aged 20–49 years), opioid use was associated with underlying mental illness. Overall, the average annual percent change (AAPC) in the rate of injuries (per 100 000 eCHIRPP cases) has been increasing since 2012 (AAPC = 11.9%, $p < .05$). The increase is particularly evident for males (AAPC = 16.3%, $p < .05$). Compared to other injuries, people with suspected opioid-related injuries were more likely to be admitted to hospital (PIR = 5.3, 95% CI: 4.6–6.2).

Conclusion: The upstream determinants of opioid-related injuries are complex and likely vary by subpopulations. Therefore, continued monitoring of risk factors is important in providing the evidence necessary to prevent future overdoses and deaths.

Keywords: *emergency department; ED; opioid; opiate; poisoning; surveillance; CHIRPP; Canada*

Highlights

- Compared to all injuries in eCHIRPP, those with opioid-related injuries were more likely to be female, and the injuries were more likely to occur with the intent to self-harm, at home, between 12:00 a.m. and 7:59 a.m. and to result in admission to the hospital.
- The average annual percentage change (AAPC) in the number of suspected opioid-related injury/poisoning cases (per 100 000 eCHIRPP cases) has been increasing since 2012 (AAPC = 11.9%, $p < .05$). The increase is particularly evident for males (AAPC = 16.3%, $p < .05$).
- Among young children (aged < 5 years), access to medication (e.g. pills found on the floor), combined with lack of supervision, was the most common factor contributing to opioid-related poisoning.
- Suicide attempt accounted for the largest proportion of cases in youth (33%), followed by older adults (28%) and adults (9%). Recreational use of opioids was most commonly reported by adults.

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Introduction

In recent years, the number of deaths and hospitalizations related to opioid use has been increasing dramatically in some regions within Canada, with little evidence that the crisis is abating. In 2016, there were 2861 apparent opioid-related deaths (8.1 per 100 000) in Canada, far exceeding the number of motor vehicle fatalities (5.2 per 100 000) in 2015.[1,2] Similarly, the Canadian Institute for Health Information (CIHI) also reported parallel increases in opioid-related emergency department (ED) visits and hospital admissions in some parts of Canada.[3] Particularly concerning were youths (aged 15–24 years), the age group for which some of the largest increases have been observed for both hospitalizations and ED visits.[3]

The current opioid crisis in Canada has been driven by high opioid-prescription rates as well as the increased importation of highly potent synthetic opioids supplying the illegal market such as fentanyl and the more potent carfentanil. Although many reports have focussed on opioid-related deaths among adults, much of the current discourse surrounding the opioid crisis has failed to examine the situation in youth and adolescents. The electronic Canadian Hospitals Injury Reporting and Prevention Program (eCHIRPP) collected data from 11 pediatric hospitals and 6 general hospitals across the country on opioid-related poisonings and injuries, and thus presents an existing data source that may provide some additional insight into the crisis. In addition, this surveillance system collected narrative information on circumstances prior to the injuries and poisonings, thereby providing opportunities for in-depth analyses.

Study objectives

The purpose of this study was to provide an overview of ED visits for suspected opioid-related poisonings or injuries recorded in eCHIRPP from March 2011 to June 2017. Specifically, the objectives of this study were to

- describe the epidemiology (person, place and time) of opioid-related poisonings/injuries and compare it to that of all other injury events in eCHIRPP;
- examine temporal trends (2011–2016), by sex and age group; and
- describe contextual factors (e.g. intent, preinjury events) surrounding opioid-related poisonings/injuries (and identify patterns by life stages) through qualitative evaluation.

Methods

Data source

eCHIRPP is an ED-based injury and poisoning sentinel surveillance system funded and administered by the Public Health Agency of Canada (PHAC). Details on the development and recent advances of the CHIRPP have been described elsewhere.[4] Established in 1990, the CHIRPP currently operates in 11 pediatric and 6 general hospitals across Canada. During their visit to the ED of a participating CHIRPP hospital, patients (or someone on their behalf, e.g. a parent or guardian) are asked to fill out a reporting form detailing the circumstances of the injury/poisoning event (e.g. time, place, activity), including both close-ended and open-ended (free-text) questions. The attending physician or other hospital staff then complete the form by providing details on clinical features (e.g. body part and nature of injury) and treatment or disposition. Since 2011, instead of centralized data entry and coding by PHAC, data have been entered directly by CHIRPP site coordinators into a web-based electronic system (eCHIRPP), which greatly enhances the timeliness of data entry and dissemination. PHAC coders then verify the data accessed through the online eCHIRPP platform, perform interpretive coding of free-text narratives and conduct data quality checks. For the purposes of this study, analyses were based on data recorded in eCHIRPP from March 2011 to June 27, 2017 (all ages; total records searched: n = 786 758). The quality of CHIRPP data has been previously evaluated.[5,6]

Case selection

We conducted a search of all relevant data fields, including narratives, product codes and substances, within the eCHIRPP database to identify all suspected opioid-related poisonings and injuries. We defined a "suspected" injury event as one meeting the search criteria. The search strategy was developed using search terms that included generic drug names (e.g. "amidone," "buprenorphine," "codeine," "fentanyl," "heroin," "hydrocodone," "hydromorphone," "laudanum," "meperidine," "methadone," "morphine," "naloxone," "oxycodone" and "tramadol"), common trade (brand) names (e.g. "Dilaudid," "Duragesic," "Empracet," "Emtec," "Endocet," "Lenoltec," "MS Contin," "Narcan," "OxyContin," "Oxycocet," "Percocet," "Roxicet," "Statex," "Suboxone," "Tramacet," "Tylenol" (#1, 2, 3 or 4) and "Vicodin"), and nonspecific terms (e.g. "opiate," "opioid" and "opium"). Synonyms, truncated terms and different spellings/misspellings were also searched where applicable. To ensure the accuracy of case selection, we reviewed the narratives of all cases captured by the search and excluded cases where the poisoning/injury event did not involve opioids (e.g. taking regular Tylenol [acetaminophen] only, or taking opioid pain medication after an injury event with no indication of poisoning or adverse reaction). Cases for which the date of poisoning/injury or date of birth were unknown were excluded (n = 2).

Variables

Variables pertaining to person (age and gender), place (location where the poisoning/injury event occurred) and time (year, day of the week and time of the day) were obtained from the eCHIRPP database. Other variables of interest included intent of poisoning/injury (unintentional, intentional self-harm or assault/maltreatment) and disposition (observation or treatment in ED or admission to hospital). Additionally, since drugs and substances are not routinely coded or are only coded into broad categories in the eCHIRPP database, we reviewed the narrative fields (Injury Event Description, Product, and Substance) of all identified cases to manually code specific opioids and any co-occurring substances (e.g. alcohol, medications, illicit drugs) involved. For combination products such as those containing acetaminophen plus an opioid (e.g. codeine in Tylenol 3, oxycodone in Percocet), the nonopioid component (acetaminophen) was coded as a co-occurring substance.

Statistical analysis

We conducted descriptive analyses to examine the distribution of characteristics (age, location, day of week, time of day, intent and disposition) of suspected opioid-related poisoning and injury cases, overall and stratified by gender. We calculated means and standard deviations (SDs) for continuous variables, while frequency distributions (counts and proportions) were

computed for categorical variables. We also generated frequency distributions to identify the most commonly involved opioids and co-occurring substances by age group (< 10, 10–19, 20–49, and ≥ 50 years) and gender. Furthermore, we used proportionate injury ratios (PIRs) to compare specific characteristics of opioid-related cases to all injury/poisoning cases within the eCHIRPP database. The PIR was calculated as a ratio of the observed number of opioid-related cases for a given characteristic (e.g. intentional self-harm) to the expected number of cases based on age- (10-year age groups) and sex-specific proportions of that characteristic among all eCHIRPP cases.[7] We calculated PIRs with 95% confidence intervals (CIs) for both sexes combined, and separately for males and females.

Since CHIRPP is not population-based, incidence rates could not be determined; instead, we calculated the proportion of opioid-related cases among all injury/poisoning cases in eCHIRPP (presented as number of opioid-related cases per 100 000 eCHIRPP cases) for each year. We evaluated temporal trends in the proportion of opioid-related poisonings/injuries among all eCHIRPP cases using negative binomial regression and calculated average annual percent changes (AAPCs) with 95% CIs, overall and by gender and age group. The AAPC was calculated using the following formula: $AAPC = [e^{\beta} - 1] \times 100$, where β is the slope from the regression of log proportions on year.[8] We included 2017 data up to the month of June but excluded anything between January and June 2017 from the trend analysis because of incomplete data due to potential delays in data entry by CHIRPP sites and possible differential (i.e. more timely) reporting of opioid-related cases relative to other injuries. We also conducted analyses excluding cases from 2011 (i.e. the year CHIRPP transitioned to eCHIRPP) and then including 2011 but excluding 2016 (because of delayed reporting by some hospitals) to examine the potential impact on trends. We also conducted additional sensitivity analysis restricting to only the 11 pediatric hospitals to determine potential impacts on the trends. All analyses were performed using SAS Enterprise Guide, version 5.1 (SAS Institute Inc., Cary, NC, USA) and Microsoft Excel 2014 (Microsoft Corp., Redmond, WA, USA).

Qualitative coding and analysis of narratives

To supplement the quantitative statistical analysis as described above, we conducted a qualitative analysis of the free-text narratives to provide a better understanding of contextual factors and circumstances that may have contributed to opioid-related poisonings and injuries. We used content analysis to code the narratives through an inductive approach.[9,10] First, we scanned the narratives to identify recurrent words, phrases, events or themes. We then developed coding categories and subcategories based on key themes emerging from the data. Next, narratives of individual cases were read and re-read in detail and coded into relevant categories in an iterative process involving ongoing interpretation of data and modification of the coding scheme (e.g. adding or collapsing categories). Coding was completed independently by two members of the research team (VC and ST), and discrepancies were resolved through discussion and consensus. Given differences in risk factors and context surrounding injuries/poisonings, results were presented by specific life-stage groups: newborns and infants (aged < 1 year); toddlers and children (1–9 years); youth (10–19 years); adults (20–49 years); and older adults (≥ 50 years). In addition to descriptions and examples of the identified themes, we also reported frequencies of coded categories. Themes and contexts were grouped into broader categories based on temporality: 1) event (the injury event itself, e.g. overdose with suicidal intent); 2) proximal (more immediate/recent) factors likely contributing to the event (e.g. recent life stressors); and 3) distal (upstream) risk factors (e.g. mental health, history of substance abuse, previous self-harm/suicide attempts).

Results

Case characteristics

A total of 583 suspected opioid-related poisoning/injury events were reported to eCHIRPP between March 2011 and June 2017, of which 55% involved females. Table 1 presents basic demographic and injury characteristics of the cases, overall and by gender. Due to the nature of CHIRPP hospitals (mostly pediatric), nearly two-thirds (66%) of all cases identified involved people under 20 years of age (males: 58%, females: 72%). Youth aged 15 to 19 years accounted for the greatest proportion of cases among both males

TABLE 1
Characteristics of suspected opioid-related emergency department visits, overall and by gender, eCHIRPP, March 2011 to June 2017

Characteristic	All n	(%)	Males n	(%)	Females n	(%)
Total	583	(100)	261	(44.8)	322	(55.2)
Age (years)						
Mean (SD)	22.1	(17.8)	24.1	(19.1)	20.5	(16.6)
Median (IQR)	16	(13–32)	16	(10–38)	16	(14–23)
Age group (years)						
< 1	18	(3.1)	8	(3.1)	10	(3.1)
1	37	(6.3)	15	(5.7)	22	(6.8)
2–9	73	(12.5)	41	(15.7)	32	(9.9)
10–14	65	(11.1)	20	(7.7)	45	(14.0)
15–19	189	(32.4)	67	(25.7)	122	(37.9)
20–29	45	(7.7)	19	(7.3)	26	(8.1)
30–39	46	(7.9)	27	(10.3)	19	(5.9)
40–49	50	(8.6)	32	(12.3)	18	(5.6)
50–64	44	(7.5)	26	(10.0)	18	(5.6)
≥ 65	16	(2.7)	6	(2.3)	10	(3.1)

Continued on the following page

TABLE 1 (continued)
Characteristics of suspected opioid-related emergency department visits, overall and by gender, eCHIRPP, March 2011 to June 2017

Characteristic	All n	(%)	Males n	(%)	Females n	(%)
Intent						
Unintentional	280	(48.0)	143	(54.8)	137	(42.5)
Intentional self-harm	261	(44.8)	96	(36.8)	165	(51.2)
Maltreatment or assault	10	(1.7)	5	(1.9)	5	(1.6)
Other/not specified	32	(5.5)	17	(6.5)	15	(4.7)
Location[a]						
Own home	299	(51.3)	116	(44.4)	183	(56.8)
Other people's homes	45	(7.7)	25	(9.6)	20	(6.2)
Residential institution	10	(1.7)	5	(1.9)	5	(1.6)
School or public administrative location	11	(1.9)	6	(2.3)	5	(1.6)
Street, highway or public road	24	(4.1)	16	(6.1)	8	(2.5)
Trade or service location	15	(2.6)	10	(3.8)	5	(1.6)
Unspecified/unknown	164	(28.1)	76	(29.1)	88	(27.3)
Day of week						
Monday	88	(15.1)	36	(13.8)	52	(16.1)
Tuesday	83	(14.2)	41	(15.7)	42	(13.0)
Wednesday	89	(15.3)	42	(16.1)	47	(14.6)
Thursday	68	(11.7)	33	(12.6)	35	(10.9)
Friday	93	(16.0)	44	(16.9)	49	(15.2)
Saturday	90	(15.4)	42	(16.1)	48	(14.9)
Sunday	72	(12.3)	23	(8.8)	49	(15.2)
Time of day						
12:00 a.m.–3:59 a.m.	51	(8.7)	22	(8.4)	29	(9.0)
4:00 a.m.–7:59 a.m.	28	(4.8)	20	(7.7)	8	(2.5)
8:00 a.m.–11:59 a.m.	48	(8.2)	23	(8.8)	25	(7.8)
12:00 p.m.–3:59 p.m.	78	(13.4)	33	(12.6)	45	(14.0)
4:00 p.m.–7:59 p.m.	105	(18.0)	38	(14.6)	67	(20.8)
8:00 p.m.–11:59 p.m.	84	(14.4)	38	(14.6)	46	(14.3)
Unknown	189	(32.4)	87	(33.3)	102	(31.7)
Disposition						
Left without being seen or advice only	52	(8.9)	23	(8.8)	29	(9.0)
Treated in ED, follow-up PRN	113	(19.4)	62	(23.8)	51	(15.8)
Treated in ED, follow-up required	93	(16.0)	37	(14.2)	56	(17.4)
Observed in ED, follow-up PRN	100	(17.2)	52	(19.9)	48	(14.9)
Observed in ED, follow-up required	52	(8.9)	17	(6.5)	35	(10.9)
Admitted to hospital	173	(29.7)	70	(26.8)	103	(32.0)

Abbreviations: eCHIRPP, electronic Canadian Hospitals Injury Reporting and Prevention Program; ED, emergency department; IQR, interquartile range; PRN, as needed; SD, standard deviation.

