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Risk of non-medical drug overdose following prescription of opioids post-injury: A retrospective cohort study

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ABSTRACT

Background

There has been increasing scrutiny of opioid prescribing following injury because of concerns that prescribed opioids may contribute to addiction and overdose. This study aimed to better understand the relationship between injury, opioids prescribed before and after injury, and non-medical drug poisoning.

Data and methods

Working age (15 to 65 years old) residents of British Columbia's Fraser Health region with an injury that involved an emergency department visit were included. Factors examined included the prescription of opioid and opioid agonist therapy (OAT) medications before and after injury, age, sex, work-related injuries, and socioeconomic status, as well as how they were associated with non-medical drug poisoning risk and post-injury prescriptions.

Results

Opioid-naïve individuals (those without an opioid prescription captured before their injury) who were prescribed OAT medication—a marker of opioid use disorder—following their injury had a higher risk of subsequent non-medical drug poisoning (Hazard ratio (HR): 21.4 to 22.4 compared with opioid-naïve individuals without an opioid or OAT prescription). Post-injury opioid prescription in these individuals increased poisoning risk (HR: 1.27 compared with those without a prescription). Being of male sex (HR: 1.80), being younger (HR: 0.76 for every 10-year increase in age) and living in the lowest-income neighbourhoods (HR: 1.44 compared with the middle quintile) increased poisoning risk. Compared with injuries sustained outside of work, work-related injuries reduced risk (HR: 0.62).

Interpretation

Among a cohort of British Columbians visiting emergency departments following an injury, opioid prescribing in patients who were opioid-naïve appears to be a minor contributor to non-medical drug poisoning, particularly when compared with other patient factors, such as being male, being younger and having a low socioeconomic status.

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What is already known on this subject?

- The overdose crisis in BC has been driven by the introduction of fentanyl and fentanyl analogues into the drug supply, along with a health system history of over-prescribing opioids, including for pain management following an injury.
- This study aimed to investigate the relationship between injury, opioid prescription, and potential drug poisoning to quantify the risk of drug overdoses and identify potential intervention points to mitigate the crisis.

What does this study add?

- This study identified that those who were opioid naive and were prescribed opioids following an injury had a 27% increased risk of drug poisoning; however, this risk was lower than the risk factors of being male, of being younger, and of having lower socioeconomic status.
- Those prescribed OAT (notably, often prescribed for opioid use disorder) after their injury had over 21 times the risk of drug poisoning, which was a magnitude higher than other risk factors, making this group a special focus for intervention efforts.
- Despite higher relative opioid prescribing, work-related injuries were observed to have a protective effect on drug poisoning risk; however, data limitations restricted the ability to tease out the observed effects from employment status. Further investigation is warranted to better understand these observed relationships.

In 2016, a public health emergency was declared in British Columbia (BC), Canada in response to a rapid increase in illegal drug overdose deaths. A major contributing factor to the overdose crisis in BC has been the introduction of fentanyl and fentanyl analogues into the illicit drug supply.¹ Another potential driver has been the non-medical use of opioids,² which were heavily prescribed as pain management medication during the early 2000s.³ Increased scrutiny of opioid prescribing and interest in opioid deprescribing by health professional organizations is hypothesized to have impeded access to pharmaceutical opioids, particularly among those with opioid use disorder (OUD),⁴ forcing people to turn to the illegal, and often contaminated, drug supply for opioid needs, in which they are at higher risk of overdose.⁵

There is evidence to suggest that some people who suffered an injury and were subsequently prescribed opioids for pain would later suffer non-medical drug poisoning events because of prescription opioid misuse or because they turned to the illicit drug supply in an effort to manage their pain.⁶ A 2017 chart review conducted in the Fraser Health region, the most populous health region in BC (with 38% of BC's population), assessed all men admitted to hospital following a non-fatal overdose event in a private residence. The review identified that a common example of people who use illegal opioids was men who were relatively older, with uncontrolled chronic pain following an injury, and an active opioid prescription.⁶

