

# Lives Lost to Opioid Toxicity among Ontarians Who Worked in the Construction Industry

## A report prepared by:

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## On behalf of:

The Ontario Drug Policy Research Network

The Office of the Chief Coroner for Ontario / Ontario Forensic Pathology Service

Public Health Ontario

July 2022

# Table of Contents

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- Background ..... 3
- Methods..... 4
- Key Findings..... 6
  - Demographic Characteristics ..... 7
  - Drug Involvement in Opioid Toxicity Deaths ..... 13
  - Circumstances Surrounding Death..... 17
  - Recent Interactions with the Healthcare System..... 19
  - Clinical Characteristics ..... 21
- Limitations ..... 26
- Discussion ..... 27
- Conclusion..... 29
- Contributors..... 30
- Funding..... 30
- Acknowledgments ..... 31
- Disclaimer ..... 31
- Office of the Chief Coroner – Privacy Statement ..... 32
- How to Cite this Document..... 32
- Contact ..... 32
- References ..... 32
- Appendix A: Definitions..... 34
- Appendix B: Diagnosis Codes Used to Identify Healthcare Encounters and Health Conditions..... 36



## Background

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Ontario continues to face a rapidly growing opioid overdose crisis, with 2,460 opioid toxicity deaths reported in 2020, a nearly 60% increase from 2019.<sup>1</sup> In 87% of these cases in 2020, unregulated fentanyl was found to have directly contributed to the death, a significant increase from the pre-pandemic period.<sup>2</sup> People working in the construction industry, who represented 3.6% of the entire Ontario population and 7.2% of all employed people in Ontario in 2021,<sup>3,4</sup> are disproportionately impacted by this rapid acceleration in opioid toxicity deaths. In Ontario, a 2021 report among people who died of opioid toxicity showed that **one-third** of those who were employed at the time of death **worked in the construction industry**.<sup>2</sup> This pattern has also been reported in British Columbia, where one-fifth of opioid toxicity deaths occurred among people working in the construction industry.<sup>5,6</sup> Premature loss of life due to opioid toxicity is a tragedy that has far-reaching impacts on friends, family, loved ones and colleagues, along with broad and long-standing economic consequences. In 2017, \$4.2 billion dollars of lost productivity was attributed to opioid use in Canada across all sectors, mainly because of the nearly 100,000 productive years of life lost due to premature opioid toxicity deaths.<sup>7</sup>

There are several reasons why people working in the construction industry may be more susceptible to opioid use and associated harms. The physical demands of construction work may explain why construction workers are prone to injuries and chronic pain, which may contribute to opioid use.<sup>8-12</sup> In addition, the mental challenges associated with long hours and precarious, competitive and stressful work environments may also contribute to opioid use among people working in the construction industry.<sup>8,13</sup> The precarious or occasional nature of some construction work may also make the construction industry a more accessible field of employment for people who use substances, compared to other sectors.<sup>14</sup> Furthermore, the high proportion of men, particularly in younger age groups, may explain the clustering of opioid-related harm in the construction industry, as these are demographic groups that tend to be most affected by opioid toxicity death.<sup>2,15,16</sup>

There is a lack of research on the characteristics and circumstances of opioid toxicity deaths among people working in the construction industry, particularly in Ontario. This report addresses this knowledge gap by describing trends in the number of opioid toxicity deaths among people who worked in the construction industry, as well as demographic characteristics, circumstances of death, and patterns of healthcare and medication use. This report aims to provide insight into root causes, contributing factors, and the role of the healthcare system in the prevention of opioid toxicity deaths. Policymakers, working groups and construction industry employers can use this information to tailor programs and policies to prevent harms related to opioid toxicity among construction workers.

# Methods

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We conducted a descriptive cross-sectional study to describe trends, characteristics, and patterns of healthcare use among people who worked in the construction industry and those with no employment history in construction who died of an opioid toxicity in Ontario, Canada between July 1, 2017 and December 31, 2020. **People who worked in the construction industry were defined as individuals who were employed or previously employed in the construction industry prior to death, as determined by the investigating coroner.** Employment in the construction industry could include work in a trade, equipment operation, or general labour and does not include employment in natural resources, mining or agriculture. Employment in the construction industry can be formal, informal, seasonal or temporary. An opioid toxicity death was defined as an acute toxicity death resulting from the direct contribution of consumed substance(s), where one or more of the substances was an opioid, regardless of how the opioid was obtained. We restricted our analysis to confirmed opioid toxicity deaths that were deemed to be accidental/unintentional (i.e., due to an occurrence, incident or event that occurred without foresight or expectation).

## Data Sources

We obtained the data used in this report from ICES (formerly known as the Institute for Clinical Evaluative Sciences), which holds databases containing information on healthcare encounters in Ontario that are covered by the Ontario Health Insurance Plan (OHIP). We identified people who worked in the construction industry (employed or previously employed at the time of death) who died due to opioid toxicity, and the circumstances surrounding these deaths, using the Drug and Drug/Alcohol Related Death Database. The Drug and Drug/Alcohol Related Death Database contains records from investigations of probable and confirmed opioid toxicity deaths completed by the death investigation service at the Office of the Chief Coroner/Ontario Forensic Pathology Service, and captures information related to prior employment among decedents as determined by the coroner during their investigation. To identify sociodemographic information, such as location of residence and neighbourhood income quintile, we used the Registered Persons Database. To examine history of medications dispensed prior to death, we used the Narcotics Monitoring System, a database that captures all claims for controlled medications, such as opioids, benzodiazepines and stimulants, dispensed from community pharmacies in Ontario, regardless of payer. For information on visits to outpatient care, we used the OHIP Claims Database and the Community Health Centre Database. To capture information on emergency department (ED) visits, acute hospital admissions, and mental health-related hospital admissions, we used the Canadian Institute for Health Information's National Ambulatory Care Reporting System, Discharge Abstract Database, Same Day Surgery Database, and Ontario Mental Health Reporting System, respectively. To determine history of a major traumatic injury, we used the Ontario Trauma Registry Database. These datasets were linked using unique encoded identifiers and analyzed at ICES. The use of data in this project was authorized under section 45 of Ontario's Personal Health Information Protection Act, which does not require review by a Research Ethics Board.

## Measures

We reported the number of opioid toxicity deaths during each quarter of the study period. We described the number and proportion of opioid toxicity deaths by age group (0 to 24, 25 to 44, 45 to 64, and 65+), sex (female, male), location of residence (urban vs. rural, and northern vs. southern; see [Appendix A](#) for definition), and employment status on death date (employed, retired, unemployed, unknown). We also examined the distribution of individuals who died of an opioid toxicity by neighbourhood income quintile (as a measure of socioeconomic status) according to their place of residence, as well as their living arrangement (private dwelling, other collective

dwelling, experiencing homelessness, other) at the time of death as determined during the death investigation. We compared the circumstances surrounding opioid toxicity deaths, including whether an individual who could intervene was present at the time of the incident, and whether naloxone was used during resuscitation. We also assessed the number and types of opioids directly contributing to death, and the prevalence of other substances that directly contributed to the death or were detected in post-mortem toxicology, including benzodiazepines, stimulants and alcohol. We classified the opioids, benzodiazepines, and stimulants involved in opioid toxicity deaths as pharmaceutical or non-pharmaceutical (see [Appendix A](#) for definition) based on available toxicology results and information about pharmaceuticals approved for use in Canada. We also described the location where the incident took place (categorized as private residence, construction site, outdoors, hotel/motel/inn (overall), hotels designated as shelters, hotels/motels used for work purposes, rooming house, shelter/supportive living, public indoor space, other and unknown), and reported whether the incident took place in the decedent's home. We assessed prior prescription medication by comparing the percentage of people who had a prescription opioid, benzodiazepine or stimulant dispensed in the 30 days and one year prior to and including the date of death. We also assessed the prevalence of healthcare encounters in the seven days prior to and including the date of death. Specifically, we reported the percentage of people who had encounters for outpatient care, primary care, emergency department visits, acute inpatient hospitalizations, mental health hospitalizations, and hospital admissions for opioid toxicity. See Tables [B1](#) and [B5](#) in [Appendix B](#) for details.