[a] Only locations with more than 5 cases are shown.

(26%) and females (38%), whereas children aged 5 to 9 years accounted for less than 1% of all cases. Overall, 48% of cases were unintentional in nature and 45% occurred with the intention to self-harm. Notably, intentional self-harm accounted for a larger proportion of cases among females (51%) than males (37%). Moreover, while cases involving patients under 10 years of age were almost exclusively unintentional, 57%, 55% and 65% of cases involving people aged 10 to 19, 20 to 49, and 50 years or older, respectively, were due to intentional self-harm (data not shown). In terms of location of injury/poisoning, the majority of cases occurred in the person's own home (51%). Other common places of occurrence (where specified) included other people's homes (8%) and street, highway or public road (4%). No clear patterns were observed by day of the week, with the highest and lowest number of cases occurring on Friday (16%) and Thursday (12%), respectively. Where time of the day was reported (n = 394), the largest proportion of cases occurred between 4:00 p.m. and 7:59 p.m. (27%). Of all suspected opioid-related cases, 30% resulted in admission to the hospital, with a higher proportion among females (32%) than males (27%).

Comparisons with all cases in eCHIRPP

Table 2 presents PIRs comparing suspected opioid-related poisoning/injury cases to all cases in eCHIRPP in terms of gender, intent, location, day of the week, time of the day and disposition. Compared to all injury/poisoning cases in eCHIRPP, opioid-related cases were significantly more likely to involve females (PIR = 1.30, 95% CI: 1.16–1.45), to occur with the intent to self-harm (PIR = 25.00, 95% CI: 22.15–28.23) and to occur in the person's own home (PIR = 1.98, 95% CI: 1.77–2.22) or in a residential institution (PIR = 2.61, 95% CI: 1.40–4.85). PIRs for day of the week were not significantly different compared to eCHIRPP cases in general, except that a lower proportion of opioid-related cases occurred on Sunday among males (PIR = 0.62, 95% CI: 0.42–0.94). Significantly elevated proportions of opioid-related cases occurred from 12:00 a.m. to 3:59 a.m. (PIR = 3.01, 95% CI: 2.29–3.96) and from 4:00 a.m. to 7:59 a.m. (PIR = 1.88, 95% CI: 1.30–2.73). Furthermore, compared to all cases in eCHIRPP, opioid-related cases were significantly more likely to be observed in the ED (follow-up as needed) (PIR = 5.54, 95% CI: 4.64–6.86)

TABLE 2
Age- and gender-adjusted proportionate injury ratios (PIR) for suspected opioid-related cases compared to all injury/poisoning cases in eCHIRPP, overall and by gender, March 2011 to June 2017

Characteristic	All		Males		Females	
	PIR	95% CI	PIR	95% CI	PIR	95% CI
Gender						
Male	0.78	0.69–0.88	n/a		n/a	
Female	1.30	1.16–1.45	n/a		n/a	
Intent						
Unintentional	0.50	0.44–0.56	0.57	0.48–0.67	0.44	0.38–0.52
Intentional self-harm	25.00	22.15–28.23	44.25	36.23–54.05	19.95	17.13–23.24
Maltreatment or assault	1.25	0.67–2.32	1.08	0.45–2.61	1.48	0.61–3.55
Other/not specified	11.08	7.83–15.66	13.64	8.48–21.95	9.13	5.50–15.14
Location[a]						
Own home	1.98	1.77–2.22	1.80	1.50–2.16	2.11	1.83–2.44
Other people's homes	1.32	0.99–1.77	1.63	1.10–2.41	1.07	0.69–1.65
Residential institution	2.61	1.40–4.85	3.50	1.46–8.40	2.08	0.86–4.99
School or public administrative location	0.13	0.07–0.23	0.18	0.08–0.40	0.10	0.04–0.23
Street, highway or public road	0.54	0.36–0.81	0.81	0.50–1.32	0.33	0.16–0.65
Trade or service location	0.94	0.57–1.57	1.43	0.77–2.66	0.56	0.23–1.35
Unspecified/unknown	1.06	0.91–1.24	1.01	0.80–1.26	1.11	0.90–1.37
Day of week						
Monday	1.09	0.88–1.34	1.00	0.72–1.39	1.16	0.88–1.52
Tuesday	1.02	0.82–1.27	1.13	0.83–1.54	0.93	0.69–1.26
Wednesday	1.08	0.88–1.33	1.14	0.84–1.54	1.04	0.78–1.38
Thursday	0.83	0.65–1.05	0.91	0.64–1.27	0.77	0.55–1.07
Friday	1.12	0.91–1.37	1.17	0.87–1.57	1.08	0.82–1.43
Saturday	0.99	0.81–1.22	1.02	0.75–1.38	0.97	0.73–1.29
Sunday	0.87	0.69–1.09	0.62	0.42–0.94	1.06	0.80–1.41
Time of day						
12:00 a.m.–3:59 a.m.	3.01	2.29–3.96	2.76	1.82–4.19	3.23	2.25–4.65
4:00 a.m.–7:59 a.m.	1.88	1.30–2.73	2.89	1.86–4.48	1.01	0.50–2.01
8:00 a.m.–11:59 a.m.	0.54	0.40–0.71	0.55	0.37–0.83	0.52	0.35–0.78
12:00 p.m.–3:59 p.m.	0.56	0.45–0.70	0.52	0.37–0.74	0.59	0.44–0.79
4:00 p.m.–7:59 p.m.	0.71	0.59–0.86	0.59	0.43–0.81	0.80	0.63–1.02
8:00 p.m.–11:59 p.m.	1.08	0.87–1.33	1.11	0.81–1.52	1.06	0.79–1.41
Unknown	1.95	1.69–2.25	2.03	1.65–2.51	1.88	1.55–2.28
Disposition						
Left without being seen, or advice only	0.36	0.27–0.47	0.39	0.26–0.59	0.33	0.23–0.48
Treated in ED, follow-up PRN	0.49	0.41–0.59	0.59	0.46–0.75	0.41	0.31–0.54
Treated in ED, follow-up required	0.67	0.55–0.82	0.55	0.40–0.76	0.78	0.60–1.02
Observed in ED, follow-up PRN	5.64	4.64–6.86	6.92	5.28–9.09	4.69	3.54–6.23
Observed in ED, follow-up required	3.77	2.88–4.95	4.74	2.95–7.62	3.43	2.46–4.78
Admitted to hospital	5.32	4.58–6.17	3.81	3.01–4.81	7.29	6.01–8.84

Abbreviations: CI, confidence interval; eCHIRPP, electronic Canadian Hospitals Injury Reporting and Prevention Program; ED, emergency department; n/a, not applicable; PIR, proportionate injury ratio; PRN, as needed.

[a] Only locations with more than 5 cases are shown.

or admitted to the hospital (PIR = 5.32, 95% CI: 4.58–6.17).

Temporal trends

Table 3 provides results of trends analyses for suspected opioid-related poisonings and injuries for the period between 2011 and 2016. In order to assess the robustness of the trends, we also examined different points within this period. Overall, there was a consistent increasing trend for suspected opioid-related poisonings/injuries for this period. Although the confidence intervals were large, significant AAPCs in the number of suspected opioid-related injury/poisoning cases (per 100 000 eCHIRPP cases) were observed starting in 2012 (AAPC = 11.9%, $p < .05$). The increase is particularly evident for males (AAPC = 16.3%, $p < .05$). Additional analyses were also conducted restricting to only the 11 pediatric hospitals to determine potential impacts on the trends. Overall, the pattern of results described above did not change (data not shown).

Opioid types and co-occurring substances

The types of opioids and co-occurring substances most commonly used in suspected opioid-related cases are summarized in Figure 1. The most commonly used types of opioids among children (< 10 years) and youth (10–19 years) were oxycodone (30%) and codeine (56%), respectively, frequently as combination medication products containing opioids plus acetaminophen (e.g. Tylenol 3, Percocet). In male adults (20–49 years), use of hydromorphone (18%), oxycodone (18%), morphine (17%), and heroin (14%) was most common. In female adults, use of hydromorphone (22%), codeine (18%), and morphine (18%) was most common. Morphine was the opioid most commonly used by male adults aged 50 years or older (34%) and the second most common type of opioid used by older female adults (25%), after oxycodone (32%). Co-occurring substance use other than acetaminophen was common in both males and females across all age groups (except for < 10 years, with very few cases). Alcohol was the most common co-occurring substance used in older male adults (44%) and the second most common co-occurring substance among youth and adults. Other common co-occurring substances included cannabinoids, benzodiazepines, nonsteroidal anti-inflammatory drugs, methamphetamine and cocaine.

TABLE 3
Average annual percentage changes (AAPC) in the number of suspected opioid-related poisoning/injury cases (per 100 000 eCHIRPP cases) during different time periods

Period and group	AAPC (%)	95% CI	*p*
2011–2016			
All	6.00	–2.81, 15.61	.188
Males	6.89	–6.06, 21.63	.312
Females	5.12	–3.69, 14.74	.262
2011–2015			
All	7.49	–5.60, 22.41	.276
Males	9.14	–9.66, 31.86	.365
Females	6.12	–7.24, 21.41	.387
2012–2016			
All	11.89	2.95, 21.61	.008*
Males	16.34	2.60, 31.93	.018*
Females	8.27	–3.55, 21.54	.178
2012–2015			
All	19.48	11.01, 28.60	< .001*
Males	28.94	18.30, 40.54	< .001*
Females	12.53	–7.28, 36.57	.232

Abbreviations: AAPC, average annual percentage change; CI, confidence interval; eCHIRPP, electronic Canadian Hospitals Injury Reporting and Prevention Program.

* $p < .05$.

Qualitative analysis of narratives

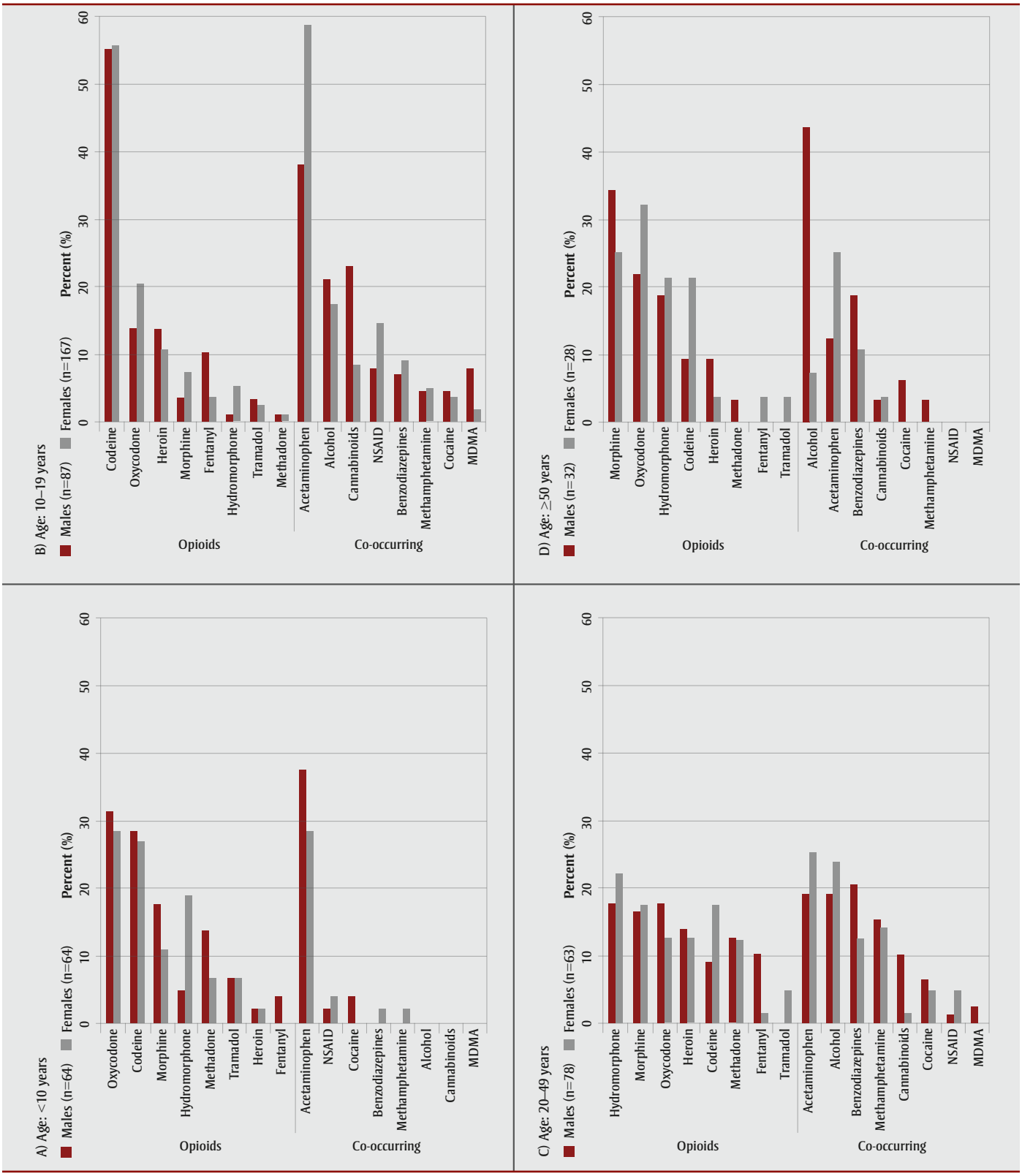
Qualitative analyses of narratives are summarized in Table 4. Among young children (aged < 5 years), access to medication (e.g. pills found on the floor, retrieved from purse or cabinet), in combination with lack of supervision (e.g. playing alone), is the most common factor contributing to opioid-related poisoning. In addition, of the poisoning cases in children younger than one year old, mothers who took opioids while pregnant were reported in six cases.