The relationship between injury, opioid prescription, and non-medical drug poisoning has been described but, to the authors' knowledge, not been systematically assessed, particularly with an opioid-naive cohort. Focusing on working-age (15 to 65 years old) residents of the Fraser Health region, this study used a linked administrative dataset to better understand the

relationships between injury (whether the injury was work-related or sustained outside of the workplace), pain management medication in the form of opioid and opioid agonist therapy (OAT) prescriptions before and after injury, and potential non-medical drug poisoning. Specifically, it aimed to determine: 1) whether non-medical drug poisoning risk was associated with post-injury opioid prescriptions in opioid-naive individuals; 2) how post-injury opioid and OAT prescriptions were associated with pre-injury prescription in all individuals; and 3) the factors associated with a post-injury OAT prescription as opposed to an opioid only prescription in opioid-naive individuals. For the purposes of this manuscript, an individual was considered opioid-naive if they did not receive an opioid or OAT prescription before their injury as captured within the study period of April 1, 2012 to March 31, 2018. Non-medical drug poisoning includes poisoning from all narcotics and psychodysleptics—with the exception of alcohol—from legal or illegal sources.

Methodology

This study used a retrospective cohort design to explore the relationship between injury, opioid use, and poisoning through linked administrative datasets. All individuals were included in this study if they presented to a Fraser Health emergency department (ED) for an injury during the study period, had a Fraser Health address, and were between the ages of 15 and 65 at the time of injury. This would capture individuals who suffered injuries serious enough for an ED visit. Since the focus was on opioid and OAT medication prescriptions, these individuals would more likely require pain medication than those who suffered less severe injuries. Fraser Health was chosen because all EDs in the health region report to the

National Ambulatory Care Reporting System (NACRS).⁷ The 15-to-65-year-old age range was chosen to represent the working-age cohort and to ensure that the comparison between those who experienced work-related injuries and those who suffered injuries outside of the workplace were between similar individuals.

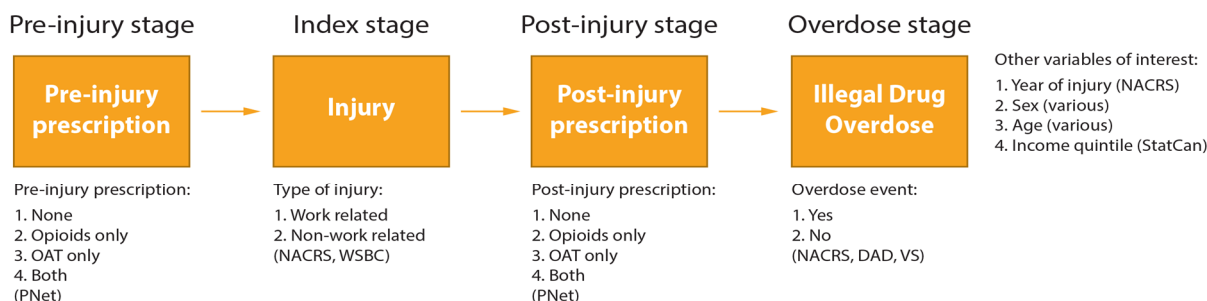
Six datasets, spanning from April 1, 2012 to March 31, 2018, were linked deterministically using personal health numbers and anonymized by Population Data BC. April 1, 2012 was chosen as the start date because that was when the NACRS started collecting data from all levels of care (1,2,3) for reporting EDs, therefore enabling full diagnostic codes to be available to identify injuries and drug poisoning events at the ED level.

The NACRS was used to capture ED visits because of injuries and non-medical drug poisoning events. Workplace claims data from WorkSafeBC (WSBC)⁸ were used to determine whether the injury was work-related, because there may be a difference in how pain management is handled in terms of opioid prescribing, insurance coverage, or even potential pressure to return to work earlier. The Discharge Abstract Database (DAD)⁹ and Vital Statistics – Death Database (VS)¹⁰ were used to capture hospitalizations and deaths, respectively. PharmaNet¹¹ was used to capture the dispensing of opioid and OAT prescriptions before and after injury. The BC PharmaNet is a province-wide network that links all pharmacies in BC. This system captures all prescribed drugs dispensed from community pharmacies, but does not include prescriptions dispensed in inpatient settings or to federally insured clients. It also excludes medications purchased without a prescription (e.g., over-the-counter medications). Statistics Canada Income Band (StatCan)¹² aggregate data were used to determine income quintile information (Figure 1). Income statistics were used to control for individuals living in lower socioeconomic neighbourhoods being associated with higher rates of opioid-related overdose.¹³