To examine the health history of those who died of an opioid toxicity, we first calculated the percentage of people who had a history of chronic pain (see Table [B2](#) in [Appendix B](#) for criteria and details). We then assessed the percentage of people with pain-related injuries and conditions in the ten years prior to death (major traumatic injury, traumatic brain injury) and five years prior to death (low back pain; fractures, dislocations, strains or sprains; arthritis and related conditions; bone and spinal conditions; unspecified musculoskeletal disorders or congenital abnormalities), defined under Table [B3](#) in [Appendix B](#). We assessed the prevalence of opioid use disorder among construction workers in the five years prior to death, defined by hospital visits for an opioid use disorder (prior to death) or the prescription of opioid agonist treatment (prior to and including date of death) (see Table [B4](#) in [Appendix B](#) for details). We further reported whether people had a history of chronic pain and an indication of opioid use disorder in the five years prior to death; a healthcare encounter for an opioid toxicity in the 30 days and one year before death; encounters for stimulant- or alcohol-related toxicity or dependency in the 30 days and one year before death; and encounters for mental health-related diagnoses (psychotic disorders, mood and anxiety disorders, substance use disorders, non-psychotic disorders, other) in the five years prior to and including death. For more information about the diagnosis and billing codes used to define the various healthcare encounters and health conditions, please see Tables [B1](#) and [B5](#) in [Appendix B](#).

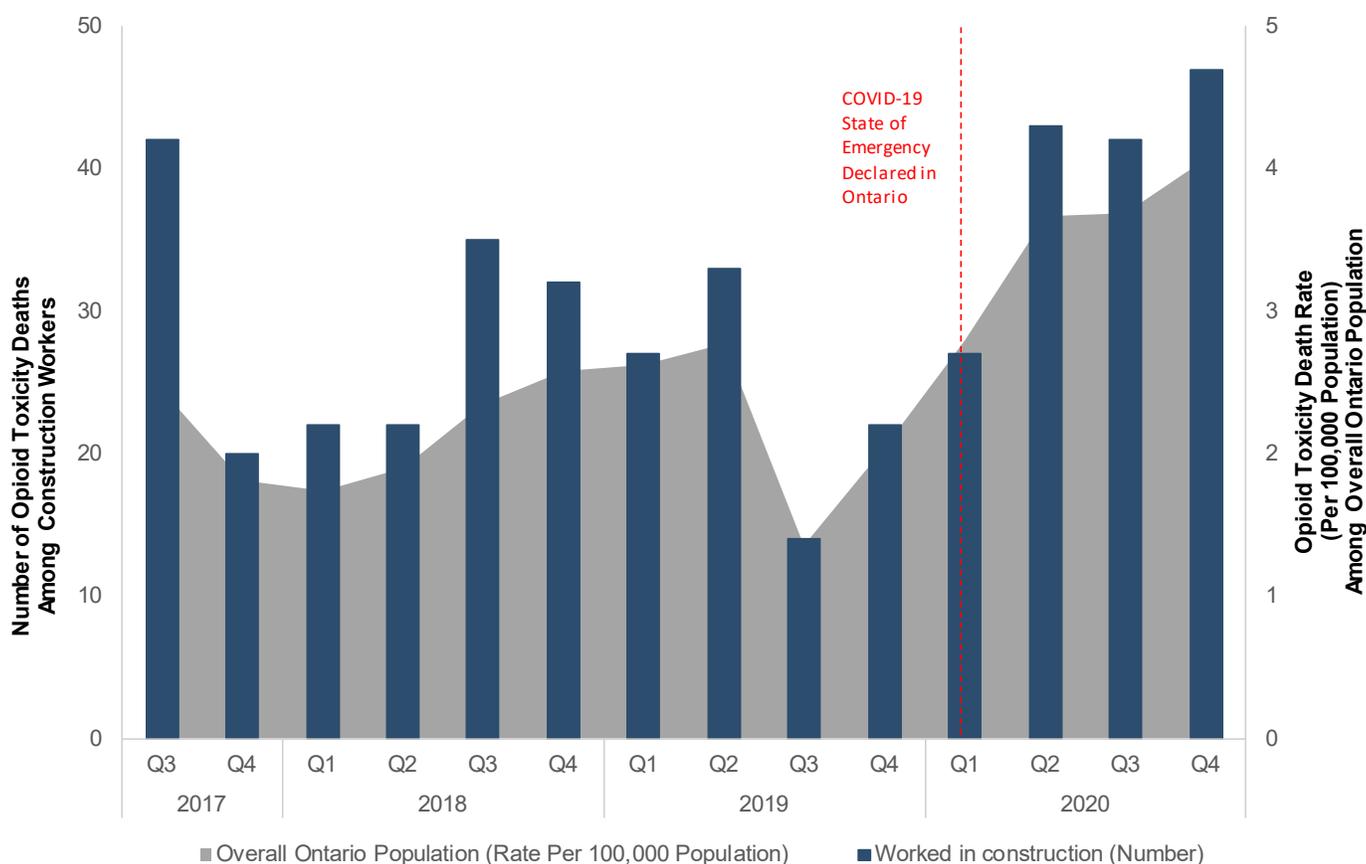
## Analysis

We reported trends in opioid toxicity deaths separately among (i) those with employment history in the construction industry, (ii) those with no employment history in the construction industry, and (iii) Ontario residents (overall) in each quarter of the study period from July 1, 2017 to December 31, 2020 (Q1, January to March; Q2, April to June; Q3, July to September; Q4, October to December). We compared those who died of an opioid toxicity and worked in construction to those who died of an opioid toxicity with no known employment history in the construction industry. We used descriptive statistics to summarize demographic characteristics, circumstances of death, medication prescribing, health services utilization and clinical characteristics in the final 3 years of the study period (January 1, 2018 and December 31, 2020). Chi-square tests were used to compare differences between groups.

# Key Findings

The terms 'people who worked in construction' and 'construction workers' refer to people who were either **currently** or **previously employed** in the construction industry prior to death, as determined by the coroner during their investigation.

**Figure 1: Number of opioid toxicity deaths by quarter among people who worked in the construction industry compared to the population-adjusted opioid toxicity death rate in Ontario**



## NOTE

There were 10 and 424 additional opioid toxicity deaths (among those with and without a history of employment in construction, respectively) that are not reported above because the deaths were not accidental (e.g., suicide).