Suicide attempt (where mentioned in narrative) accounted for the largest proportion of cases in youth (33%), followed by older adults (28%) and adults (9%). Recreational use of opioids was most commonly reported by adult cases. Mental health was a major reoccurring theme identified from the narratives among youth, adults and older adults. Proximal (direct/recent) contributing factors included recent life stressors (e.g. argument with family, breakup, death of a loved one) and emotional distress (e.g. feeling sad, upset, depressed or stressed). Distal factors (upstream risk factors) included history of substance abuse, depression or other mental health issues and previous self-harm or suicide attempts. Many opioid-related cases also involved other injuries (co-occurring with poisoning or as a result of taking opioids). For example, self-inflicted injuries (e.g. cutting wrists) were common among youth, particularly females aged 15 to 19, and fall-related injuries (e.g. feeling dizzy from medication) were common among older adults. Other injuries included motor vehicle crashes and drug-related assaults.

Discussion

In this study, we described the epidemiology of opioid-related injuries using data collected from eCHIRPP. Consistent with the literature,[1,3] our analysis of the eCHIRPP data showed significant increases in the rate of opioid-related injuries (per 100 000 eCHIRPP events) over time. We also observed that females made up the majority (55%) of these cases seen at CHIRPP sites. While the higher proportion of females may reflect differences in health care–seeking behaviours between men and women, the literature also suggests that men in general are more likely

FIGURE 1
Most commonly used opioids and co-occurring substances among suspected opioid-related cases, by age group and gender, eCHIRPP, March 2011 to June 2017



Abbreviations: eCHIRPP, electronic Canadian Hospitals Injury Reporting and Prevention Program; MDMA, 3,4-methylenedioxymethamphetamine (i.e., ecstasy); NSAID, nonsteroidal anti-inflammatory drug.

Note: Percentages do not add up to 100% because more than one opioid and/or co-occurring substance may be involved, and only the most common types are shown here.

TABLE 4
Contextual factors surrounding suspected opioid-related cases (by age group): qualitative analysis

Age group; total # of cases		Theme	Description/examples	Frequency n (%)	Selected case characteristics: n (%)
Newborns & infants (< 1 year) n = 18		Newborn withdrawal	• Mother was taking opioids during pregnancy • Newborn suffered from withdrawal symptoms (neonatal abstinence syndrome) and/or were tested positive for opioids	6 (33%)	Age 0–2 months: 6 (100%)
		Supervision/ accessibility	• Child was playing and ingested opioids (pills) within reach, e.g. found on the floor (most common) or table	9 (50%)	Age 9–11 months: 8 (89%)
Toddlers & children (1–9 years) n = 110		Supervision/ accessibility	• Child was playing (some mentioned "unsupervised," "alone," or "by him/herself") and ingested opioids (pills or liquid) within reach, e.g. found on the floor or table/counter, retrieved from cabinet or (mother's) purse	99 (90%)	Male: 50 (51%) Age 1–2 years: 76 (77%)
		Incorrect medication/dose	• Parent/guardian mistakenly gave the wrong drug (i.e. opioid instead of the intended medication) or the wrong dose of opioid medication to child	5 (5%)	—
Youth (10–19 years) n = 254	Event	Suicide attempt	• Overdose/poisoning with suicidal intent (e.g. "suicide attempt," "suicidal gesture," "suicidal," "suicidal ideation," "wants to die")	83 (33%)	Female: 63 (76%) Age 15–19 years: 57 (69%)
	Event	Recreational	• Use of opioids for recreation or pleasure (e.g. "to get high") • Many (50%) mentions of "hanging out with friends" or "at a party"	38 (15%)	Female: 20 (53%) Age 15–19 years: 32 (84%)
	Event	Therapeutic	• Adverse effect or accidental poisoning/overdose from medication used for pain relief/management (e.g. dental pain, injury, or chronic condition)	13 (5%)	Female: 7 (54%) Age 15–19 years: 8 (62%)
	Proximal	Emotional distress	• Mentions of feeling "sad," "depressed," "upset," "stressed," etc., and/or wanting to "feel better" or "block out things" (with or without suicidal intent)	38 (15%)	Female: 28 (74%) Age 15–19 years: 25 (66%)
	Proximal	Recent life stressors	• Argument with parent (most common), sibling, friend or boy/girlfriend • Other stressors: e.g. breakup, death of a loved one, abandoned, abused or raped	31 (12%)	Female: 22 (71%) Age 15–19 years: 24 (77%)
	Distal	History of mental health–related issues	History of substance abuse or addiction (including withdrawal)	20 (8%)	Male: 12 (60%) Age 15–19 years: 18 (90%)
	Distal	History of mental health–related issues	History of depression or other mental health issues (e.g. PTSD, "hearing voices")	11 (4%)	Female: 5 (45%) Age 15–19 years: 11 (100%)
	Distal	History of mental health–related issues	History of intentional self-harm (e.g. cutting) or previous suicide attempt(s)	8 (3%)	Female: 7 (88%) Age 15–19 years: 7 (88%)
	Other injury	Intentional self-harm	Self-inflicted injuries (e.g. cutting wrists, strangling) where opioids were involved	19 (7%)	Female: 18 (95%) Age 15–19 years: 16 (84%)
	Other injury	Unintentional	Injuries due to MVC, falls or other mechanism (under the influence of opioids)	11 (4%)	Female: 6 (55%) Age 15–19 years: 8 (73%)
	Other injury	Assault	Injuries due to assault by others (e.g. kicked), opioids involved	—	—

Continued on the following page

than women to use more types of illegal drugs[11] that would increase their risk for ED visits and overdose deaths.

Our analysis of eCHIRPP data also showed that most (51%) of the injuries occurred in the person's own home. Although eCHIRPP data come mostly from pediatric populations, similar observations have been reported in the general population. For example, in British Columbia, 61% of deaths due to illicit drug overdoses occurred in private residences.[12] This finding is important as it presents opportunities for prevention. For example, our analysis shows that some injuries were caused by young children ingesting medication left unattended. Proper storage of medication or other engineering solutions could be used to prevent child access to medications.

For this study, we have also analyzed the eCHIRPP data using a qualitative methodology in order to identify common themes across life-stages. Using this approach, there were some unexpected findings that

TABLE 4 (continued)
Contextual factors surrounding suspected opioid-related cases (by age group): qualitative analysis

Age group; total # of cases		Theme	Description/examples	Frequency n (%)	Selected case characteristics: n (%)
Adults (20–49 years) n = 141	Event	Recreational	• Use of opioids for recreational purposes • Few cases (mostly < 30 years of age) mentioned "with friends" or "at a party"	21 (15%)	Male: 12 (57%) Age 20–29 years: 12 (57%)
		Suicide attempt	• Overdose/poisoning with suicidal intent (e.g. "suicide attempt")	13 (9%)	Female: 8 (62%) Age 20–29 years: 7 (54%)
		Therapeutic	• Adverse effect or accidental poisoning/overdose from medication used for pain relief/management (e.g. dental pain, acute or chronic pain)	5 (4%)	—
	Proximal	Recent life stressors	• Most involved argument with a spouse or partner • Other stressors: e.g. breakup, stressors at home, job loss	10 (7%)	Female: 67% Age 30–49 years: 60%
		Emotional distress	• Most related to difficulty coping with stress (with no mention of suicide) • Some mentions of feeling "angry" or "depressed"; or "wanted to forget"	8 (6%)	
	Distal	History of substance abuse	• Regular substance user (often multiple drugs), addiction problems, or going through withdrawal	18 (13%)	Male: 11 (61%) Age 30–49 years: 10 (56%)
	Other injury	Unintentional	Fall (e.g. walking after taking opioid medication/drug)	8 (6%)	Male: 15 (65%) Age 30–49 years: 13 (57%)
			MVC (e.g. driving under the influence of opioids)	—	
			Other unintentional injury involving opioids (e.g. needlestick, hitting head)	11 (8%)	
		Intentional self-harm	Self-inflicted injuries (e.g. cutting wrists) where opioids were involved	—	Female: 5 (56%) Age 30–49 years: 6 (67%)
		Assault	Drug-related assault (e.g. beaten up, kicked, stabbed)	5 (4%)	
Older adults (50+ years) n = 60	Event	Suicide attempt	• Overdose/poisoning with suicidal intent (e.g. "suicide attempt")	17 (28%)	Male: 9 (53%) Age 50–64 years: 12 (71%)
		Recreational	• Use of opioids for recreational purposes	—	—
		Therapeutic	• Adverse effect or accidental poisoning/overdose from medication used for pain relief/management (e.g. chronic pain)	—	—
	Proximal	Recent life stressors	• A mix of life stressors, e.g. relationship or family problems, death of a loved one, work-related stress, diagnosis of illness	10 (17%)	Female: 7 (70%) Age 50–64 years: 8 (80%)
	Other injury	Unintentional	Fall-related injury under the influence of medication/drug (e.g. feeling dizzy)	9 (15%)	Male: 5 (56%) Age 65+ years: 6 (67%)
			Other unintentional injury involving opioids (e.g. MVC)	—	—
		Intentional self-harm	Self-inflicted injuries (e.g. cutting) where opioids were involved	—	—

Abbreviations: MVC, motor vehicle collision; PTSD, post-traumatic stress disorder.
Note: — Suppressed due to small cell size.

merit discussion. Among cases involving children less than one year of age, we were surprised to find a number of newborns with withdrawal symptoms. These cases may be due to either neonatal abstinence syndrome (NAS) not identified in the postpartum period, or to inadequate duration of treatment of NAS prior to hospital discharge. A report from the United States showed that the rate of NAS has doubled from 3.6 cases in 2009 to 7.3 cases per 1000 live births in 2013.[13] It is not clear, and should be investigated, whether the same trends exist in Canada.

Mental health was a major reoccurring theme identified from the narrative among youth, adults and older adults. Proximal (direct/recent) contributing factors included recent life stressors (e.g. argument with family, breakup, death of a loved one) and emotional distress (e.g. feeling sad, upset,

depressed or stressed). Distal factors (upstream risk factors) included history of substance abuse, depression or other mental health issues, and previous self-harm or suicide attempts. The themes identified in the qualitative assessment were also confirmed by significantly elevated PIR (PIR = 25.00, 95% CI: 22.15–28.23) for intentional self-harm. Similarly, opioid-related cases were more likely to be admitted to the hospital compared to other injuries (PIR = 5.32, 95% CI: 4.58–6.17).

Strengths and limitations

This study benefited from data collected in near real-time from 17 sentinels across Canada. Validation studies previously conducted shows the eCHIRPP data are representative of all injuries captured.[5,6] Furthermore, eCHIRPP contains narrative information that provides detailed information on the circumstances prior to the injury. In this study, we were able to use the narrative to qualitatively identify reoccurring themes. To our knowledge, this is the first time qualitative methodology has been used on eCHIRPP data. In this study, the qualitative information provided context for interpreting the quantitative risk estimates. For example, the increase in PIR was supported by the reoccurring theme of mental health relating to distal factors such as history of substance abuse and previous self-harm attempts.

Our study also has several limitations, which may impact the interpretation of the results. Given that eCHIRPP is sentinel in nature, it cannot provide information on the burden of opioid-related injuries or provide estimates of true incidence rate. However, eCHIRPP data has been found to be representative of the injuries in specific contexts, mechanisms and ages; therefore, it can be used to monitor trends to identify changes in the patterns of the opioid-related injuries.[5,6] Furthermore, PIR methodology can be used to compare opioid-related injuries to other types of injuries.

Qualitative analysis (narrative coding) was based on information provided (written in the text) at the time of the injury. Therefore, the quality and comprehensiveness of the data are largely dependent on the patients at that time. It is possible that in more severe cases, patients are not capable of providing a complete account of the events prior to the injury or of recalling past history of mental illness. Furthermore, our case definition was based on search strings derived from narratives; it is possible that newer terms have been introduced and as such, some cases could have been missed. Therefore, results should be interpreted with those caveats.

Conclusion

The opioid epidemic is currently a major public health problem in Canada. Results from this study provide some evidence on upstream risk factors associated with opioid use that may be useful to inform injury prevention, health promotion and harm reduction efforts. The causes of opioid-related poisonings and injuries are complex and likely vary by subpopulations, and therefore continued monitoring of risk factors is important in providing the evidence necessary to prevent future overdoses and deaths.