Injury ED visits were identified by ICD-10-CA¹⁴ codes (all S and T codes, with the exception of non-medical drug poisoning codes) in the discharge diagnosis. Non-medical drug poisoning events were identified by ICD-10 codes for opium, heroin, cocaine, other opioids, synthetic narcotics (including fentanyl), other narcotics, lysergic acid diethylamide (aka LSD), and psychedelics (T40.0 to 40.6, T40.8 to 40.9) in the discharge diagnosis for ED visits, the primary injury code for hospitalizations, and any underlying cause of death. An injury event was considered a work injury if the injury claim date for WSBC was within 15 days of the injury ED visit, so as to account for administrative differences between the different datasets. The index injury event was identified as the first injury event captured in the NACRS dataset during the study period. A prescription was classified as an opioid or an OAT by a list of Drug Identification Numbers/Product Identification Numbers as determined by pharmacology experts at Fraser Health.

The year of injury was the year the index injury occurred. Injuries were classified as work-related or not. Sociodemographic variables were age at the time of injury (age groups: 15 to 25 years, 26 to 35 years, 36 to 45 years, 46 to 55 years, 56 to 65 years) and sex (male, female). Post-injury prescription was classified as none, opioid, OAT, or both if they were prescribed neither opioids nor OAT, opioids only, OAT only, or both any time after the index injury event to the end of the follow-up. Likewise, pre-injury prescription was classified as none, opioid, OAT, or both for prescriptions between the start of the study and index injury date. Income quintiles (5 being highest income) were calculated at the dissemination area (DA) level using 2016 census information. The index injury period was from April 1, 2012 to December 31, 2017, with a follow-up period of April 1, 2012 to March 31, 2018. Of note, as opioid prescriptions prior to April 1, 2012 were not available for this study, opioid-naïve individuals may be misclassified, with a higher likelihood of misclassification for individuals with an injury that occurred earlier in the study period.

Figure 1
Conceptual flow of stages, variables of interest, and datasets used



Notes: PNet = PharmaNet, NACRS = National Ambulatory Care Reporting System, WSBC = WorkSafe BC, DAD = Discharge Abstract Database, OAT = opioid agonist therapy, VS = Vital Statistics - Death Database, StatsCan = Statistics Canada Income Band, Various = data came from multiple data sources listed above.

Sources: National Ambulatory Care Reporting System, WorkSafe BC, Discharge Abstract Database, Vital Statistics - Death Database, PharmaNet, Statistics Canada Income Band.

Table 1
Number and proportion of injury and drug poisoning events by variables of interest, opioid-naive residents aged 15 to 65 years old with an injury that involved an emergency department visit, Fraser Health region, British Columbia, Canada, 2012 to 2017

Variable of interest	Injury events		Drug poisoning events	
	number	%	number	% of injuries
Year of injury				
2012	25,221	12.0	362	1.4
2013	32,981	15.7	312	0.9
2014	45,941	21.9	323	0.7
2015	39,267	18.7	236	0.6
2016	35,220	16.8	109	0.3
2017	31,342	14.9	33	0.1
Sex				
Female	88,497	42.2	398	0.5
Male	121,475	57.9	977	0.8
Age				
15 to 25	55,137	26.3	527	0.9
26 to 35	45,120	21.5	371	0.8
36 to 45	38,037	18.1	222	0.6
46 to 55	38,821	18.5	200	0.5
56 to 65	32,857	15.7	55	0.2
Work injury				
No	175,482	83.6	1,247	0.7
Yes	34,490	16.4	128	0.4
Post-injury prescription				
None	147,269	70.1	524	0.4
Opioid	60,679	28.9	421	0.7
OAT	1,033	0.5	200	19.4
Both	991	0.5	230	23.2
Income quintile (1 = lowest, 5 = highest)				
1	43,484	20.7	400	0.9
2	45,513	21.7	312	0.7
3	44,640	21.3	245	0.5
4	43,651	20.8	240	0.5
5	31,832	15.2	170	0.5
Overall				
Total	209,972	100.0	1,375	0.7

Notes: The 2012 period only included data for nine months (April 1 onwards). Censored events are included in the total. OAT = opioid agonist therapy.

Sources: National Ambulatory Care Reporting System, WorkSafeBC, Discharge Abstract Database, Vital Statistics - Death Database, PharmaNet, Statistics Canada Income Band.