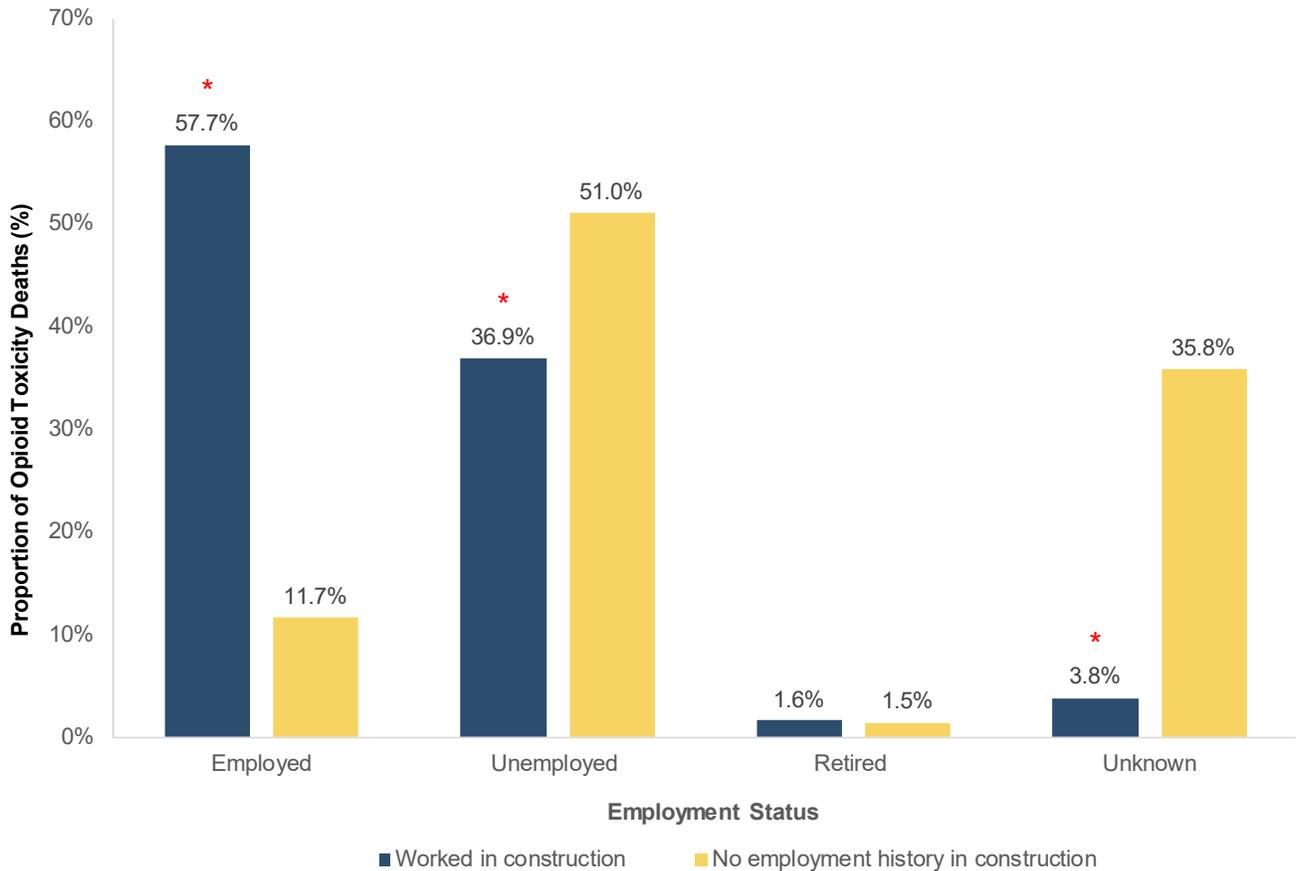
Trends in the number of opioid toxicity deaths among people who worked in the construction industry followed a similar pattern to the overall rate in the Ontario population. Opioid toxicity deaths in the construction industry increased by 65.9% between 2019 and 2020 (96 to 159 deaths), a similar increase to what was observed among those with no history of employment in construction (61.8% increase; 1,234 to 1,997 deaths) and the overall rate of opioid toxicity deaths in the Ontario population (62.1% increase; 2.20 to 3.56 per 100,000 population).

There were a total of 428 opioid toxicity deaths among individuals who had a history of employment in the construction industry from July 2017 to the end of 2020 in Ontario. This means that construction workers accounted for nearly 1 in 13 opioid toxicity deaths across Ontario over this time (7.9%; 428 of 5,386).

Throughout the remainder of the report, data from **January 1, 2018 to December 31, 2020** were used to compare characteristics between people who worked in the construction industry (N=366 deaths) and those without a history of employment in the construction industry (N=4,394 deaths).

## Demographic Characteristics

**Figure 2: Employment status** among individuals who died of an opioid toxicity in Ontario, by history of employment in the construction industry (2018-2020)



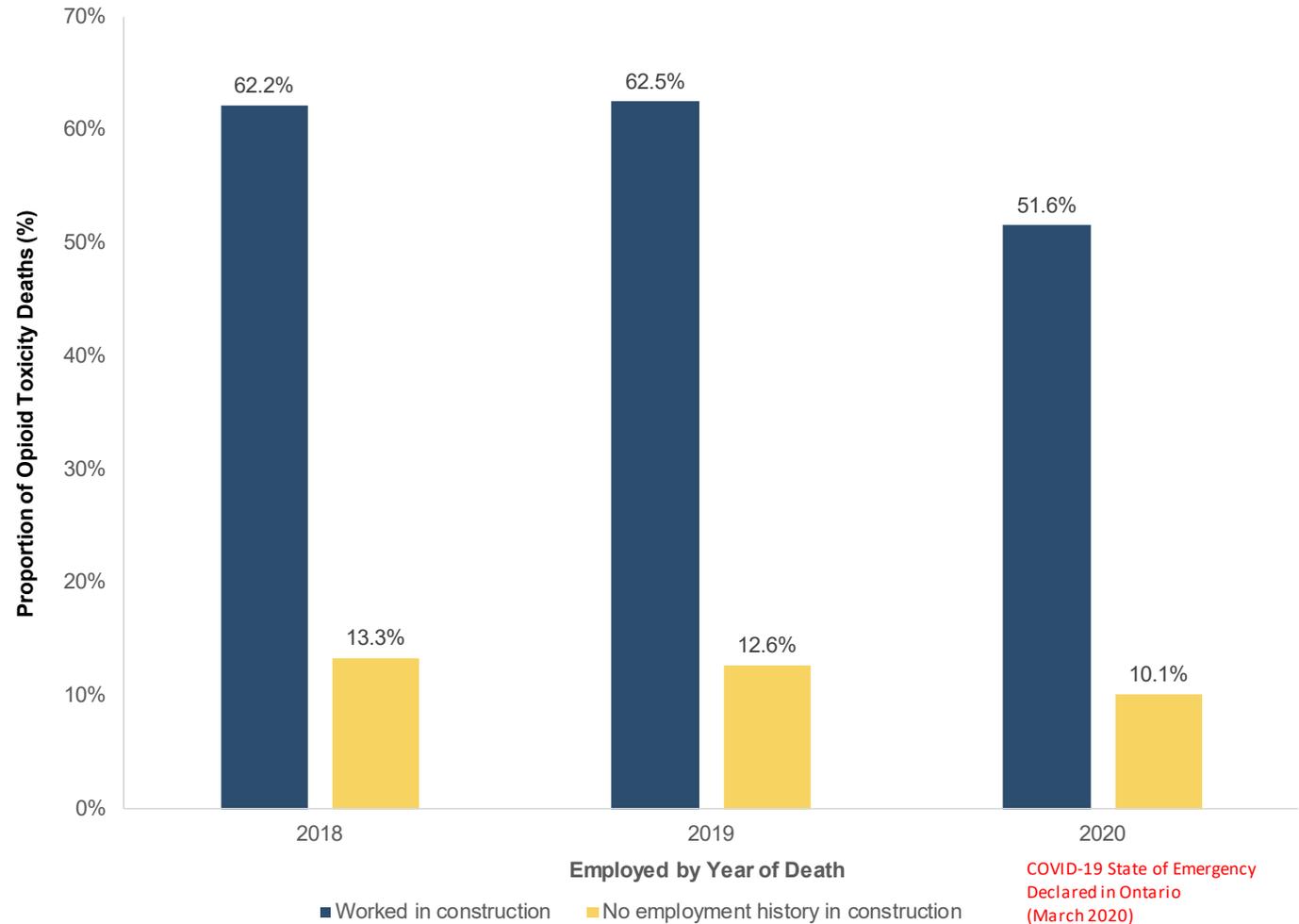
### NOTE

\*Red asterisk indicates statistically significant difference between construction workers vs. those with no employment history in construction ( $p < 0.05$ ). See [Appendix A](#) for definitions.