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Conflicts of interest

The authors declare no conflicts of interest.

Authors' contributions and statement

MD, VC, and ST designed, analyzed and interpreted the data and drafted and revised the paper. WT and AU interpreted the data and revised 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.

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Original quantitative research

Patterns of health care utilization among people who overdosed from illegal drugs: a descriptive analysis using the BC Provincial Overdose Cohort

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Abstract

Introduction: British Columbia (BC) declared a public health emergency in April 2016 in response to a rapid rise in overdose deaths. Further understanding of health care utilization is needed to inform prevention strategies for individuals who overdose from illegal drugs.

Methods: The Provincial Overdose Cohort includes linked administrative data on health care utilization by individuals who experienced an illegal drug overdose event in BC between 1 January 2015 and 30 November 2016. Overdose cases were identified using data from ambulance services, coroners' investigations, poison control centre calls and hospital, emergency department and physician administrative records. In total, 10 455 overdose cases were identified and compared with 52 275 controls matched on age, sex and area of residence for a descriptive analysis of health care utilization.

Results: Two-thirds (66%) of overdose cases were male and about half (49%) were 20–39 years old. Over half of the cases (54%) visited the emergency department and about one-quarter (26%) were admitted to hospital in the year before the overdose event, compared with 17% and 9% of controls, respectively. Nevertheless, nearly one-fifth (19%) of cases were recorded leaving the emergency department without being seen or against medical advice. High proportions of both cases (75%) and controls (72%) visited community-based physicians. Substance use and mental health–related concerns were the most common diagnoses among people who went on to overdose.

Conclusion: People who overdosed frequently accessed the health care system in the year before the overdose event. In light of the high rates of health care use, there may be opportunities to identify at-risk individuals before they overdose and connect them with targeted programs and evidence-based interventions. Further work using the BC Provincial Overdose Cohort will focus on identifying risk factors for overdose events and death by overdose.

Keywords: *drug overdose, harm reduction, healthcare, opioids, street drugs*

Highlights

- BC's Provincial Overdose Cohort is a linked database with data on health care utilization of individuals overdosing from illegal drugs. People's health histories provide insight into patterns of acute and primary care prior to overdose events.
- Overdose cases have high rates of health care use, suggesting opportunities to identify at-risk individuals before they overdose and connect them with targeted programs and evidence-based interventions.
- A substantial proportion of people who went on to overdose left the emergency department without being seen or against medical advice, which suggests missed opportunities for engagement in care.
- Substance use and mental health–related concerns were the most common diagnoses among people who went on to overdose.

Note: Under the guidelines of the International Committee of Medical Journal Editors (www.icmje.org) about the dissemination of information relevant to a public health emergency, a summary of these results was provided ahead of publication to public health stakeholders involved in responding to the overdose crisis in British Columbia. A lay summary was also made available to the public ahead of publication through the BC Centre for Disease Control (http://www.bccdc.ca/health-professionals/data-reports/overdose-reports).

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Introduction

British Columbia (BC) declared a public health emergency in April 2016 due to a rapid rise in opioid overdose deaths.[1] Despite expanded opioid-related harm reduction and public health efforts, deaths from illegal drug overdose continue to rise, with 1422 deaths in 2017 alone. More than 80% of these deaths involved the potent opioid fentanyl.[2]

Established strategies to prevent or treat an opioid overdose include the distribution of take-home naloxone kits,[3] treatment of mental illness[4] and opioid agonist therapy (OAT).[5] Understanding how people who overdose use the health care system could help identify points of contact for engagement in supportive care and in delivery of evidence-based interventions.[6] Furthermore, an investigation of health care diagnoses may reveal patterns that indicate a high risk of overdose or that can provide information on comorbidities that increase risk of death from overdose.

The purpose of this study was to describe health care utilization and associated diagnoses among individuals who experienced an illegal drug overdose event, as identified in BC's Provincial Overdose Cohort. We compared frequencies and patterns of health care use among overdose cases and matched controls, using hospital, emergency department and physician administrative data.

Methods

Data source

The Provincial Overdose Cohort includes linked administrative data on health care utilization by individuals experiencing an illegal drug overdose event in BC. Detailed information on the cohort is available from the authors upon request. Briefly, individuals experiencing overdoses were identified using data from the BC Ambulance Service (BCAS), Drug and Poison Information Centre (DPIC), BC Coroners Service (BCCS), case-based reporting from emergency departments, National Ambulatory Care Reporting System (NACRS), Discharge Abstract Database (DAD) and Medical Services Plan (MSP). Five years of health history were then appended at a patient-level from DAD (all hospital discharge summaries), NACRS (all emergency department visits), MSP (all fee-for-service physician billing records) and PharmaNet (all prescription dispensations in community pharmacies).

The cohort includes individuals who experienced an overdose event between 1 January 2015 and 30 November 2016. This period represents the beginning of the rapid rise in opioid-related illicit drug deaths observed in BC. An overdose event is defined by any of the following criteria: administration of the opioid antagonist naloxone by paramedics; a call to the Drug and Poison Information Centre about an opioid-related event; physician-diagnosed opioid overdose at the emergency department (from case-based reporting); coroner-determined illegal drug overdose death;* visit to hospital, emergency department or physician with an associated opioid overdose diagnosis code (from DAD [ICD-10-CA codes T40.0, T40.1, T40.2, T40.3, T40.4 or T40.6 as most responsible diagnosis], NACRS [ICD-10 codes T40.1 or T40.6 in the primary discharge diagnosis field] or MSP [ICD-9 codes 965.0 or E850.0 in the primary diagnostic field]). Related events present in multiple datasets (e.g. a single overdose involving ambulance response, transport to emergency department and admission to hospital) were grouped to prevent double counting of overdoses. A detailed description of the Provincial Overdose Cohort and validation of the overdose case definition are currently being prepared for publication.

Health care utilization among cases was compared with matched controls. Controls were selected from a 20% random sample of the 2016 BC population (overdose cases removed). Cases were matched 1:5 without replacement to controls based on birth year, sex and Local Health Area of residence. For each case, health care utilization was examined over the one-year period prior to the first recorded overdose event in the cohort data; we did not consider any subsequent overdoses for an individual or their health care utilization after this first overdose event. For controls, health care utilization was compared during the same one-year period as the matched case.

Data analysis

For this analysis, we considered only diagnoses in the primary diagnostic field of each dataset. DAD and NACRS diagnoses were grouped based on the first three characters of the ICD-10-CA code. MSP visits included only those occurring in a community setting (i.e. where service location was indicated as practitioner's office in the community), because our focus was to characterize engagement with community-based physicians. We compared cases and controls in two ways: the number of individuals with at least one visit and the total number of visits in each setting. We focused on the most common diagnoses among cases in the year prior to (but not including) the first recorded overdose event. Chi-square tests were used to compare differences in proportions and exact Poisson tests to compare rates.

The Provincial Overdose Cohort included 10 456 individuals who experienced an illegal drug overdose event in BC during the study period (1 January 2015 to 30 November 2016). As suitable controls could not be found for one case, our comparisons of health care utilization used 10 455 cases and 52 275 matched controls.

Results

The demographic and health care utilization profiles of cases and controls are shown in Table 1. Two-thirds of overdose cases were male (66% vs. 34% female) and about half were 20–39 years of age (5%, 0–19 years; 49%, 20–39 years; 35%, 40–59 years; 12%, 60+ years). Over half of the cases (60%) visited the emergency department in the year before the overdose event, compared with 17% of the controls ($p < 0.001$). Approximately one-third (32%) were admitted to hospital, compared with 9% of controls ($p < 0.001$). High proportions of both cases and controls visited community-based physicians (81% vs. 72%, respectively; $p < 0.001$). Overall, 89% of cases had at least one visit to the emergency department, hospital or community physician in the year prior to the overdose event compared with 74% of controls ($p < 0.001$). There were no records of any visits during this time for 11% of cases and 26% of controls. Considering rates of health care use, cases

*Open or closed coroner investigations involving street drugs (e.g. heroin, cocaine, MDMA, methamphetamine); medications that were not prescribed to the deceased; combinations of the above, with prescribed medications; and overdoses where the origin of the drug is not known.

TABLE 1
Summary of demographics and health care utilization by overdose cases and matched controls in the BC Provincial Overdose Cohort

Parameter		Overdose cases		Matched controls		*p*-value
		Number (n)	Proportion (%)	Number (n)	Proportion (%)	
Sex	Male	6 927	(66.3)	34 635	(66.3)	1.00
	Female	3 528	(33.7)	17 640	(33.7)	1.00
Age group, years	0–19	469	(4.5)	2 405	(4.6)	0.63
	20–39	5 123	(49.0)	25 655	(49.1)	0.89
	40–59	3 652	(34.9)	18 181	(34.8)	0.78
	60+	1 211	(11.6)	6 034	(11.5)	0.92
Health care, number (and proportion) of individuals with any visits	Any emergency department visits	6 310	(60.4)	8 990	(17.2)	< 0.001
	Any hospital admissions	3 295	(31.5)	4 912	(9.4)	< 0.001
	Any community physician visits	8 445	(80.8)	37 425	(71.6)	< 0.001
	Any emergency department or hospital or community physician visits	9 284	(88.8)	38 480	(73.6)	< 0.001
Health care, number (and rate) of total visits	Emergency department visits	30 830	(2 948.8)[a]	16 105	(308.1)[a]	< 0.001
	Hospital admissions	7 356	(703.6)[a]	6 790	(129.9)[a]	< 0.001
	Community physician visits	156 944	(15 011.4)[a]	279 385	(5 344.5)[a]	< 0.001

[a] Rate per 1000 individuals.

visited the emergency department 9.6 times more often than controls, were admitted to hospital 5.4 times more often than controls and visited community physicians 2.8 times more often than controls ($p < 0.001$ for each comparison; Table 1).

Among cases, 3 of the top 10 emergency department diagnoses and 4 of the top 10 hospital diagnoses concerned drug- and alcohol-related disorders (Table 2). Across all visits, substance-related diagnoses (includes all diagnoses related to alcohol and drugs) were more common among cases than controls in emergency departments (18% vs. 2% of all visits with diagnosis; $p < 0.001$) and as a primary reason for hospitalization (21% vs. 1% of all admissions; $p < 0.001$). Similarly, across all visits, mental health–related diagnoses (includes all diagnoses related to mental health conditions excluding those implicating drugs or alcohol) were more common among cases than controls in emergency departments (11% vs. 5% of all visits with diagnosis; $p < 0.001$) and in hospitals (14% vs. 5% of admissions; $p < 0.001$). A notably larger proportion of cases than controls (19% vs. 4% of individuals; $p < 0.001$) left the emergency department without being seen or against medical advice.

A large proportion of the visits made by cases to community-based physicians were coded as drug dependence (37% among cases vs. 6% among controls; $p < 0.001$). The majority of these drug dependence visits (72.8% for cases; 88.3% for controls) were during periods when the individual was on opioid agonist therapy, as determined by prescription dispensation history. Aside from visits related to drug dependence, the frequencies of common community physician diagnoses were similar among cases and controls. However, when numbers of individuals rather than numbers of visits are compared, a greater proportion of cases were diagnosed with depression (18% vs. 6%; $p < 0.001$), anxiety (14% vs. 6%; $p < 0.001$), neurotic disorders (12% vs. 4%; $p < 0.001$) and schizophrenic psychoses (3% vs. 1%; $p < 0.001$) in the year before the overdose event.

Other diagnoses that were more common among cases than controls included chronic obstructive pulmonary disease (COPD: 3% vs. 1% of hospital admissions; $p < 0.001$) and skin infections (cellulitis: 5% vs. 3% of emergency department visits; $p < 0.001$). Pain-related diagnoses represented a slightly smaller fraction of visits among cases than among controls (abdominal, pelvic and back pain: 5% vs. 7% of emergency department visits; $p < 0.001$).