Three independent multivariable regression models were performed to assess each objective. For the first objective, Cox proportional hazards regression modelling was used to determine the association between non-medical drug poisoning risk and post-injury opioid prescription, with time to drug poisoning or censor as the outcome variable of interest. The independent variables of interest were the year of injury, sex, age, work injury, time exposed to post-injury opioid and OAT prescription (with no prescription as the reference category), and income quintiles (with the middle quintile as the reference category). Censors were deaths unrelated to non-medical drug poisoning events. All pre-injury opioid and OAT prescription cases were removed, because initial analysis indicated a strong association between pre-injury and post-injury prescription. All those with a non-medical drug poisoning event before the index injury date were also removed, because past evidence of drug poisoning would indicate they were at high risk of future drug poisoning. Post-injury prescription was modelled as a time-dependent variable to capture the time exposed to each type of prescription. This model determined whether each independent variable of interest was associated with the risk of non-medical drug poisoning following an injury among opioid-naive

individuals, while adjusting for each other. Adjusted hazard ratios (HR), with 95% confidence intervals (CI), were calculated for each independent variable of interest.

For the second objective, multinomial regression modelling was used to determine the association between post-injury opioid and OAT prescription and pre-injury prescription, with post-injury prescription as the categorical outcome variable of interest (with no prescription as the reference category). The independent variables of interest were the year of injury, sex, age, work injury, pre-injury prescription (with no prescription as the reference category), and income quintiles (with the middle quintile as the reference category). All individuals were included in the model. This model determined whether each independent variable of interest was associated with the odds of a post-injury prescription of opioid-only, OAT-only, or prescriptions of both opioids and OAT, with neither as the comparison category while adjusting for each other. Adjusted odds ratios (OR), with 95% confidence intervals, were calculated for each independent variable of interest.

For the third objective, logistic regression modelling was used to determine the association between the odds of being

prescribed OAT over only opioids after an injury and variables of interest. All pre-injury opioid and OAT prescription cases and those without any post-injury opioid or OAT prescriptions were removed. The independent variables of interest were the year of injury, sex, age, work injury, and income quintiles (with the middle quintile as the reference category). This model determined whether each independent variable of interest was associated with the odds of being prescribed OAT medication (either OAT-only or both opioid and OAT) compared with an opioid-only prescription following the injury among opioid-naive individuals, while adjusting for each other. Adjusted odds ratios, with 95% confidence intervals, were calculated for each independent variable of interest.

Alpha level of $p \leq 0.05$ was used to determine significance for all models. All analyses were conducted using SAS software, version 9.4 (Cary, North Carolina, United States) within the Population Data BC secure research environment. The study was approved by The University of British Columbia/Children’s and Women’s Research Ethics Board (Certificate # H18-02097).

Results

Objective 1: Drug poisoning risk

There were 209,972 unique opioid-naive individuals who suffered an injury that required an ED visit in Fraser Health between April 1, 2012 and December 31, 2017. Among those cases, 1,375 (0.7%) people had a drug poisoning event captured during the follow-up period and 2,010 (1.0%) were censored because of deaths unrelated to drug poisoning. The majority of injuries were among males (57.9%), were younger in age (47.8% were 35 years old or younger), and were generally unrelated to work (83.6%). The majority was not prescribed any

opioids or OATs (70.1%). Based on neighbourhood income quintiles, this group had a lower proportion (15.2%) living in the highest quintile as compared with the general population (Table 1).

Cox proportional hazards regression modelling showed that older individuals had a reduced risk of drug poisoning (HR: 0.76; 95% CI: 0.73 to 0.79 for every 10-year age group following the 15 to 25 age group), males had a higher risk (HR: 1.80; 95% CI: 1.62 to 2.00), work-related injuries were associated with lower risk (HR: 0.62; 95% CI: 0.53 to 0.72 compared with those with injuries sustained outside of work), and lowest income quintile reflected higher risk (HR: 1.44; 95% CI: 1.25 to 1.66 compared with middle quintile). In contrast, post-injury opioid-only prescriptions (HR: 1.27; 95% CI: 1.13 to 1.43), OAT-only prescriptions (HR: 22.36; 95% CI: 18.30 to 27.32), and both opioid and OAT prescriptions (HR: 21.40; 95% CI: 16.75 to 27.33) all showed increased risk of drug poisoning (Table 2). Of note, individuals with post-injury OAT prescriptions had increased the non-medical drug poisoning risk that was a magnitude higher than the other factors.