Employment status at time of death differed considerably among construction workers and those without a history of employment in the construction industry. Specifically, over half (57.7%; N=211) of individuals in the construction industry were known to be employed at the time of opioid toxicity death, compared to only 11.7% of those with no employment history in the construction industry ( $p < 0.001$ ). In contrast, there was a high degree of unemployment at time of death (51.0%) among individuals with no employment history in construction.

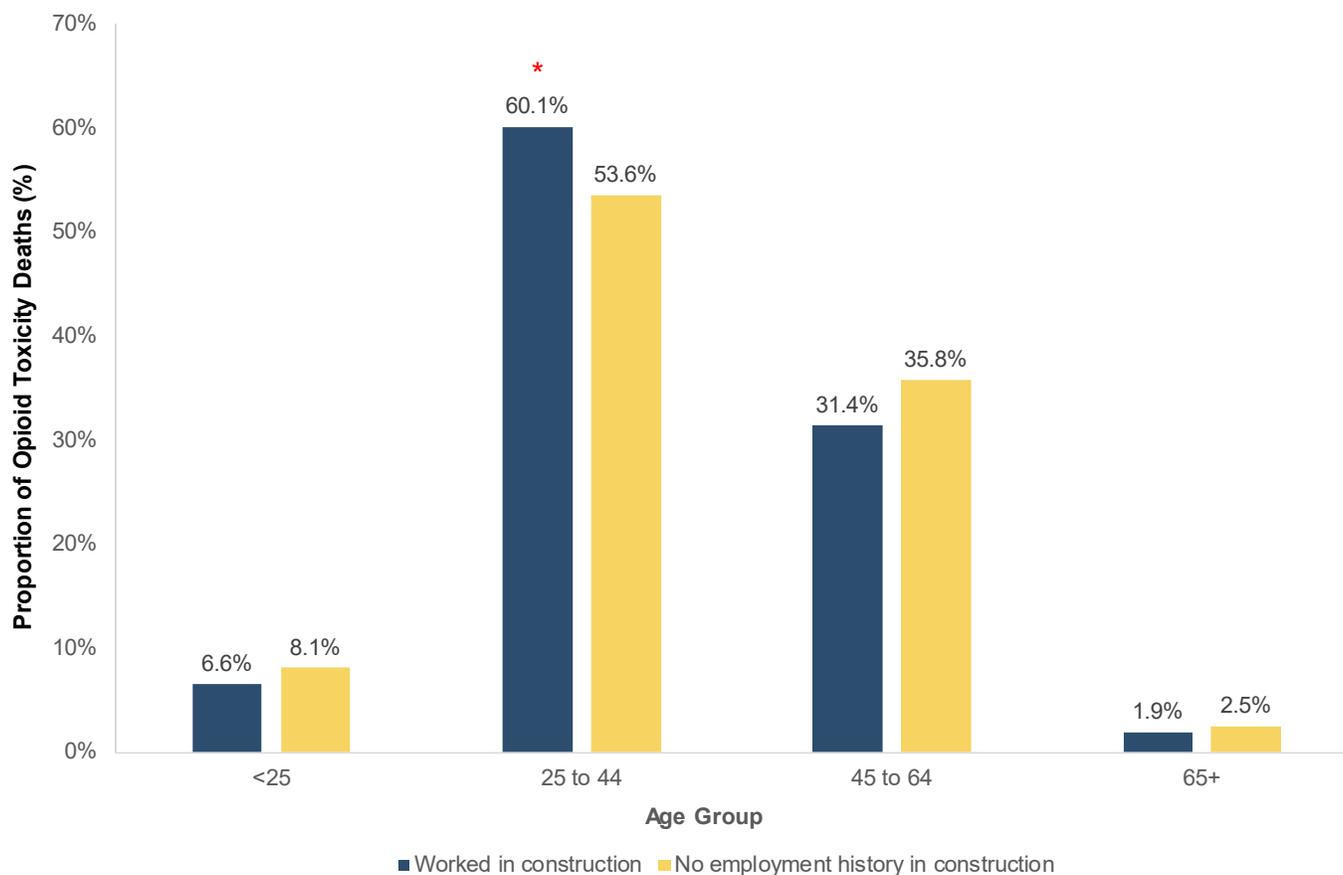
It should be noted that interpretation of these findings is challenging because of a high degree of unknown employment status, particularly among those with no employment history in construction which could lead to an underestimate of employment rate. Nonetheless, even if all individuals with unknown employment were assumed to be employed, the employment rate among construction workers would still be higher than among those with no employment history in the construction industry.

**Figure 3: Proportion employed by year of opioid toxicity death in Ontario and by history of employment in the construction industry (2018-2020)**



The proportion of construction workers who were employed at time of opioid toxicity death was relatively stable prior to the pandemic (62.2% and 62.5% in 2018 and 2019), but decreased slightly in 2020 after the state of emergency related to the COVID-19 pandemic was declared in Ontario (51.6%). Although deaths among employed construction workers decreased proportionally, the absolute number of opioid toxicity deaths in this group increased during the pandemic to 82 deaths in 2020 (from 69 deaths in 2018 and 60 deaths in 2019). Similar trends, with slight reductions in the prevalence of employment, were noted among those without a history of employment in construction.

**Figure 4: Age distribution** among individuals who died of an opioid toxicity in Ontario, by history of employment in the construction industry (2018-2020)



**NOTE**

\*Red asterisk indicates statistically significant difference between construction workers vs. those with no employment history in construction ( $p < 0.05$ ).

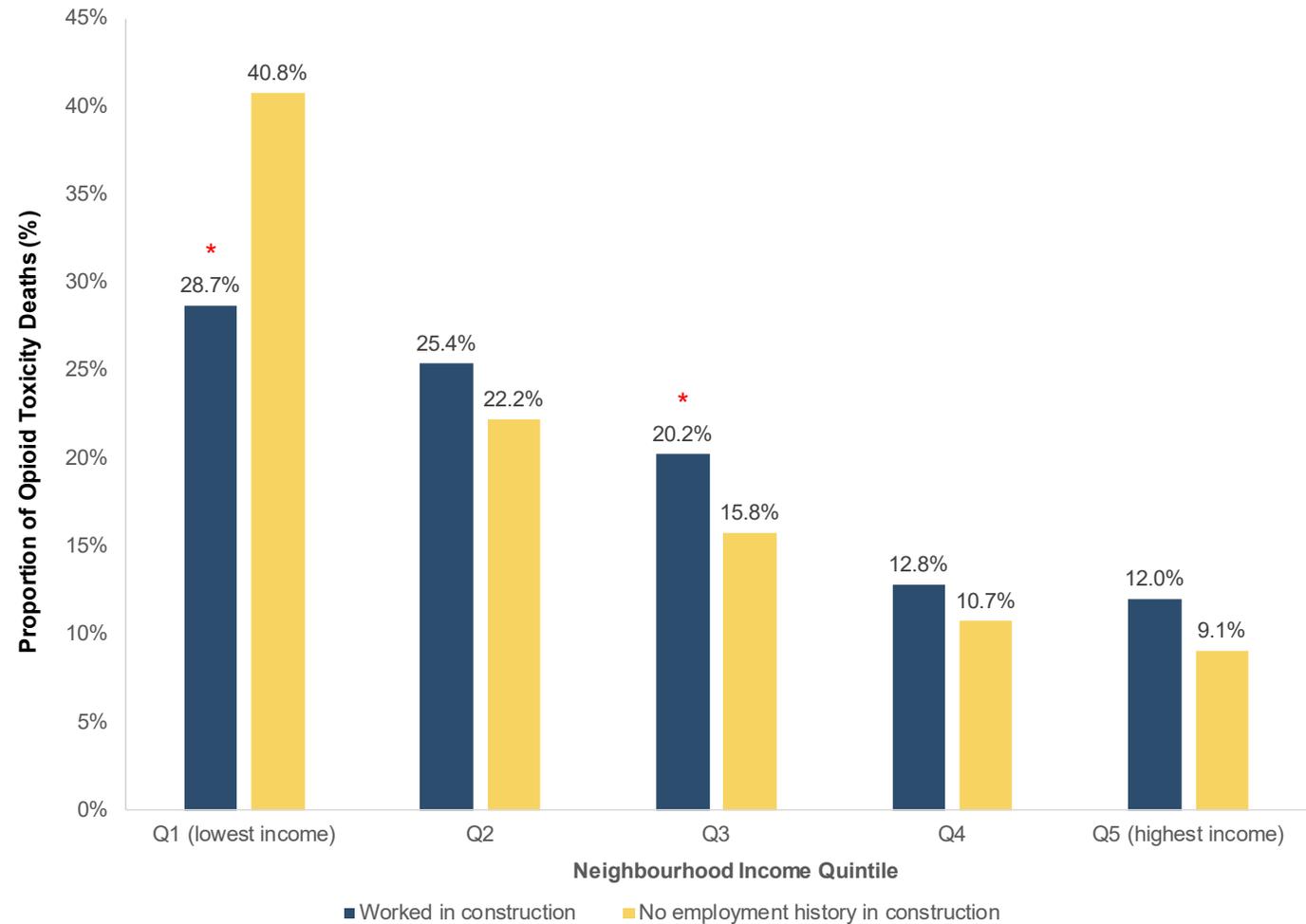
Opioid toxicity deaths were more concentrated among those aged 25 to 44 years, with almost two-thirds of deaths among people who worked in the construction industry falling in this age group (60.1%;  $N=220$  deaths) compared to just over half among those with no employment history in the construction industry (53.6%;  $p=0.02$ ). There were no significant differences across any other age groups, and the median age of death among construction workers (38 years,  $IQR=31$  to 48 years) was only slightly younger than among those with no employment history in the construction industry (40 years,  $IQR=31$  to 51 years;  $p=0.06$ ).