Discussion

People who overdosed from illegal drugs used the health care system frequently in the year prior to the event as observed in terms of emergency department visits, inpatient admissions and appointments with community physicians. Previous studies in Australia and the United States found similar high levels of emergency department and hospital use among drug users.[7–10] Although other studies have suggested that people who use drugs visit primary care and preventive health services at lower rates,[8] we found the proportion accessing community physicians to be about the same as matched controls. An important caveat is that about one-quarter of community physician visits coincided with periods of opioid agonist therapy (e.g. methadone, suboxone) and thus may have been regular clinic check-ins and urine drug testing.[5]

A small but significant percentage of cases (11%) had no contact with emergency departments, hospitals or community physicians in the year before the overdose event. Preventing these overdoses should focus on identifying and reducing barriers to caring for people who use drugs, including stigma among health care providers. The proportion of people not engaged with medical care also highlights a need for interventions outside a clinical

TABLE 2
Health care diagnoses in the year prior to the first recorded overdose among illegal drug overdose cases compared with matched (non-overdose) controls, BC Provincial Overdose Cohort

Type	Rank	ICD-9/10 code[a]	Diagnosis	Overdose cases		Matched controls	
				Visits, %[b] (n)	Individuals, %[b] (n)	Visits, %[b] (n)	Individuals, %[b] (n)
Emergency department visits	1	Missing	No diagnosis recorded[c]	21.4 (5 132)	35.5 (1 987)	24.4 (3 936)	28.6 (2 567)
	2	Z76	LWBS / AMA[d]	7.1 (1 707)	19.0 (1 063)	2.7 (433)	4.3 (390)
	3	L03	Cellulitis/acute lymphangitis	5.0 (1 213)	11.5 (643)	2.7 (432)	2.9 (262)
	4	F10	Alcohol-related disorders	4.6 (1 114)	7.6 (424)	0.5 (82)	0.8 (74)
	5	F19	Mental/behavioural disorders from multiple drugs	2.8 (684)	8.8 (492)	0.2 (27)	0.3 (24)
	6	R10	Abdominal and pelvic pain	2.7 (650)	7.1 (399)	4.3 (693)	6.2 (554)
	7	T51	Toxic effect of alcohol	2.6 (635)	3.8 (214)	0.2 (39)	0.4 (35)
	8	Z51	Other medical care	2.4 (582)	6.1 (341)	2.1 (346)	2.9 (262)
	9	F23	Brief psychotic disorder	2.2 (524)	5.4 (303)	0.6 (91)	0.7 (59)
	10	M54	Back pain	2.0 (487)	5.6 (313)	2.4 (392)	3.9 (347)
Hospital admissions	1	F10	Alcohol-related disorders	6.6 (372)	8.4 (230)	0.4 (25)	0.5 (23)
	2	F19	Mental/behavioural disorders from multiple drugs	4.6 (260)	7.7 (211)	0.2 (12)	0.2 (11)
	3	F15	Mental/behavioural disorders from stimulants	3.7 (208)	5.8 (157)	0.5 (35)	0.5 (23)
	4	J44	COPD	3.2 (182)	3.5 (95)	0.9 (59)	0.9 (45)
	5	F11	Mental/behavioural disorders from opioids	2.4 (138)	4.5 (122)	0.1 (6)	0.1 (5)
	6	Z51	Other medical care	2.4 (137)	2.1 (56)	3.4 (228)	1.9 (91)
	7	F20	Schizophrenia	2.4 (135)	3.0 (81)	1.2 (79)	1.0 (47)
	8	F29	Unspecific psychosis (non-drug)	2.2 (123)	3.6 (99)	0.6 (38)	0.6 (31)
	9	L03	Cellulitis/acute lymphangitis	2.1 (121)	3.7 (101)	0.4 (26)	0.4 (22)
	10	J18	Pneumonia	1.8 (102)	3.3 (91)	0.7 (46)	0.9 (44)
Community physician visits	1	304	Drug dependence	36.7 (45 012)	29.9 (2 356)	5.6 (15 669)	1.4 (522)
	2	01L[e]	Laboratory tests	2.9 (3 622)	11.1 (879)	1.0 (2 827)	3.1 (1 143)
	3	311	Depression	2.6 (3 233)	18.1 (1 428)	2.0 (5 671)	6.4 (2 397)
	4	781	Nervous and musculoskeletal symptoms	2.1 (2 593)	14.9 (1 176)	2.1 (5 940)	9.5 (3 570)
	5	50B[e]	Generalized anxiety	1.9 (2 369)	14.4 (1 138)	1.3 (3 767)	5.5 (2 041)
	6	780	General symptoms	1.9 (2 299)	14.8 (1 164)	2.4 (6 787)	12.0 (4 509)
	7	300	Neurotic disorders[f]	1.6 (2 009)	12.2 (959)	1.1 (3 084)	4.0 (1 506)
	8	724	Other/unspecified back disorders	1.3 (1 587)	8.3 (652)	1.1 (2 993)	4.1 (1 551)
	9	250	Diabetes	1.1 (1 401)	5.2 (409)	2.6 (7 140)	6.0 (2 246)
	10	295	Schizophrenic psychoses	0.9 (1 126)	3.2 (256)	0.3 (901)	0.5 (196)

Abbreviations: AMA, Against Medical Advice; COPD: chronic obstructive pulmonary disease; ICD, International Classification of Diseases; LWBS, Left Without Being Seen

[a] Ten most common health care diagnoses, in terms of number of visits.

[b] Percentages are the proportions of all visits or individuals, not just of those in the top 10 diagnoses.

[c] Similar proportions of case and control visits to emergency departments lacked a diagnosis code, reflecting incompleteness of the data submitted to the National Ambulatory Care Reporting System (NACRS).

[d] Emergency department diagnosis Z76 modified to include only Left Without Being Seen / Against Medical Advice (LWBS / AMA) and excludes issues of repeat prescriptions.

[e] Codes 01L and 50B are specific to Medical Services Plan (MSP) and not part of standard ICD classification.

[f] Neurotic disorders include various anxiety, dissociative and somatoform disorders, but not depression.

setting, such as supervised consumption sites/overdose prevention sites[11,12] and advocacy organizations of people who use drugs.

It is troubling, but not entirely unexpected, to note the high rates of subsequent overdose among people who leave the emergency department without being seen or against medical advice. This finding is consistent with a recent systematic review that found that drug use is a risk factor for leaving inpatient treatment against medical advice.[13] Interventions to reduce leaving against medical advice include providing harm reduction services in hospitals[†], improving responses to subjective symptoms such as pain and withdrawal, and developing initiatives to challenge stigma in health care settings.[14]

Substance use and mental health–related concerns were found to be the most common diagnoses during health care visits by people who later overdose, which is consistent with previous studies.[7,15] Of particular note is that diagnoses related to alcohol, stimulant and polysubstance use were frequent in this population, highlighting (as others have found[16,17]) the role of polysubstance use in predisposing to overdose.

Several other physical health diagnoses were more common among cases than controls. COPD stands out as a relatively frequent reason for hospitalization among cases. Tobacco use—the most important risk factor for developing COPD—is more prevalent among people with mental health and substance use disorders.[18,19] In addition, hospitalization is typically recommended when a patient with COPD is known to have unstable housing or is otherwise at risk of being lost to follow-up, which may be true of many people with problematic substance use. A similar rationale may be applied when ensuring adequate supervision of care for patients with pneumonia and cellulitis. Cellulitis, in particular, is known to be more common among injection drug users.[20]

Given that our results are based on available administrative data, some limitations should be noted. These data do not capture all individuals who overdosed and may not be equally representative across time and health regions due to differences in reporting and completeness. Furthermore, diagnoses recorded in administrative datasets do not necessarily indicate the specific context of a health care visit. The lack of specific information on exposure substances, for example, makes it difficult to distinguish overdoses from street drugs versus overdoses from prescription medication. In addition, approximately 20% of the emergency department (NACRS) data did not have a physician diagnosis, both for cases and controls, which therefore limited our understanding of these visits. In addition, coroner cases included both suspected and concluded investigations; suspected cases are based on preliminary circumstances and may change to a different classification or cause of death once the coroner investigation is concluded.

This study was conducted in collaboration with data providers and the provincial and regional stakeholders involved in overdose response. Findings were disseminated through these partners to inform service delivery and improve our understanding of opportunities for overdose prevention. Further analyses are under way to incorporate other patient characteristics (e.g. age, gender, socioeconomic status, comorbidities) that may be important in determining health care utilization and risk of overdose death. Understanding patterns of health care use among people who use illegal drugs could help to identify at-risk individuals, as well as inform targeted treatment efforts that connect individuals to further follow-up and evidence-based interventions.

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Conflicts of interest

The authors have no conflicts of interest to declare.

Authors' contributions and statement

MCO designed, analyzed and interpreted the data and drafted and revised the paper; AC interpreted the data and drafted and revised the paper; SD analyzed and interpreted the data and revised the paper; BK, SK, AL, JMH, CM, MP, AWT and LZ interpreted the data and revised 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.

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[†] A growing number of BC hospitals now have a suite of harm reduction services in place, including overdose outreach teams, take-home naloxone kit distribution[21] and addiction nursing / addiction medicine teams in emergency departments and inpatient units.

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At-a-glance

Concurrent monitoring of opioid prescribing practices and opioid-related deaths: the context in Nova Scotia, Canada

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Abstract

Timely public health surveillance is required to understand trends in opioid use and harms. Here, opioid dispensing data from the Nova Scotia Prescription Monitoring Program are presented alongside fatality data from the Nova Scotia Medical Examiner Service. Concurrent monitoring of trends in these data sources is essential to detect population-level effects (whether intended or unintended) of interventions related to opioid prescribing.

Keywords: *public health surveillance, opioid-related disorders, prescription drug monitoring programs, coroners and medical examiners*

Highlights

- The annual opioid toxicity mortality rate in Nova Scotia remained stable from 2011 to 2017.
- The number of individuals dispensed any opioid (excluding those used for treatment of dependency) has decreased over time in Nova Scotia. The number of morphine equivalents dispensed has also decreased in recent quarters.
- Because changes in the availability of prescription opioids can influence illicit opioid markets, timely monitoring of trends in both opioid dispensing and toxicity fatalities by opioid type is essential to understand the impact of changes to prescribing guidelines.

Introduction

Acute opioid toxicity claimed an estimated 2861 lives in Canada in 2016.[1] The introduction of highly potent opioids, mainly nonpharmaceutical fentanyl, into illicit drug markets in Canada and the USA has been a major factor in significant increases in acute opioid toxicity mortality rates in some jurisdictions.[1-3] In others, including Nova Scotia (NS), there has not been an increase in opioid toxicity mortality to date.[1]

Correlations between population-level prescription opioid consumption and opioid-related morbidity and mortality rates have been well documented.[4-6] Research also supports the individual-level association between higher morphine milligram equivalents (MME) prescribed and risk of toxicity death.[7] The recent revisions to opioid prescribing guidelines[8,9] have offered regulators a powerful mechanism to impact outmoded prescribing behaviours and promote new considerations for therapeutic interventions related to pain and dependency. Considering the evidence that some people who use prescription opioids switch to or use heroin concurrently over time,[10,11] that changes in the availability of prescription opioids can influence drug availability and price in the illicit opioid market,[11,12] and that nonpharmaceutical opioids contributed to the majority of opioid deaths in jurisdictions with high mortality rates,[2,3] the fundamentals of these aspects of "supply" and "demand" are important to consider.

Understanding the pathways for pharmaceutical and nonpharmaceutical opioid access is central to designing intervention strategies and informing policy development. Where dispensing information is available, it is possible to monitor prescribing trends concurrently with opioid-related death data as part of a comprehensive public health surveillance system. This report highlights the findings of these surveillance activities in NS.

Methods

Data sources

All deaths that may be due to drug intoxication fall within the legislative mandate of the Nova Scotia Medical Examiner Service (NSMES). The NSMES uses an electronic application to collect and store case information, including demographics and cause of death, related to fatality investigations. As standard practice, the medical examiners include the generic names of the parent drugs contributing to death in the cause of death statement and routine toxicology testing covers numerous fentanyl analogues and other novel

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opioids. We extracted data for cases investigated by NSMES for deaths occurring between 1 January, 2011, and 31 December, 2017.

Since its inception in 1993, the Nova Scotia Prescription Monitoring Program (NSPMP) has been monitoring all community pharmacy dispensing of opioids listed as controlled substances in the *Controlled Drugs and Substances Act*.[13] The data we extracted from the NSPMP database included counts of unique health card numbers for which monitored opioids were dispensed and sums of MME, by drug type and quarter from 2011 to 2017. MME were not assigned to methadone, buprenorphine or to infrequently prescribed opioids butorphanol, diphenoxylate, normethadone, opium, pentazocine, tapentadol, or sufentanil.

Case definitions

Deaths that occurred in NS and were investigated by the NSMES were included in our study. Cause and antecedent causes of death were used to classify acute toxicity deaths, by specific opioid type, according the case definitions in Table 1.

We categorized nonpharmaceutical opioid toxicity deaths to include suspected nonpharmaceutical fentanyl, fentanyl analogues, heroin and U-47700. No other nonpharmaceutical opioids were reported among opioid toxicity deaths in NS during the time period. Opioid toxicity fatalities are often multidrug toxicity events involving multiple drugs from various drug classes. Fatality data presented by opioid type are not mutually exclusive; total numbers of fatalities are less than the sum of fatalities by drug type.

Analysis

We conducted our analyses of NSMES and NSPMP data using Stata software version 13.0 (StataCorp, College Station, TX, USA) and Microsoft Excel 2016 (Microsoft Corporation, Redmond, Washington, USA). Population estimates were based on Statistics Canada census data from 2011 and 2016.

Results

The acute opioid toxicity mortality rate in NS remained stable from 2011 to 2017, with a mean annual rate of 6.3 deaths per 100 000 population. Hydromorphone was involved in the largest proportion of deaths, followed by methadone (Figure 1). The number of deaths related to nonpharmaceutical opioids increased in 2016 (Figure 1), when six deaths were attributed to nonpharmaceutical fentanyl, furanylfentanyl, despropionyl fentanyl, U-47700 and heroin (sometimes in combination). In comparison, nonpharmaceutical opioids caused between zero and two deaths per year in previous years, of which all but one were related to heroin. In 2017, there were three toxicity deaths related to nonpharmaceutical opioids, which included toxicity related to suspected nonpharmaceutical fentanyl, despropionyl fentanyl and U-47700 (sometimes in combination).

Overall, the number of individuals dispensed any monitored opioid excluding methadone and buprenorphine has decreased over time, from 43 922 to 35 640 individuals per quarter (a decrease from 4.6% to 3.7% of the population; Figure 2). Of individuals dispensed monitored opioids in any quarter, excluding those people dispensed only methadone and/or buprenorphine, over 40% were dispensed a codeine product, alone or in combination with other opioid products. Since 2016 Quarter 1 (Q1), there has been a decreasing trend in MME dispensed, with a mean reduction of over 4000 MME per 1000 population per quarter (Figure 2). Hydromorphone products consistently contributed to over 40% of the total MME dispensed per quarter. The number of individuals dispensed methadone and buprenorphine, drugs used for opioid dependency treatment, increased from 2062 to 4088 over the time period (from 0.2% to 0.4% of the population; Figure 2).