Objective 2: Post-injury prescription

Between April 1, 2012 and December 31, 2017, 281,284 unique individuals required an ED visit in the Fraser Health region. The majority of the injuries were among males (56.1%), were in younger age groups (43.9% were 35 years old or younger), were unlikely to be related to work (83.6%), and did not involve an opioid or OAT prescription (51.8%) in the follow-up period, though some people (26.3%) were already exposed to prescribed opioids before the injury (Table 3). Of note, individuals who were prescribed opioids or OAT before the injury were prescribed opioids or OAT after the injury, respectively.

Table 2
Results from the Cox proportional hazards model showing hazard ratios, with 95% confidence intervals, between time to drug poisoning and the variables of interest (N = 209,972), opioid-naive residents aged 15 to 65 years old with an injury that involved an emergency department visit, Fraser Health region, British Columbia, Canada, 2012 to 2017

Variable of interest	Hazard ratio	95% Confidence interval	
		Lower bound	Upper bound
Age			
per 10 years	0.759	0.730	0.788
Sex			
Male greater than female	1.797	1.615	2.000
Work Injury			
Yes greater than no	0.619	0.530	0.722
Post-injury prescription			
Opioid greater than none	1.270	1.128	1.430
OAT greater than none	22.358	18.297	27.320
Both greater than none	21.397	16.752	27.329
Year of injury			
per year	1.202	1.146	1.261
Income quintile			
1 greater than 3	1.438	1.247	1.658
2 greater than 3	1.152	0.993	1.337
4 greater than 3	1.060	0.907	1.240
5 greater than 3	0.992	0.835	1.180

Note: OAT = opioid agonist therapy

Sources: National Ambulatory Care Reporting System, WorkSafeBC, Discharge Abstract Database, Vital Statistics - Death Database, PharmaNet, Statistics Canada Income Band.

Table 3
Number and proportion of injury events and number and proportion with subsequent prescription of opioids only, OAT only, and both opioids and OAT, by variables of interest, all residents aged 15 to 65 years old with an injury that involved an emergency department visit, Fraser Health region, British Columbia, Canada, 2012 to 2017

Variable of interest	Injury events		Post-injury prescription of opioids only		Post-injury prescription of OAT only		Post-injury prescription of both opioids and OAT	
	number	%	number	% of injuries	number	% of injuries	number	% of injuries
Year of injury								
2012	27,334	9.7	13,892	50.8	269	1.0	814	3.0
2013	40,494	14.4	19,969	49.3	441	1.1	954	2.4
2014	60,792	21.6	29,215	48.1	589	1.0	1,053	1.7
2015	55,261	19.6	25,128	45.5	545	1.0	746	1.3
2016	51,362	18.2	22,096	43.0	470	0.9	509	1.0
2017	46,471	16.5	18,422	39.6	420	0.9	290	0.6
Sex								
Female	123,671	43.9	59,898	48.4	722	0.6	1,349	1.1
Male	158,043	56.1	68,824	43.5	2,012	1.3	3,017	1.9
Age								
15 to 25	65,030	23.1	23,292	35.8	648	1.0	743	1.1
26 to 35	58,599	20.8	23,898	40.7	963	1.6	1,400	2.4
36 to 45	52,566	18.7	24,657	46.9	635	1.2	1,060	2.0
46 to 55	55,877	19.8	28,956	51.8	332	0.6	803	1.4
56 to 65	49,542	17.6	27,919	56.4	156	0.3	360	0.7
Work injury								
No	235,636	83.6	107,395	45.6	2,512	1.1	3,923	1.7
Yes	46,078	16.4	21,327	46.3	222	0.5	443	1.0
Pre-injury prescription								
None	204,726	76.7	57,025	27.9	967	0.5	842	0.4
Opioid	72,826	25.9	71,506	98.2	0	0.0	1,320	1.8
OAT	2,071	0.7	0	0.0	1,231	59.4	840	40.6
Both	2,091	0.7	191	9.1	536	25.6	1,364	65.2
Income Quintile								
1	58,911	20.9	26,549	45.1	902	1.5	1,452	2.5
2	61,030	21.7	28,173	46.2	635	1.0	951	1.6
3	60,136	21.4	27,667	46.0	514	0.9	813	1.4
4	58,272	20.7	26,839	46.1	373	0.6	637	1.1
5	42,229	15.0	19,084	45.2	290	0.7	464	1.1
Overall								
Total	281,714	100.0	128,722	45.7	2,734	1.0	4,366	1.5

Notes: The 2012 period only included data for nine months (April 1 onwards). OAT = opioid agonist therapy.