98.4%

of construction workers who died of an opioid toxicity were **male**

Although a higher proportion of opioid toxicity deaths occurred among males (vs. females) regardless of history of employment in the construction industry, these sex differences were more pronounced among people who worked in the construction industry. Specifically, over 98.4% of construction workers who died of an opioid toxicity were male, compared to 72.0% among those without a history of employment in the construction industry ( $p < 0.001$ ). This is consistent with the sex distribution of the construction industry workforce in Ontario.<sup>15</sup>

**Figure 5: Income distribution** among individuals who died of an opioid toxicity in Ontario, by history of employment in the construction industry (2018-2020)

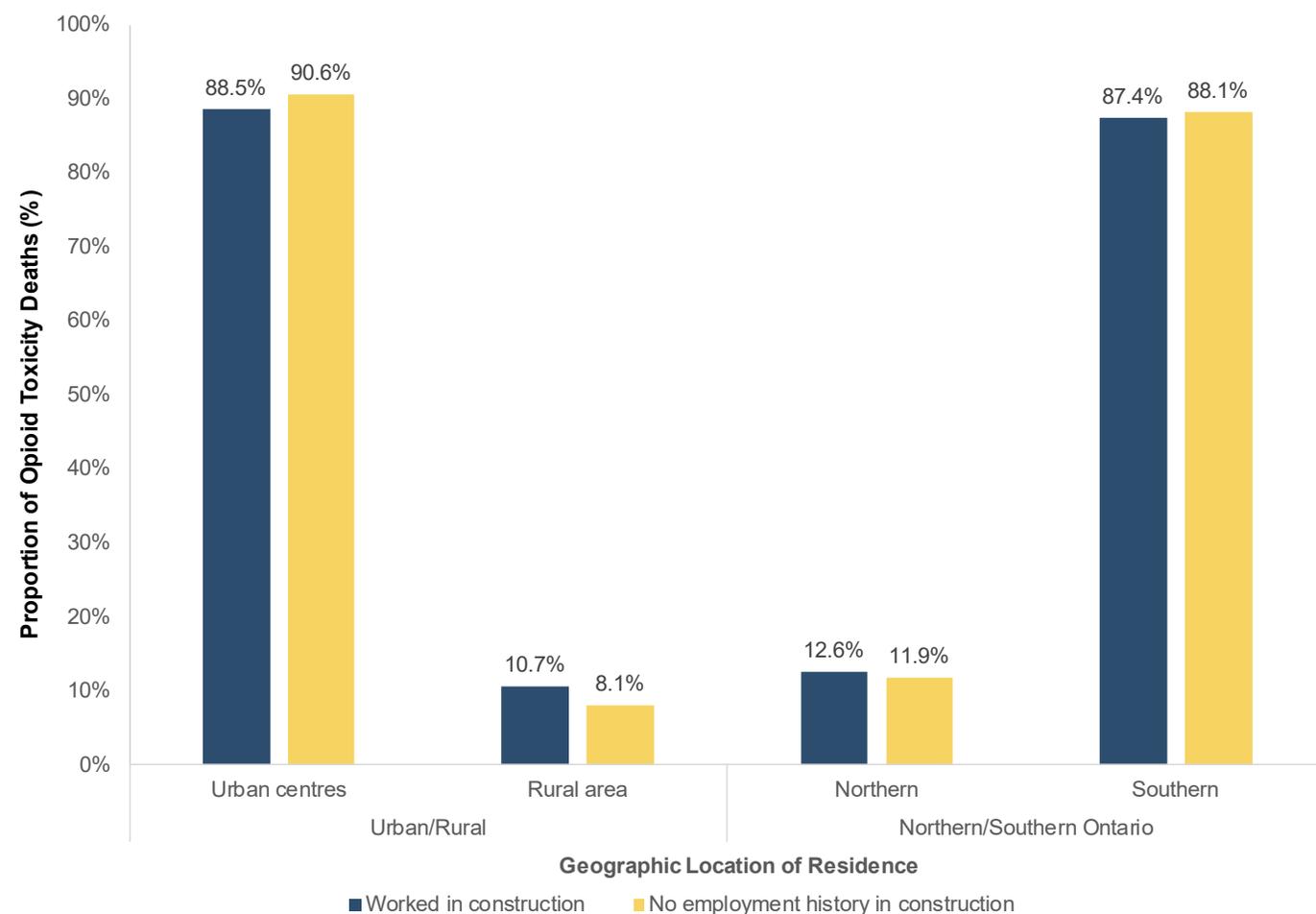


**NOTE**

\*Red asterisk indicates statistically significant difference between construction workers vs. those with no employment history in construction ( $p < 0.05$ ). 0.8% and 1.4% of data was missing on neighbourhood income quintile among construction workers and those with no employment history in construction, respectively.

Although there was a clustering of opioid toxicity deaths among people living in lower income neighborhoods in both groups, differences were less dramatic among people who worked in the construction industry compared to those without a history of employment in the construction industry. For example, the proportion of opioid toxicity deaths occurring among individuals residing in a neighbourhood in the lowest income quintile (Q1) was significantly lower among construction workers (28.7%, N=105 deaths) compared to those without a history of employment in the construction industry (40.8%;  $p < 0.001$ ). This could reflect the low prevalence of employment among the group of people without a history of work in the construction industry (see Figure 2).