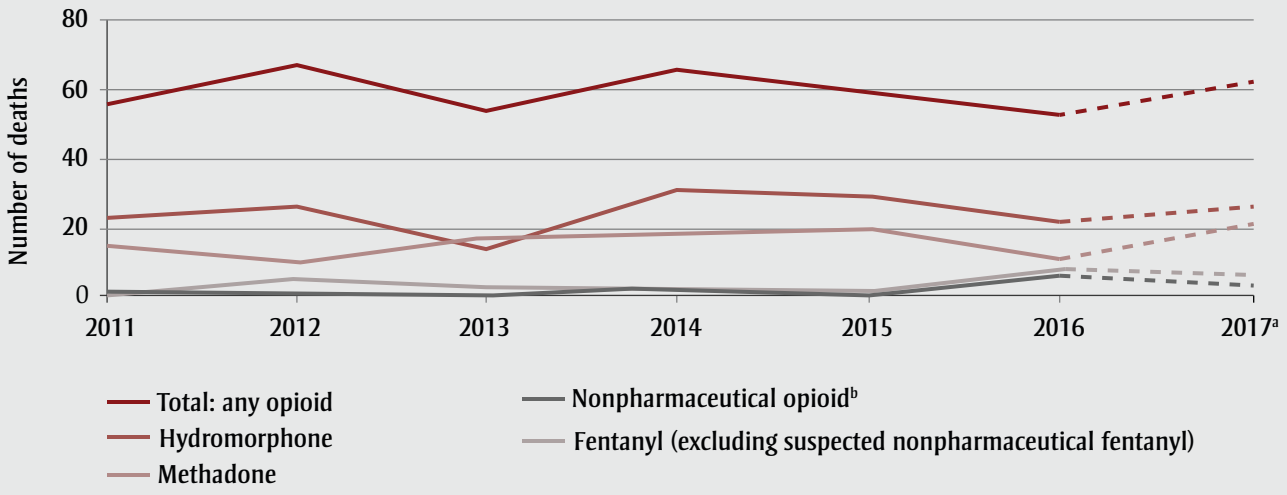
Discussion

NS has not experienced an increase in opioid toxicity mortality to date. However, nonpharmaceutical opioids, including suspected nonpharmaceutical fentanyl and fentanyl analogues, were involved in acute opioid toxicity deaths more frequently in 2016 and 2017 than in previous years. This is important given that nonpharmaceutical fentanyl is largely responsible for the ongoing public health emergency in Western Canada.[1,2,14] The selling of fentanyl or fentanyl-adulterated heroin as heroin is considered to have contributed to a large proportion of toxicity events in which the individuals involved were unaware of the risks associated with the drug obtained.[15,16] Illicit drug producers have sought to meet the demand for authentic prescription opioids through the production of counterfeit prescription opioid tablets, often containing illicit fentanyl

TABLE 1
Case definitions for confirmed and probable opioid toxicity deaths in Nova Scotia

	Acute opioid toxicity death	Suspected nonpharmaceutical fentanyl toxicity death
Confirmed case	Cause of death is acute drug toxicity with one or more opioids listed	Cause of death is acute fentanyl toxicity (with or without other drugs) History or scene investigation indicates use of nonpharmaceutical fentanyl powder/tablets No evidence of pharmaceutical patches or hospital administration of fentanyl
Probable case	Cause of death remains under investigation post-autopsy Positive toxicology findings for one or more opioids	Cause of death remains under investigation Positive toxicology findings for fentanyl History or scene investigation indicates use of nonpharmaceutical fentanyl powder/tablets No evidence of pharmaceutical patches or hospital administration of fentanyl

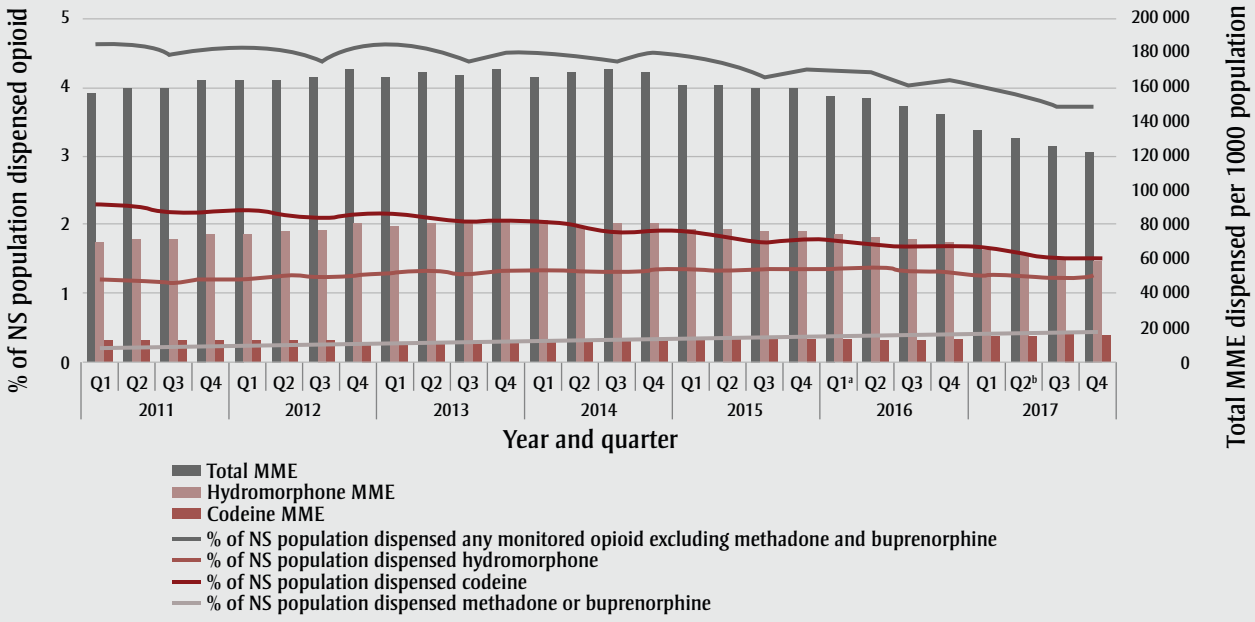
FIGURE 1
Confirmed and probable acute opioid toxicity deaths in Nova Scotia by drug type and year, 2011 to 2017[a]



[a] 2017 data are incomplete as toxicology results remain outstanding for some December cases. Nineteen percent of 2017 cases were classified as probable and remain under investigation; <1% of cases for 2011 to 2016 were classified as probable.

[b] Nonpharmaceutical opioid category includes heroin, U-47700, furanyl-fentanyl, despropionyl fentanyl and suspected nonpharmaceutical fentanyl.

FIGURE 2
Opioids dispensed through community pharmacies in Nova Scotia, Canada, by population and morphine equivalents over time, 2011 to 2017



Abbreviations: MME, morphine milligram equivalents; NS, Nova Scotia.

Note: Morphine equivalents not assigned to methadone, buprenorphine or to infrequently prescribed opioids butorphanol, diphenoxylate, normethadone, opium, pentazocine, tapentadol, or sufentanil.

[a] Release of CDC Guideline for Prescribing Opioids for Chronic Pain.[9]

[b] Release of Canadian Guideline for Opioid Therapy and Chronic Noncancer Pain.[8]

or fentanyl analogues.[15] Consequently, preferences for specific drug types and changes to the composition of those drug types, mostly related to variations in potency, will predict risk of toxicity. The majority of pharmaceutical opioid toxicity fatalities in NS were related to opioids obtained illicitly (data not shown). Whether limited or well dispersed distribution networks for nonpharmaceutical opioids exist in NS requires further investigation.

Appropriate and judicious prescribing is a sound approach to decreasing opioid harms in the long term.[17] Reductions in MME dispensed per quarter in NS followed the release of updated guidelines for prescribing opioids for chronic pain, first in the US by the CDC in 2016 Q1,[9] and then in Canada in 2017,[8] and may also be attributable to interventions by the NSPMP, increased awareness of the issue and other factors. To date, hydromorphone remains the most common opioid detected among opioid toxicity fatalities as well as the opioid with the highest MME dispensed per quarter in NS. Diversion of hydromorphone, or any opioid, is difficult to track given that it is an illegal activity. Information from testing of samples from drugs seized by law enforcement[18] may not be reflective of or proportionate to the true picture of drugs in circulation. Some jurisdictions have implemented surveys of key populations or web monitoring (or both) to characterize localized shifts in availability and price of diverted opioids.[19] These types of surveillance activities could provide some evidence for determining whether population-level decreases in MME dispensed translate to decreases in numbers of opioid products diverted.

Attempts must be made to monitor all opioids, obtained both licitly and illicitly, when describing trends in opioid use and harms in a population. Discontinuing the prescribing of one pharmaceutical can result in increased prescribing of other opioids as substitutes.[20] Also, the availability of prescription opioids is known to influence the heroin market.[11,12] Heroin purity, availability and cost are factors associated with the introduction of fentanyl into the illicit opioid market.[12] Changes to prescribing practices must be considered in the context of the illicit market, when the goal of preventing new dependencies is coupled with that of keeping those accessing opioids safe. Notably, the greatest reduction in prescribing in Canada from 2015 to 2016 was found in British Columbia,[21] which coincided with the highest rate of fentanyl-related deaths in the country in 2016.[1] This does not imply a causal relationship. Still, if type of opioid used is dependent on availability, populations accessing pharmaceutical and nonpharmaceutical opioids illicitly likely overlap. In fact, making pharmaceutical opioids more easily available to those currently accessing an opioid supply with dangerously inconsistent potency is a novel response under consideration in British Columbia.[22] NS has not yet experienced an increase in opioid fatalities and pharmaceutical opioids have been more commonly seized by police than nonpharmaceuticals.[18] As prescribing rates decrease, there is an opportunity to monitor and respond to shifts in population rates of opioid dispensing and harms.

Strengths and limitations

Using the NSMES and NSPMP to understand opioid harms and monitor interventions is a novel approach to public health surveillance. Not all jurisdictions have a prescription monitoring program in place. NSPMP includes all opioids dispensed, not only those that are publicly funded. NSMES and NSPMP data offer significant historic baseline information and timely information related to opioid-specific fatalities and opioid prescribing practices. The measures presented serve as population surveillance indicators, which can stimulate further monitoring and research activities to better understand the relationships between opioid prescribing, opioid use and opioid harms including acute toxicity death.

It is possible that some acute drug toxicity deaths may not be reported to the NSMES, especially deaths in which the fatal effects of toxicity are significantly delayed. It is thought that this number is low, but this is difficult to verify. For a small proportion of 2017 cases, cause of death and/or toxicology results remain outstanding; however, numbers are small and are not expected to affect the findings presented.

Conclusion

An evidence-based approach to reducing opioid harms includes an overall reduction in opioid prescribing coupled with increases to harm reduction services and access to treatment for opioid dependency.[23,24] Timely monitoring of trends in both opioid dispensing and toxicity fatalities by opioid type is essential to understand the impact of changing prescribing guidelines and to detect and respond to any associated shifts in mortality rates.

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Conflicts of interest

All authors have no conflicts of interest to disclose.

Authors' contributions and statement

All authors agreed on the surveillance design and concept of the paper. ES and KC analyzed the data. ES drafted the paper. All authors critically reviewed and revised the paper. All authors read and gave final approval of this version to be published.

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At-a-glance

What can paramedic data tell us about the opioid crisis in Canada?

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Abstract

The nature of Canada's opioid crisis necessitates additional data sources that can provide a more comprehensive picture of the epidemic, in order to provide public health officials and decision-makers with a robust evidence base. Paramedic data provide a conduit into the community where overdoses occur.

Prehospital events and circumstances surrounding opioid-related overdoses provide unique opportunities to collect evidence that can contribute to prevention, harm reduction and health promotion efforts. Using data extracted from the Ottawa Paramedic Service (OPS), this proof-of-concept study demonstrated that paramedic response data were useful in providing near real-time epidemiological information (person, time and place) on the opioid epidemic and in assessing trends and opportunities to develop alert triggers.

Between January and June 2017, the OPS responded to an average of four opioid-related calls each week. On average, 0.5 mg of naloxone was administered each time. For the study period, linear trends show a small but insignificant increase in calls ($p = 0.18$). A higher volume of calls occurred between April 16 and 29, 2017. According to local media reports, this spike in paramedic responses was due to the arrival of high-grade fentanyl in Ottawa.

With further validation, paramedic data can potentially provide a novel data source to monitor opioid-related overdoses.

Keywords: *opioids, paramedic, prehospital care, early warning system, Canada*

Highlights

- Paramedic data can provide prehospital information that could be used in the systematic monitoring and detection of sudden changes in the number of opioid-related events community.
- As some of the people who overdose are not transported to hospitals, the paramedic record may offer the only medical record of their overdose event.
- In this proof-of-concept study, significant spikes in the number of paramedic responses to opioid-related events were detected in advance of media reports about the arrival of high-grade fentanyl arriving in Ottawa, Canada.

Introduction

Canada is in the midst of an opioid epidemic. In some parts of the country, the number of deaths has been increasing,[1] with little sign of the crisis abating. In 2016, a total of 2861 deaths were attributed to apparent opioid use.[1] This number is expected to increase to more than 4000 in 2017 if the current trend continues.[1]

In response, resources have been mobilized to closely monitor the epidemic. For example, as a result of the collaboration between the provinces and territories, lag times for documenting opioid-related death data have been significantly reduced. Similarly, enhanced surveillance of emergency department visits has also been implemented. In Ontario, hospitals are required to report opioid-related emergency department visits on a weekly basis.[2] However, despite the coordinated public health response, there remains a data gap for the systematic monitoring of overdoses occurring in communities across the country.

In Canada, paramedics are usually the first health care professionals to arrive on the scene of an overdose event. It is routine practice for the paramedics to collect information about the circumstances of the overdose. In most jurisdictions, these "prehospital" data are entered into an electronic system within 24 hours of the

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event. Such information could be invaluable in providing context for understanding the opioid crisis. As such, the objective of this proof-of-concept study is to determine whether paramedic data can be routinely used for public health monitoring purposes.