Sources: National Ambulatory Care Reporting System, WorkSafeBC, Discharge Abstract Database, Vital Statistics - Death Database, PharmaNet, Statistics Canada Income Band.

Multinomial regression modelling showed that post-injury prescription was highly associated with pre-injury prescription, where being prescribed both opioids and OAT before their injury increased the odds of post-injury prescription of both opioids and OAT (OR: 879.16; 95% CI: 771.73 to 1000.00), being prescribed only OAT before their injury increased the odds of post-injury OAT-only prescription (OR: 319.13; 95% CI: 284.63 to 357.93), and being prescribed opioids only before their injury increased the odds of post-injury opioid-only prescription (OR: 185.20; 95% CI: 175.08 to 195.92). In addition, being younger (OR: 0.85; 95% CI: 0.84 to 0.86 for every 10-year age group after the 15 to 24 age group), being male (OR: 1.08 to 1.78), and living in the lowest-income neighbourhoods (OR: 1.07 to 1.41 when compared with the middle quintile) increased the odds of opioids or OAT prescription, while work-related injuries (OR: 0.50 to 0.82 when compared with those who were injured outside the workplace) reduced the odds (Table 4).

Objective 3: Opioids-only versus opioid agonist therapy cohort comparison

Between April 1, 2012 and December 31, 2017, 57,025 opioid-naive individuals suffered an injury and were subsequently

prescribed opioid or OAT prescriptions. The vast majority (96.9%) were given only opioids. In the cohort that were prescribed OAT medication, when compared with the opioid-only cohort, males were more prevalent (75.5% vs. 56.9%), those 35 years or younger were more prevalent (75.4% vs. 42.5%), non-work-related injuries were more prevalent (90.5% vs. 81.7%) and those living in the lowest-income quintile neighbourhoods (29.2% vs. 20.4%) were more prevalent (Table 5).

Logistic regression modelling showed that each 10-year increase in age reduced the odds of being prescribed OAT (OR: 0.59; 95% CI: 0.56 to 0.61), that being male increased the odds (OR: 2.32; 95% CI: 2.08 to 2.59), that a work injury reduced the odds (OR: 0.45; 95% CI: 0.39 to 0.53), and that living in the lowest income-quintile neighbourhood increased the odds (OR: 1.59; 95% CI: 1.38 to 1.82) when compared with the middle quintile (Table 6).

Discussion

This study demonstrated that of the people who were not exposed to opioid or OAT medication prior to injury, most

Table 4
Results from the multinomial regression model showing odds ratios, with 95% confidence intervals, between the odds of being prescribed opioids only, OAT only, or both and the variables of interest (N = 281,714), all residents aged 15 to 65 years old with an injury that involved an emergency department visit, Fraser Health region, British Columbia, Canada, 2012 to 2017

Variable of interest	Opioids greater than none			OAT greater than none			Both greater than none		
	Odds ratio	95% Confidence Interval		Odds ratio	95% Confidence Interval		Odds ratio	95% Confidence Interval	
		Lower bound	Upper bound		Lower bound	Upper bound		Lower bound	Upper bound
Age									
per 10 years	0.85	0.84	0.86	0.70	0.67	0.73	0.78	0.76	0.80
Sex									
Male greater than female	1.08	1.06	1.10	1.78	1.61	1.98	1.62	1.50	1.75
Work injury									
Yes greater than no	0.82	0.79	0.85	0.50	0.43	0.59	0.70	0.62	0.78
Pre-injury prescription									
Both greater than none	1.72	1.67	1.76	76.72	67.82	86.79	879.16	771.73	1000.00
OAT greater than none	N/A	N/A	N/A	319.13	284.63	357.83	174.21	154.62	196.28
Opioid greater than none	185.20	175.08	195.92	N/A	N/A	N/A	7.04	6.43	7.70
Year of injury									
per year	1.29	1.28	1.30	1.07	1.04	1.10	0.60	0.58	0.62
Income quintile									
1 greater than 3	1.07	1.04	1.10	1.23	1.08	1.41	1.35	1.22	1.50
2 greater than 3	0.99	0.96	1.02	1.13	0.98	1.30	1.05	0.94	1.17
4 greater than 3	0.96	0.93	0.99	0.79	0.67	0.92	0.88	0.78	0.99
5 greater than 3	1.00	0.97	1.04	0.84	0.71	1.00	0.87	0.76	1.00

N/A = "Not applicable" indicates insufficient counts to estimate the odds ratio.