**Figure 6: Geographic location of residence** among individuals who died of an opioid toxicity in Ontario, by history of employment in the construction industry (2018-2020)

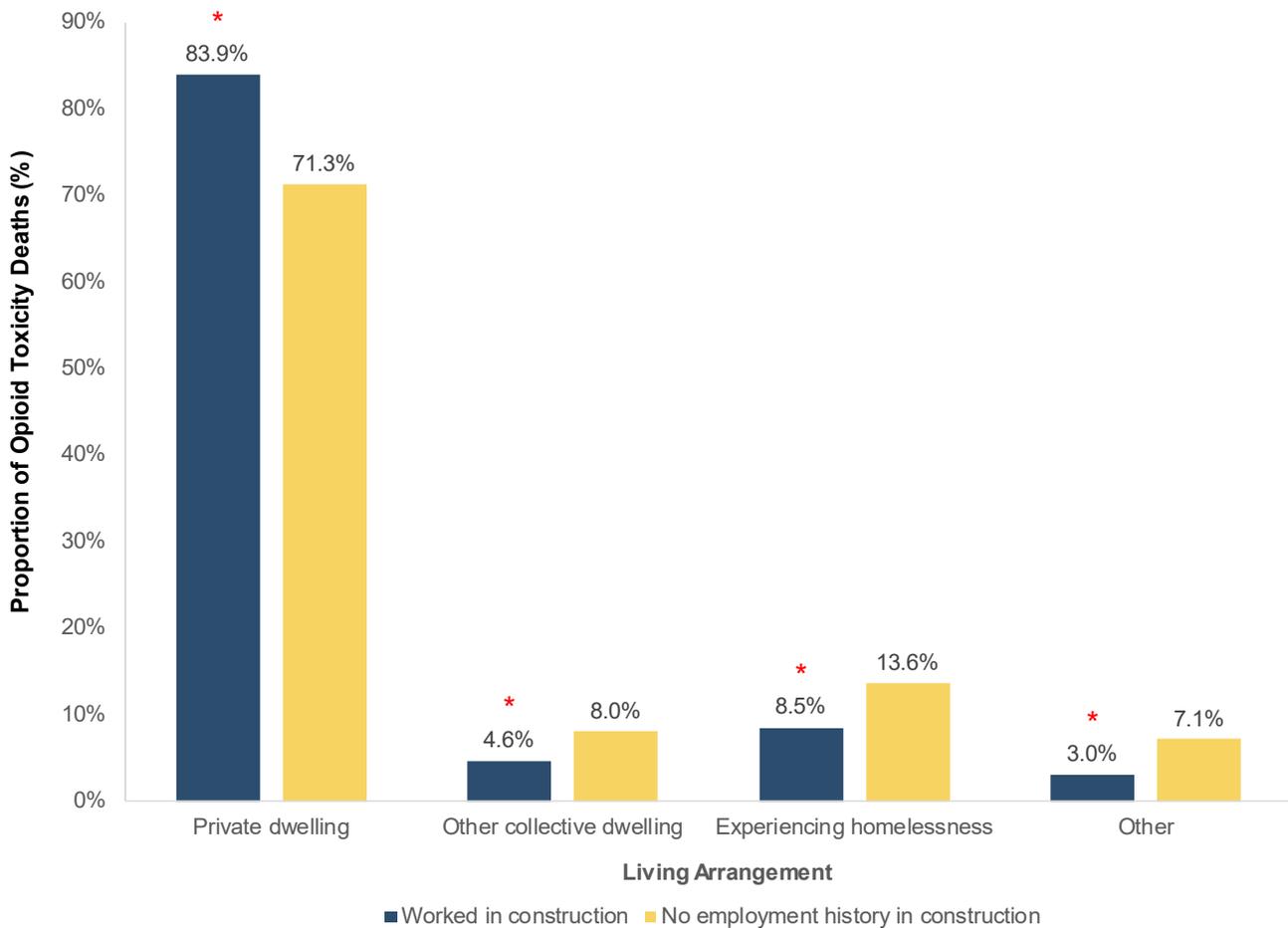


## NOTE

See [Appendix A](#) for definitions. 0.8% and 1.3% of data was missing on geographic location of residence among construction workers and those with no employment history in construction, respectively.

The majority of opioid toxicity deaths occurred among those living in urban centres and in Southern Ontario, and this did not differ on the basis of employment in the construction industry ( $p > 0.05$  for all comparisons). Specifically, approximately 90% of opioid toxicity deaths occurred among people living in urban centres (88.5%; N=324 deaths among construction workers) and/or in Southern Ontario (87.4%; N=320 deaths among construction workers). However, because we do not have data on the concentration of construction workers within different geographic regions in Ontario, we cannot determine whether the observed patterns would be sustained if the underlying population at risk was taken into account.

**Figure 7: Living arrangement** among individuals who died of an opioid toxicity in Ontario, by history of employment in the construction industry (2018-2020)



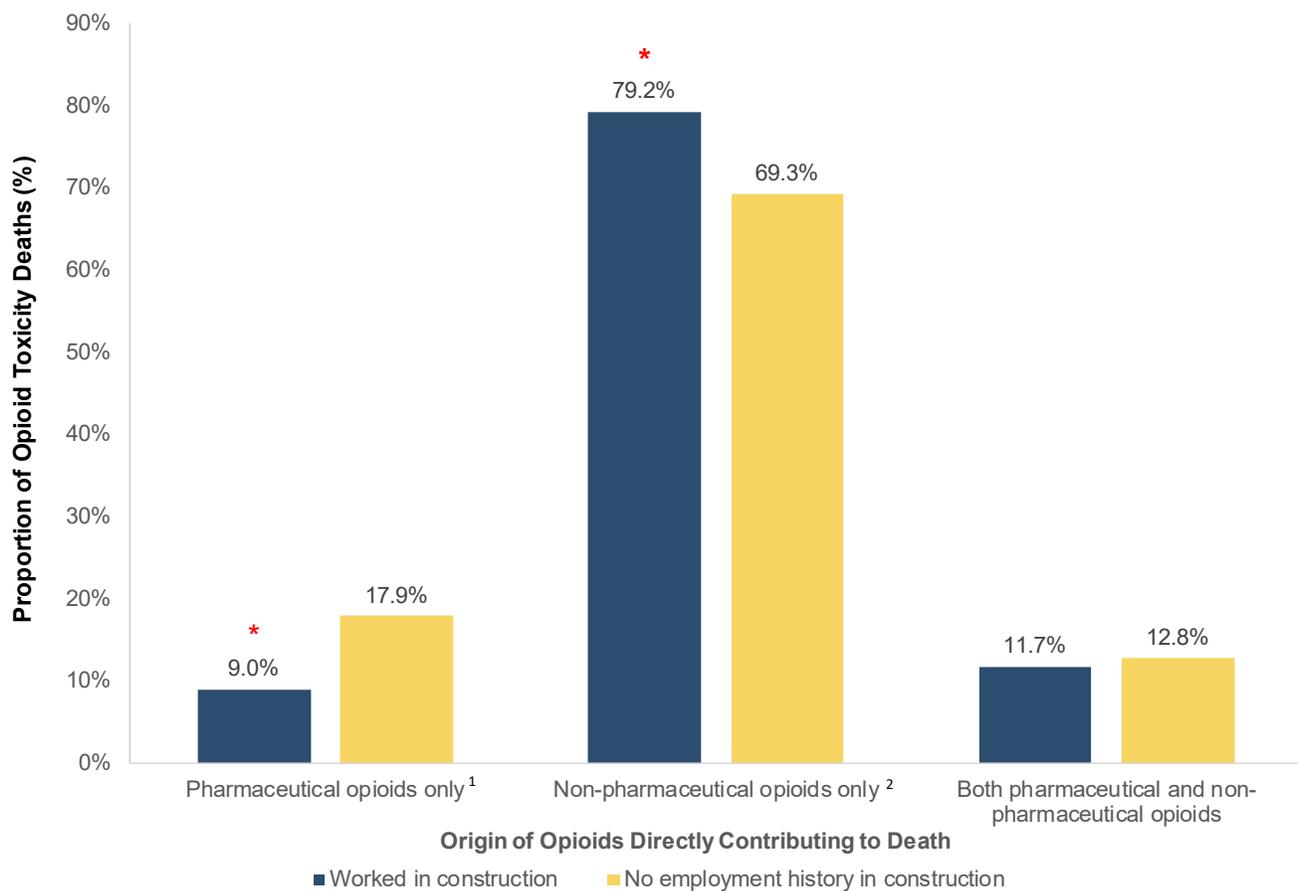
**NOTE**

\*Red asterisk indicates statistically significant difference between construction workers vs. those with no employment history in construction ( $p < 0.05$ ). See [Appendix A](#) for definitions.