Methods

The Ottawa Paramedic Service (OPS) collates data from dispatches to medical emergencies in the city of Ottawa (population approximately one million in an area of 2796 square kilometres). The OPS collects information on patient characteristics, the nature of the emergency response and the treatment, if provided, for example, the dose of naloxone administered.

For this proof-of-concept study, data collected between 1 January 2017 and 17 June 2017 were extracted from the OPS on 27 June 2017. Although geocoding information was available (i.e. location of overdose by address, full postal codes), these data were not shown for privacy reasons.

Statistical methods

We used anonymous and aggregate data in this analysis. An opioid-related event is defined as a response requiring administration of naloxone to counteract the effects of an opioid-related overdose. Due to small cell counts, events were reported on a weekly basis and aggregated into 5-year age groups. Descriptive statistics were conducted to examine distributions of events.

As part of a trend analysis, an alert threshold was computed. A 7-week moving average was used to compute stable expected values. Given the count nature of the data, a Poisson distribution was used to compute the 95% confidence interval (CI) around the expected value.[3] Statistical cutoffs ($\alpha = 0.05$) were arbitrarily used to define alert thresholds. An Excel macro-enabled template produced by the European Centre for Disease Prevention and Control (ECDC) was used for the analyses.[3] The number of paramedic responses exceeding the upper bounds was considered a threshold event or a departure from the expected range, and required further investigation (i.e. alert level).

Results

Between 1 January 2017 and 17 June 2017, there were 86 paramedic responses to opioid-related overdoses that required administration of naloxone. An average dose of 0.5 mg of naloxone was administered each time. Two-thirds (66%) of the cases were males, and 57% of all cases were between 25 and 39 years of age (mode: 30–34 years).

Linear trends show a small but insignificant increase in the number of weekly paramedic responses ($p = 0.18$). During the study period, the OPS received an average of four calls per week. The numbers of responses exceeded threshold levels between April 16 and April 29 (Figure 1). The highest number of calls was received during week 17 (23–29 April, 2017), when nine calls resulted in naloxone administration by paramedics. The spike in the number of calls was reported by local print and broadcast/online media[4,5] and in social media one week later.[6]

Discussion

The purpose of this study was to evaluate whether paramedic response data can be used to monitor the opioid crisis. Public health surveillance is defined as the "systematic and continuous collection, analysis, and interpretation of data, closely integrated with the timely and coherent dissemination of the results and assessment to those who have the right to know so that action can be taken."[7] In this context, the systematic collection of data by the OPS provided epidemiological information on person, place and time—information necessary for public health surveillance.

This information is consistent with what is known about the opioid crisis in Canada. Most of the paramedic responses (66%) involved opioid-related overdoses by males, which is similar to mortality data (74% of apparent opioid-related deaths occurred among men[1]). Likewise, both prehospital (paramedic response data) and hospital data (emergency department visits and hospital admissions data) indicate that young adults are at high risk of opioid-related overdoses.[8] The ongoing collection of OPS data also provided opportunities to evaluate trends, with spikes exceeding statistical thresholds in advance of media reports. This lead-time health intelligence could prove to be invaluable for public health action.

In most parts of Canada, response data are entered into electronic databases within 24 hours of paramedics responding to an emergency event. This makes the data accessible for near real-time analysis and thus appropriate for contributing to an early warning systems.

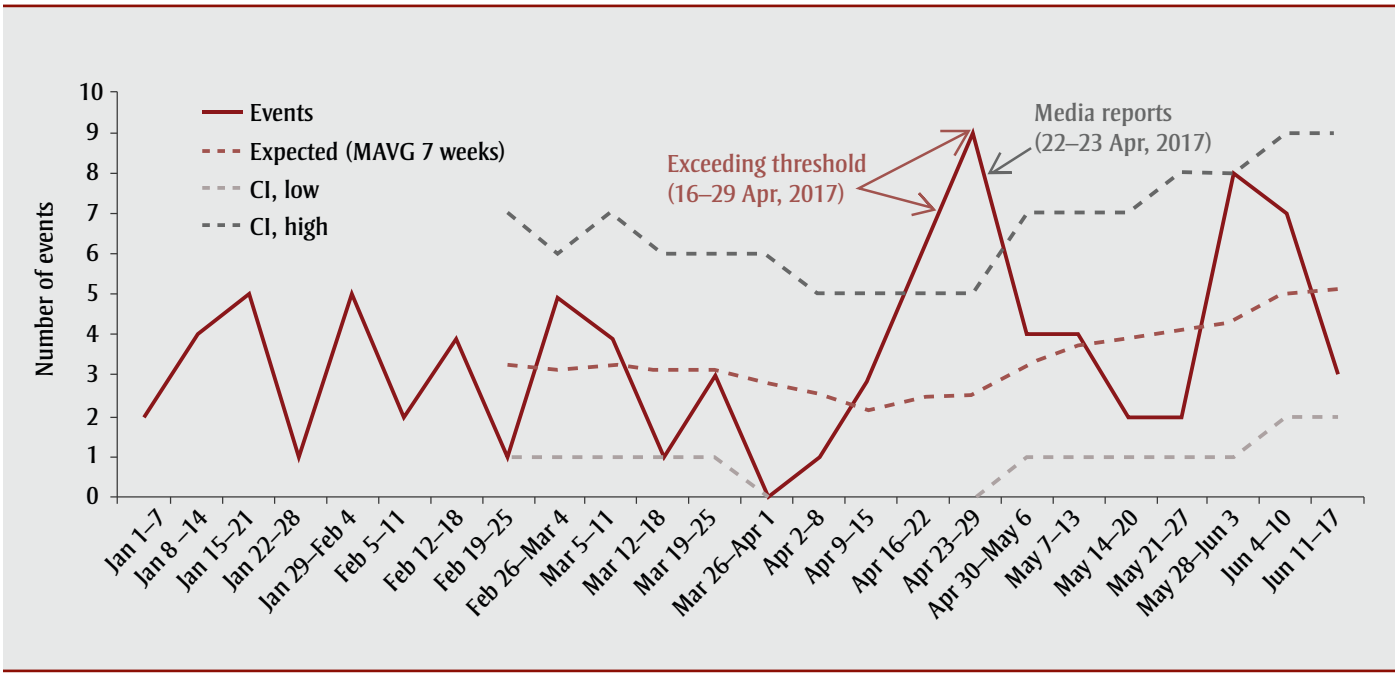
Secondly, paramedic response data are geocoded (data not shown), as paramedics require an exact location in order to respond to an event. Accurate geographically indexed information would be available for public health surveillance to help identify hotspots and generate heat maps. Thirdly, as some individuals who overdose are not transported to hospitals, the paramedic record may be the only record of an overdose.

Finally, paramedic response data can be used to evaluate the impact of a particular public health policy or intervention. For example, the policy of making naloxone kits available to the general public without prescriptions may result in fewer individuals being transported to emergency departments because naloxone reverses the effects of the opioid-related overdose. Since the paramedic service has broad coverage and is active in most municipalities in Canada, there is the potential to provide a national picture of the opioid crisis.

Despite these advantages from the perspective of public health surveillance, there are limitations to using paramedic response data. These include the different infrastructure, prioritizing mechanisms and case definitions of opioid-related overdoses used by providers of paramedic services. In some jurisdictions, data on paramedic services are available at the provincial level, whereas in others such data are only available at the municipal level. Therefore, data quality needs to be evaluated for consistency, accuracy and precision.

From a national perspective, while pooling paramedic data in order to get a national picture would be desirable, comparing opioid-related overdoses in different jurisdictions with different case definitions is not possible. To this end, case definitions would need to be harmonized before comparisons across jurisdictions could be made. Alternatively, it would be valuable to be able to examine changes in trends as a way of monitoring the opioid crisis. There is also the potential to misclassify opioid-related events

FIGURE 1
Distribution of observed and expected values and the 95% confidence interval threshold limits for number of paramedic responses by the Ottawa Paramedic Service to opioid-related overdoses requiring naloxone, 1 January 2017 to 17 June 2017, Ottawa, Canada



Abbreviations: CI, confidence interval; MAVG, moving average.

(for example, individuals who experience an opioid-related overdose may not be given naloxone and therefore would not meet the case definition).

Another consideration is that paramedics may not be called to attend all opioid-related overdoses in the community, so OPS data may fail to capture a proportion of overdoses.

In this study, we used a statistical cutoff ($\alpha = 0.05$) to establish the alert threshold. It was an arbitrary decision to demonstrate a proof-of-concept. Depending on the context, a less conservative statistical threshold (e.g. $\alpha = 0.1$) or a clinical cutoff could also be established.

Conclusion

Paramedic response data can provide prehospital information that has the potential to be used for systematic monitoring and detection of sudden changes in the number of opioid-related events in a community. In this proof-of-concept study, significant spikes in paramedic responses to opioid-related events in Ottawa were detected in advance of media reports. With further validation, paramedic response data can potentially provide a novel data source for monitoring public health events such as those related to opioid-related overdoses.

Authors' contributions and statement

MD designed, analyzed and interpreted the data and drafted and revised the paper; GF and MR interpreted the data and drafted and revised the paper; ML analyzed and interpreted the data and revised the paper; MN, PP, BF and WT interpreted the data and revised 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.

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At-a-glance

The role of opioid toxicity in suicide deaths in Alberta, 2000 to 2016

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Abstract

Given the current opioid crisis in Canada, there is interest in the role of opioid toxicity in suicide deaths, particularly in whether any observed patterns are similar to those of unintentional deaths. The present analysis examined characteristics of opioid-toxicity suicide, and its role in relation to other suicide methods, from 2000 to 2016 in Alberta. It does not appear that the opioid crisis has resulted in a disproportionately higher number of suicides in Alberta. Individuals who die from unintentional opioid toxicity and those who die by opioid-toxicity suicide are likely distinct populations, requiring nuanced public health responses for prevention.

Keywords: *opioids, opioid analgesics, suicide, public health surveillance, Canada*

Highlights

- From 2000 to 2016, approximately 20% of suicides in Alberta were suicides by drug toxicity, of which 22% were opioid related.
- More females than males died by suicide by opioid toxicity, and older age predicted the use of opioids among suicides by drug toxicity.
- The average rate of suicide by opioid toxicity was 0.61 per 100 000 person-years for females and 0.57 per 100 000 for males. There was no substantial increase in rates of suicide by opioid toxicity from 2000 to 2016.
- The most commonly used opioids for suicide included morphine, codeine, hydromorphone and oxycodone.

Introduction

Canada is in the midst of a nationwide opioid crisis, spurred in part by an increase in opioid prescribing frequency, dosage and potency from the 1990s onward,[1,2] with increasing rates of opioid-related harms and deaths. In 2016, there were over 2800 arguably preventable opioid-related deaths in Canada.[3,4] Although there is no long-term, national-level mortality data, opioid-related deaths in Ontario reportedly doubled between 1991 and 2004.[2] In the past 10 years, the rate of hospitalizations in Canada due to opioid poisoning increased by 53%.[4]

While the majority of opioid-related harms and deaths are unintentional, opioids may also be involved where a death is intentional.[5-7] Approximately 30% of hospitalizations for opioid poisonings in Canada in 2016 were the result of self-inflicted harm, including suicide attempts.[4] Further, 16% of all opioid-related deaths in Ontario from 2006 to 2008 were suicides.[5]

It is known that opioids are commonly used for suicide (e.g. a Toronto-based study found opioids to be in 30% of suicides by overdose—the most frequently detected drug class—between 1998 and 2007[8]), and that individuals with chronic pain, who historically have frequently received opioid prescriptions, may be more likely to die by suicide.[6,9,10] However, there is a lack of information on the use of opioids for suicide in the context of Canada's opioid crisis, such as whether the number of suicides by opioid toxicity has increased and whether patterns in opioid use for suicide are similar to those for unintentional deaths due to opioids. The present analysis aimed to address this knowledge gap by examining the demographics and opioid types used for suicide by opioid toxicity, as well as the role of opioid toxicity in relation to other methods of suicide, in Alberta over a 17-year period.

Methods

We examined de-identified data from Alberta Vital Statistics for suicide deaths in Alberta from 2000 to 2016. We identified manner (e.g. intentional/suicide) and method (e.g. poisoning) of death using International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) codes. Data were extracted where the underlying cause of death indicated death by suicide (ICD-10 codes X60–X84, Y87.0). Suicides for which the underlying cause of death was coded as ICD-10 X60 to X64 were considered suicides by drug toxicity. We broke down drug toxicity further using the following ICD-10 codes: T40.0 (opium), T40.1 (heroin), T40.2 (other opioids), T40.3 (methadone), T40.4 (other synthetic narcotics)

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and T40.6 (other and unspecified narcotics). Deaths with these codes were considered suicide deaths by opioid toxicity, regardless of the presence of other nonopioid drugs. We calculated descriptive statistics and performed logistic regression analyses with sex and age as predictors, for suicide by drug toxicity and suicide by opioid toxicity. We examined trends over time for patterns and tested for significance using chi-square and ANOVA tests.

Results

Demographics and trends over time

Between 2000 and 2016, there were 8344 deaths by suicide in Alberta; 2049 (24.5%) were females and 6295 (75.4%) were males. While the majority of suicide deaths (80%) were nondrug suicides, 20% were suicides by drug toxicity, of which 52.9% occurred in females. Approximately 22% of suicides by drug toxicity involved opioid toxicity; 51.4% of these opioid-toxicity suicides occurred among females. In a model fitting sex and age, females had 5.7 times the odds (95% confidence interval [CI]: 5.02–6.36) of suicide by drug toxicity compared to males ($p < .0001$). However, sex did not significantly predict opioid toxicity among suicides by drug toxicity.