Note: OAT = opioid agonist therapy.

Sources: National Ambulatory Care Reporting System, WorkSafeBC, Discharge Abstract Database, Vital Statistics - Death Database, PharmaNet, Statistics Canada Income Band.

(70%) were not prescribed opioids or OAT medication after suffering an injury that was serious enough for an ED visit. The most important predictor for having an opioid or OAT prescription following an injury was having a pre-injury prescription for opioids or OAT. This is unsurprising, because clinicians would likely continue prescribing similar regimens, and patients would likely request the same medications for pain management if these medications were found to be effective in the past.

Among opioid-naive individuals who were prescribed opioids following an injury, the risk of non-medical drug poisoning was 27% higher than for those who were not prescribed opioids or OAT after adjusting for other factors. Those prescribed post-injury OAT had the highest post-injury drug poisoning risk by far (2,136% higher risk than those not prescribed opioids or OAT). Given that OAT is the gold standard treatment for OUD, and that these medications work by preventing opioid withdrawal and reducing cravings,¹⁵ it is expected that many who were prescribed OAT may have met criteria for OUD.¹⁶ Since OUD is a major risk factor for drug poisoning, it is also unsurprising that people prescribed OAT in this study had the highest risk of drug poisoning. In this case, OAT prescription measured in this study may be a proxy variable for OUD.

Being male increased non-medical drug poisoning risk by 80%, and age had a protective effect by reducing risk by 24% per every 10-year incremental increase in age. This finding is consistent with the evidence indicating that men are at much higher risk of overdose death, with the highest rates being observed among those 30 to 39 years of age in BC, with

decreasing rates for older age groups.¹ Those living in the lowest-income neighbourhoods had 44% higher risk of post-injury drug poisoning than those living in middle quintile neighbourhoods, which is also consistent with lower socioeconomic status being a risk factor for overdose.¹³ It is also worth noting that these risk factors—being male, being younger, and living in the lowest-income quintile neighbourhoods—were the same for being prescribed OAT prescription in our analysis, and, therefore, are likely risk factors for OUD.

Of note, work-related injuries had a protective effect, with a 38% reduction in non-medical drug poisoning risk. While some literature suggests that those who are injured on the job are at higher risk of overdose than their non-injured counterparts,^{17,18} these data suggest that injuries occurring outside of the workplace pose a higher drug poisoning risk. There are several explanations for this discrepancy. First, those who experienced a workplace injury were employed by definition—they may have been healthier than the cohort of patients with non-workplace injuries, who may or may not be employed.¹⁹ Second, those who had a workplace injury had 45% lower odds of being prescribed OAT. As OAT prescription is a likely proxy for OUD, this finding may reflect that employed individuals were less likely to suffer from OUD and were, thus, less likely to experience drug poisoning. Third, while those with work-related injuries had 18% lower odds of being prescribed opioids, it is possible that the protocols employed by WSBC following injury may involve more frequent monitoring of workers along

Table 5
Number and proportion of individuals with a prescription of opioids only (opioid cohort) and OAT (OAT cohort) after an injury, by variables of interest, opioid-naïve residents aged 15 to 65 years old with an injury that involved an emergency department visit, Fraser Health region, British Columbia, Canada, 2012 to 2017

Variable of interest	Opioid cohort		OAT cohort	
	number	%	number	%
Year of injury				
2012	10,956	19.2	493	27.3
2013	12,166	21.3	418	23.1
2014	14,372	25.2	438	24.2
2015	9,505	16.7	267	14.8
2016	6,333	11.1	132	7.3
2017	3,693	6.5	61	3.4
Sex				
Female	24,578	43.1	444	24.5
Male	32,447	56.9	1,365	75.5
Age				
15 to 25	12,915	22.7	750	41.5
26 to 35	11,284	19.8	614	33.9
36 to 45	10,696	18.8	281	15.5
46 to 55	11,775	20.7	131	7.2
56 to 65	10,355	18.2	33	1.8
Work injury				
No	46,594	81.7	1,637	90.5
Yes	10,431	18.3	172	9.5
Income quintile				
1	11,606	20.4	528	29.2
2	12,591	22.1	431	23.8
3	12,211	21.4	359	19.9
4	11,909	20.9	269	14.9
5	8,435	15.0	212	11.7
Overall				
Total	57,025	96.9	1,809	3.1

Notes: The 2012 period only included data for nine months (April 1 onwards). OAT = opioid agonist therapy.