Although general patterns in living arrangement were similar between people who worked in the construction industry and those without a history of employment in construction, a higher proportion of construction workers lived in a private dwelling at time of death (83.9%;  $N=307$ ) compared to those with no employment history in construction (71.3%;  $p < 0.001$ ). A lower proportion of construction workers were experiencing homelessness at time of death (8.5%;  $N=31$  vs. 13.6%;  $p=0.005$ ) or were living in a collective dwelling (4.6%;  $N=17$  vs. 8.0%;  $p=0.02$ ).

## Drug Involvement in Opioid Toxicity Deaths

**Figure 8:** Distribution of the **origin of opioid†** directly contributing to opioid toxicity deaths, by history of employment in the construction industry (2018-2020)



### NOTE

\* Red asterisk indicates statistically significant difference between construction workers vs. those with no employment history in construction ( $p < 0.05$ ).

† See [Appendix A](#) for definitions. Categories (i.e., pharmaceutical opioids only, non-pharmaceutical opioids only, and both pharmaceutical and non-pharmaceutical opioids only) are mutually exclusive.

#### Limitations:

1. Some deaths included in the pharmaceutical opioid category could include morphine which was metabolized from heroin if there was no detection of other heroin metabolites in toxicology (see Appendix A).
2. A small number of non-pharmaceutical opioid toxicity deaths could include prescription fentanyl.

Among construction workers, 79.2% (N=290) of opioid toxicity deaths involved solely non-pharmaceutical opioids as direct contributors to death\*, a proportion that was significantly higher compared to those with no history of employment in construction (69.3%,  $p < 0.001$ ). Consequently, opioid toxicity deaths where only pharmaceutical opioids directly contributed to death were relatively rare among people who worked in the construction industry (9.0%, N=33), and significantly lower than among those without a history of employment in construction (17.9%,  $p < 0.001$ ).

\***Note:** A [recent report](#) among the entire Ontario population found that fentanyl and fentanyl analogues accounted for over 99% of deaths where non-pharmaceutical opioids were a direct contributor to death during the study period.

**Table 1: Specific types of opioids** directly contributing to an opioid toxicity death in Ontario, by history of employment in the construction industry (2018-2020)†

	Worked in construction N=366	No employment history in construction N=4,394	Stat. Sig.
<b>Non-pharmaceutical opioids</b>	333 (91.0%)	3,606 (82.1%)	*
Fentanyl and fentanyl analogues	330 (90.2%)	3,580 (81.5%)	*
Heroin	19 (5.2%)	173 (3.9%)	
<b>Opioids indicated for pain</b>	41 (11.2%)	863 (19.6%)	*
Hydromorphone	17 (4.6%)	334 (7.6%)	*
Oxycodone	15 (4.1%)	284 (6.5%)	
Other	13 (3.6%)	362 (8.2%)	*
<b>Opioid agonist treatment‡</b>	36 (9.8%)	550 (12.5%)	
<b>Unknown§</b>	1 (0.3%)	6 (0.1%)	

## NOTE

\* Stat. Sig. = statistical significance between construction workers vs. those with no employment history in construction, where the presence of a red asterisk indicates  $p < 0.05$ .

† Not mutually exclusive. Some deaths were attributed to multi-drug toxicity where more than one substance can contribute to an individual death.

‡ Most deaths were attributed to methadone.

§ The type of opioid was missing for the one individual included under "unknown" in the construction industry.

Non-pharmaceutical opioids (predominantly fentanyl) directly contributed to over 90% of opioid toxicity deaths among people who worked in the construction industry (91.0%), which was slightly higher than what was observed among those without a history of employment in the construction industry over this same period (82.1%;  $p < 0.001$ ). In general, the contribution of non-pharmaceutical opioids to opioid toxicity death was stable between 2018 and 2020 among construction workers (88.3% in 2018 vs. 91.2% in 2020; data not shown), whereas it grew among those with no employment history in construction (from 73.6% to 88.5% from 2018-2020).

In contrast, the proportion of opioid toxicity deaths where opioids indicated for pain directly contributed to death was lower among construction workers compared to those with no employment history in construction (11.2% vs. 19.6%;  $p < 0.001$ ). The attribution of opioid agonist treatment (i.e., methadone or buprenorphine) to the cause of death was fairly uncommon, and did not differ significantly between construction workers (9.8%) and those with no employment history in construction (12.5%;  $p = 0.13$ ).

Only one opioid directly contributed to the majority of opioid toxicity deaths among construction workers (84.2%,  $N = 308$ ) and those not working in the construction industry (81.4%), and this did not differ significantly between groups (data not shown).

**Table 2: Other non-opioid substances directly contributing to an opioid toxicity death in Ontario, by history of employment in the construction industry (2018-2020)†**

	Worked in construction N=366	No employment history in construction N=4,394	Stat. Sig.
<b>Benzodiazepines</b>	30 (8.2%)	426 (9.7%)	
Pharmaceutical benzodiazepines	13 (3.6%)	288 (6.6%)	*
Non-pharmaceutical benzodiazepines	17 (4.6%)	138 (3.1%)	
<b>Stimulants</b>	206 (56.3%)	2,352 (53.5%)	
Non-pharmaceutical stimulants‡	205 (56.0%)	2,330 (53.0%)	
Methamphetamines	64 (17.5%)	1,036 (23.6%)	*
Cocaine	164 (44.8%)	1,695 (38.6%)	*
<b>Alcohol</b>	64 (17.5%)	568 (12.9%)	*

## NOTE

\* Stat. Sig. = statistical significance between construction workers vs. those with no employment history in construction, where the presence of a red asterisk indicates  $p < 0.05$ .

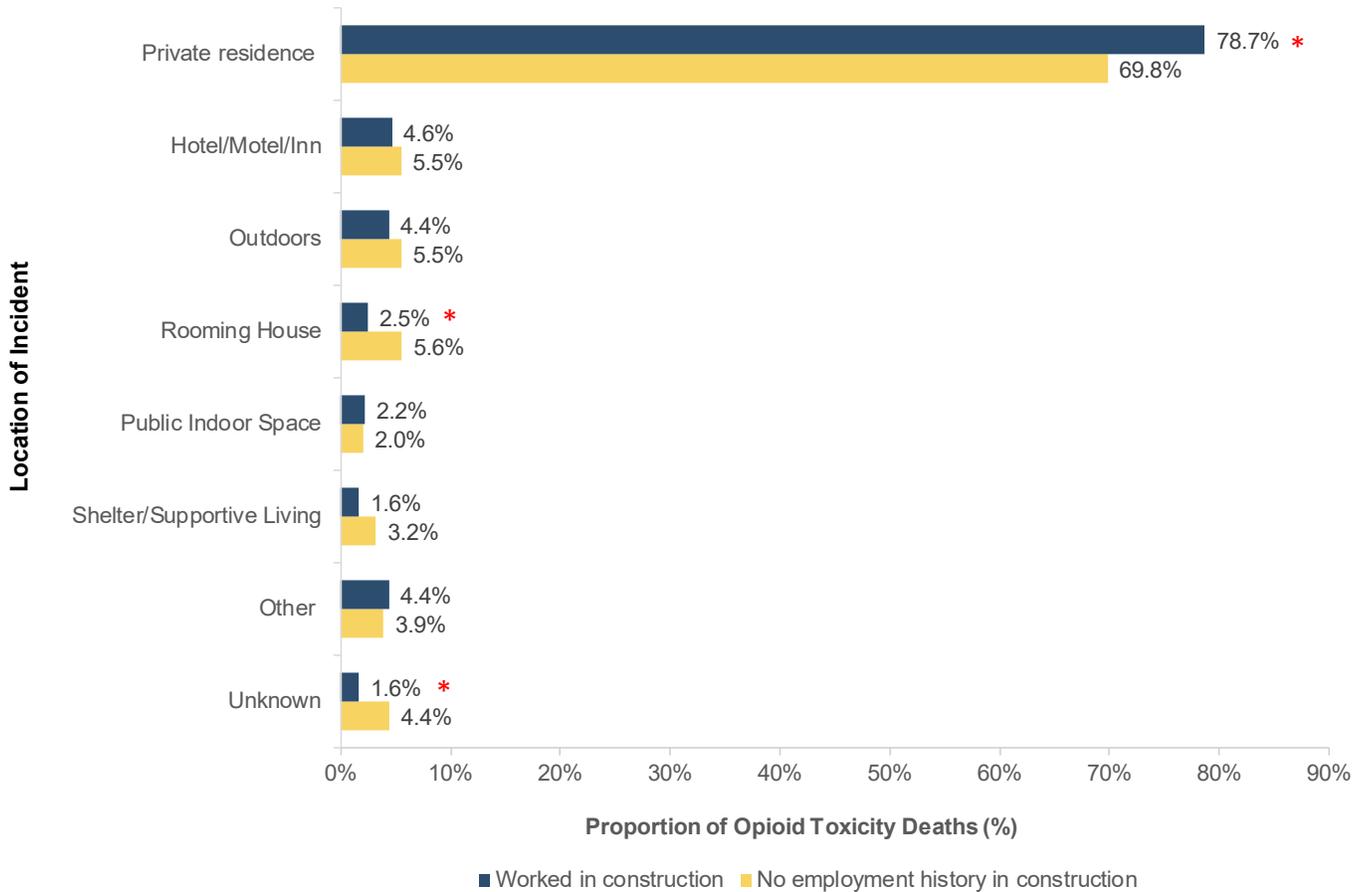
† Not mutually exclusive. Some deaths were attributed to multi-drug toxicity where more than one substance can contribute to an individual death.