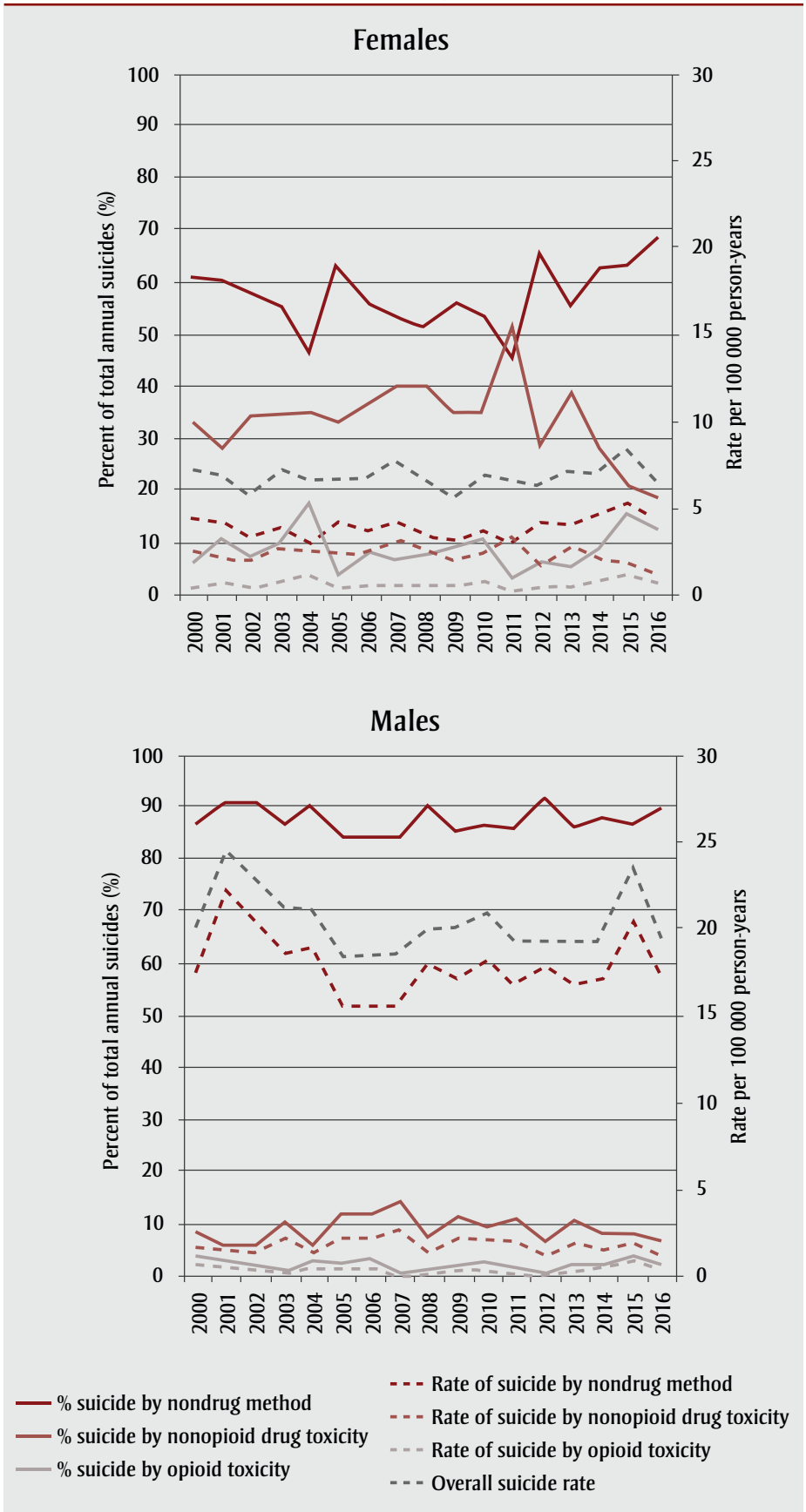
Individuals who died by drug-toxicity suicide were older than individuals who died by suicide by nondrug means (average age 47.4 [standard deviation (SD) 14.2] vs. 42.0 [SD 17.0] years, respectively). In a model adjusting for sex, the odds of suicide by drug toxicity versus nondrug means increased by 2.4% (95% CI: 2.0–2.7%) for every one-year increase in age ($p < .0001$). The sex-adjusted odds of opioid-toxicity death among suicides by drug toxicity also increased by 0.8% (95% CI: 0–1.7%) for every additional year of age ($p < .05$). The mean age for individuals dying by opioid-toxicity suicide was 48.8 (SD 14.4) years.

The proportion of females to males for overall suicide ($p = .35$), suicide by drug toxicity ($p = .71$) and suicide by opioid toxicity ($p = .62$) remained fairly constant from 2000 to 2016. Mean age for overall suicide ($p = .063$), suicide by drug toxicity ($p = .36$) and suicide by opioid toxicity ($p = .43$) were stable over the 17-year period examined.

Methods of suicide over time

Suicide by nondrug causes was generally more common than suicide by drug toxicity

FIGURE 1
Overall suicide rates, and rates and percentages of suicide methods used, Alberta, 2000–2016, by sex



in Alberta from 2000 to 2016. Among females, nondrug methods accounted for 57% of annual suicides, on average, and represented a higher proportion of suicides than drug toxicity (using any drug) in every year except 2004 and 2011, when drug toxicity accounted for 53% and 55% of suicides, respectively. The average annual rate of suicide by nondrug methods in females was 3.9 per 100 000 person-years. In males, nondrug methods were the primary means of suicide death, accounting for an average of 88% of annual suicides and an average annual rate of 17.9 per 100 000 person-years. The average rate of suicide by nonopioid drug toxicity was slightly higher for females compared to males (2.3 vs. 1.9 per 100 000 person-years) but nonopioid drug toxicity accounted for a much higher average percentage of suicide deaths in females than males (34% vs. 10%) (Figure 1). Similarly, the average rate of suicide by opioid toxicity per 100 000 person-years was 0.61 for females and 0.57 for males, while the average annual percentage of suicides attributed to opioid toxicity was 9% in females versus 3% in males.

Method of suicide fluctuated more for females than males, while the overall suicide rate fluctuated more in males (Figure 1). In females, from 2014 onwards, there was a downward trend in suicide by nonopioid drug toxicity to previously unobserved levels, and concurrent upward trends in nondrug and opioid-toxicity suicides. In males, rate and percentage contribution of suicide by opioid toxicity also rose, peaking in 2015.

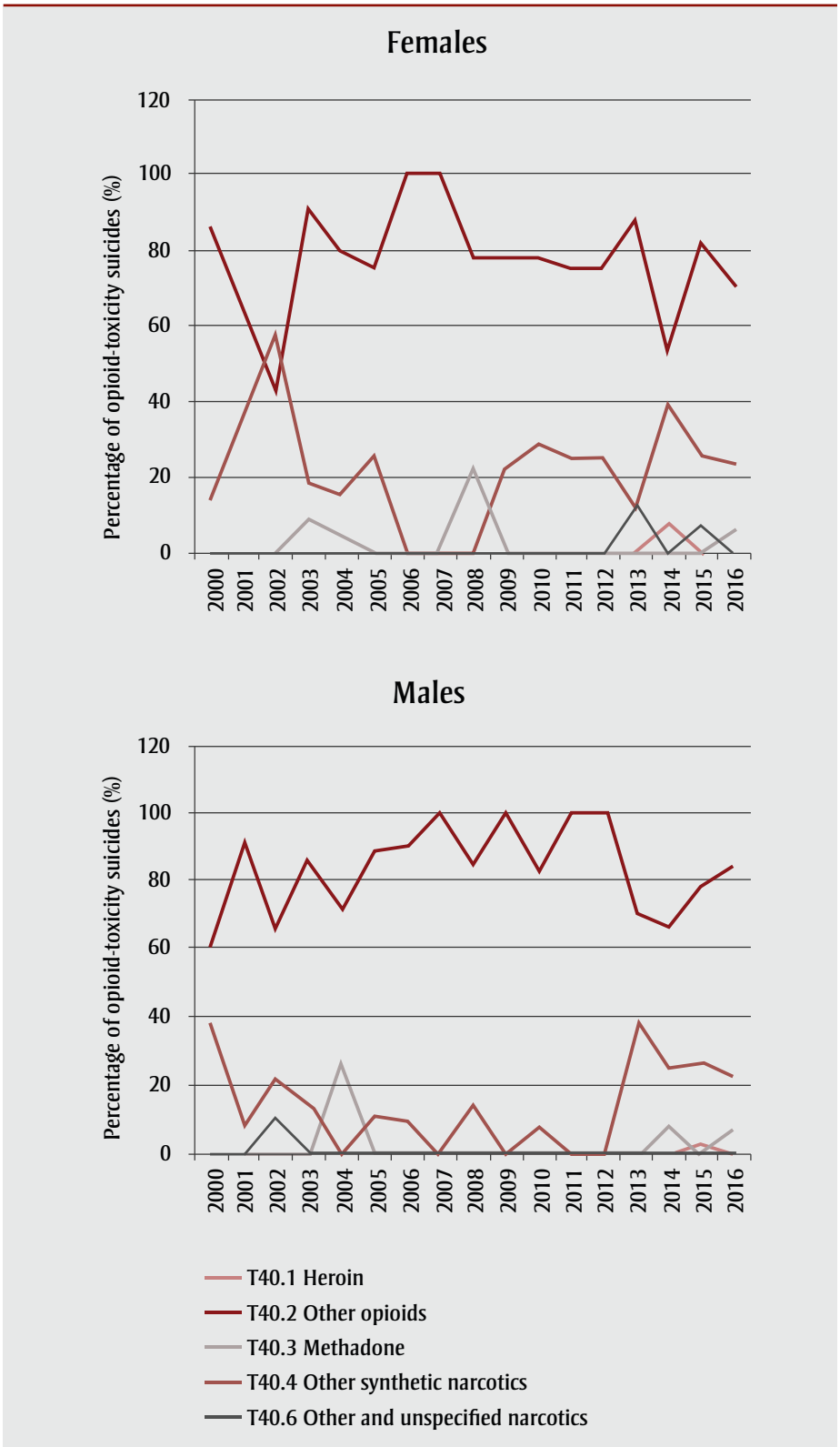
Types of opioids used in opioid-related suicides over time

In both females and males, the most commonly used opioids for suicide by opioid toxicity included morphine, codeine, hydromorphone and oxycodone (Figure 2). The second most common opioids recorded were "other synthetic narcotics," which include fentanyl and U-47700. The early 2000s (for both sexes), 2013 (for males) and 2014 (for females) all saw an increased percentage of "other synthetic narcotics" use, and a decreased percentage of "other opioids" use for suicide.

Discussion

Individuals in Alberta who died from unintentional opioid toxicity deaths in 2016 were predominantly male (73%) and

FIGURE 2
Types of opioids used for opioid-toxicity suicides, Alberta, 2000–2016, by sex



Notes: International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) codes were used to identify opioid types. T40.0 "Opium" was not used for suicide in Alberta from 2000 to 2016. T40.2 "Other opioids" include morphine, codeine, hydromorphone and oxycodone. T40.4 "Other synthetic narcotics" include synthetic opioids such as fentanyl and U-47700.

between 30 and 39 years of age.[11] In comparison, suicide deaths by opioid toxicity were observed in slightly more females, with a mean age of 49 years. These data suggest that unintentional and suicide opioid-toxicity deaths occur in distinct populations, and may thereby represent different public health concerns. Previous study results have also shown more opioid-toxicity suicides among females and more opioid-misuse toxicity deaths among males.[12]

There was no substantial increase in rates of suicide by opioid toxicity from 2000 to 2016 like that observed in unintentional deaths in Alberta between 2011 and 2016,[7] nor was there a significant change in suicide decedent demographics over time. The varied proportions of suicide method and stable overall suicide rate in females suggest a substitution of suicide methods rather than changes in frequency of suicide. The increased proportion of suicide by opioid toxicity around 2014 and 2015 may be a result of individuals utilizing an increased availability of synthetic opioids such as fentanyl.

Suicide deaths by opioid toxicity show a different opioid-type usage pattern compared to unintentional opioid toxicity deaths; fentanyl is the main contributor to unintentional opioid toxicity deaths,[7] but other opioids (morphine, codeine, hydromorphone and oxycodone) are predominantly used for suicides. Combined with the differences in demographics, it is likely that opioid-related suicides and unintentional deaths largely occur in different population groups in Alberta, with differing access to various types of opioids.

Strengths and limitations

Strengths of this study include the use of Alberta Vital Statistics data to capture all suicide deaths in Alberta over a 17-year span. However, only suicides for which the main cause of death was drug toxicity were considered drug-toxicity suicides; suicides for which the main cause of death was another method (e.g. hanging, firearm), but that also involved drug toxicity, were excluded. In addition, the use of ICD-10 codes prevented identification of the contribution of specific opioids, limiting the level of detail to that inherent in the code. Further, the contribution of opioids to drug toxicity deaths may also be underestimated, especially in earlier years, as coding practices occasionally do not identify specific drugs contributing to drug toxicity. There is potential for confounding in using administrative data over a long time period, whereby observed differences could reflect changes in coding practices over time and in response to known crises rather than true differences.

Conclusion

There are differences in population demographics, observed patterns and the types of opioids used for opioid-related unintentional and suicide deaths in Alberta, which suggests that these are separate phenomena within the opioid crisis. Prevention of suicide by opioid toxicity likely requires a public health response separate to the current response used to prevent predominantly illicit fentanyl-driven and unintentional opioid-toxicity deaths.

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Conflicts of interest

The authors have no conflicts of interest to report.

Authors' contributions and statement

EC, BM and LS conceived and designed the study. BM extracted and de-identified the data for analysis, and EC conducted the analysis. All authors were involved in drafting the manuscript and interpreting the data. All authors read and approved the final manuscript.

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