Sources: National Ambulatory Care Reporting System, WorkSafeBC, Discharge Abstract Database, Vital Statistics - Death Database, PharmaNet, Statistics Canada Income Band.

Table 6
Results from the logistic regression model showing odds ratios, with 95% confidence intervals, between odds of being prescribed OAT instead of opioids only and the variables of interest (N = 58,834), opioid-naïve residents aged 15 to 65 years old with an injury that involved an emergency department visit, Fraser Health region, British Columbia, Canada, 2012 to 2017

Variable of interest	Odds ratio	95% Confidence interval	
		Lower bound	Upper bound
Age			
per 10 years	0.586	0.562	0.610
Sex			
Male greater than female	2.316	2.075	2.585
Work injury			
Yes greater than no	0.452	0.385	0.531
Year of injury			
per year	0.872	0.843	0.903
Income quintile			
1 greater than 3	1.585	1.380	1.820
2 greater than 3	1.169	1.012	1.350
4 greater than 3	0.761	0.647	0.894
5 greater than 3	0.837	0.703	0.996

Note: OAT = opioid agonist therapy.

Sources: National Ambulatory Care Reporting System, WorkSafeBC, Discharge Abstract Database, Vital Statistics - Death Database, PharmaNet, Statistics Canada Income Band.

with increased access to non-pharmaceutical modalities of pain management, thus leading to improved recovery and lower risk of drug poisoning.

Some limitations of the study include injury, prescription, and drug-poisoning events occurring outside of the study period and

outside the province that could not be accounted for; thus opioid-naïve individuals may be misclassified, all counts were likely underestimated, and first events may not be true first events. All drug poisoning counts are also likely underreported, because events that were not attended to or did not make it to the ED or hospital would not be captured in the datasets. The

15-day grace window was used to determine whether an injury was work-related; thus, some injuries may have been misclassified. The dispensing of opioid and OAT prescriptions may not be for the purposes of pain management as a result of the injury. Since the study only focused on Fraser Health residents, further studies should be conducted in other jurisdictions to see whether the associations found in this study apply to the broader population. Gender information was not available within the administrative datasets; therefore, some Sex- and Gender-Based Analysis Plus components could not be assessed. Lastly, administrative data are limited in assessing risk and protective factors in detail (e.g., determining employment status based on workplace claims and OAT prescription as a surrogate marker for OUD); therefore, further investigation of the trends observed is warranted.

Notwithstanding these limitations, this study combines several large administrative datasets and determines that post-injury opioid prescription is not as strong a predictor of post-injury drug poisoning as other risk factors, such as being male, being younger, and living in lowest-income neighbourhoods. The data suggest that opioid prescribing following an injury can be more nuanced, but that it should still be done carefully for the purposes of pain management,²⁰ particularly for those in higher-risk groups (male, of younger age, and of lower socioeconomic

status). Considering the lower drug-poisoning risk among opioid-naive individuals who do not belong to higher-risk groups, as well as the risk of individuals turning to the illicit drug supply because of impeded access to prescribed opioids, opioid prescribing guidelines may benefit from reassessing whether the guidance provided appropriately balances patients' real pain needs.

Given the magnitude difference in drug poisoning risk for those with post-injury OAT prescription, a likely marker for OUD, more support for this cohort may be required in order to reduce non-medical drug poisoning risk. Given that stressful life events and psychiatric comorbidities are known to exacerbate drug relapse,^{21,22} active monitoring and access to counselling services may be important therapeutic considerations for this group, particularly since discontinuation of OAT greatly increases overdose risk.^{23,24}

Disclaimer

All inferences, opinions and conclusions drawn in this manuscript are those of the authors, and do not reflect the opinions or policies of the data steward(s) at Population Data BC.

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