‡ Includes Methamphetamines, Cocaine, Methylenedioxyamphetamine (MDA) and Methylenedioxymethamphetamine (MDMA).

Benzodiazepines contributed to approximately 1 in 12 (8.2%) opioid toxicity deaths among construction workers, with significantly lower prevalence of pharmaceutical benzodiazepines in this population (3.6%) compared to those with no employment history in construction (6.6%,  $p=0.02$ ). Interestingly, although there was a similar prevalence of stimulant involvement in opioid toxicity deaths among construction workers and those with no employment history in construction (56.3% vs 53.5%, respectively), the types of stimulants directly contributing to death differed between groups. Specifically, cocaine directly contributed to a significantly higher proportion (44.8%) of opioid toxicity deaths among construction workers compared to those with no employment history in construction (38.6%;  $p=0.02$ ), whereas methamphetamines were less commonly found to have directly contributed to deaths among construction workers (17.5% vs 23.6%;  $p=0.008$ ). Finally, alcohol was more commonly a direct contributor to opioid toxicity deaths among construction workers (17.5%) compared to those with no employment history in construction (12.9%;  $p=0.01$ ).

## Circumstances Surrounding Death

**Figure 9: Location of incident** among individuals who died of an opioid toxicity in Ontario, by history of employment in the construction industry (2018-2020)



### NOTE

\*Red asterisk indicates statistically significant difference between construction workers vs. those with no employment history in construction ( $p < 0.05$ ).

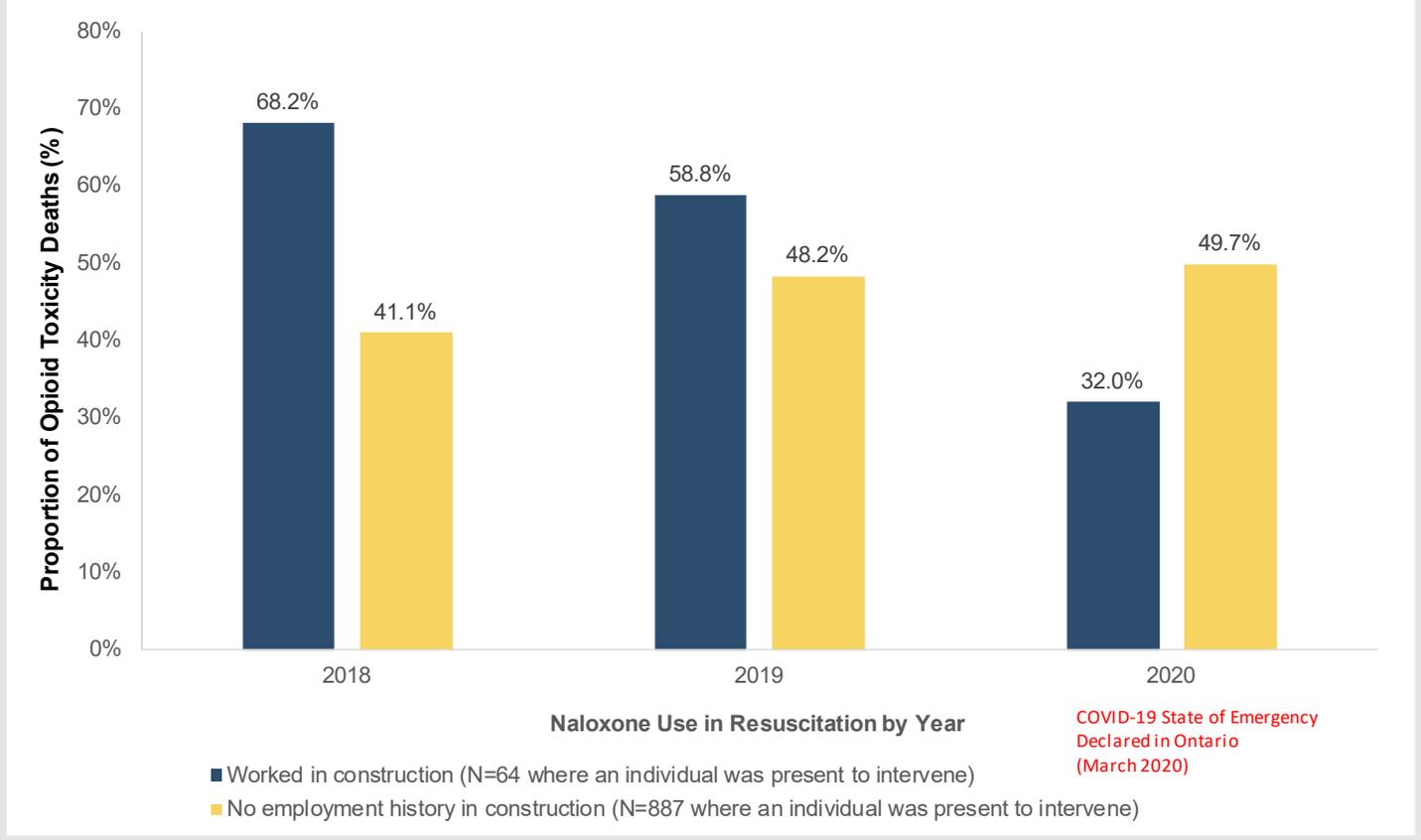
Almost 80% (N=288) of opioid toxicity deaths among construction workers occurred in a private residence, with 72.1% (N=264) occurring at the decedent's home address specifically. Among construction workers, very few opioid toxicity deaths occurred on a construction site (N<6; <1.6%), in a hotel/motel designated as a shelter (N<6; <1.6%), or in a hotel/motel used for work purposes (N=7; 1.9%).

When compared to those with no employment history in construction, a higher percentage of opioid toxicity deaths among construction workers occurred in a private residence (78.7% vs. 69.8%;  $p < 0.001$ ); however, there was no significant difference in the overall proportion of deaths that occurred at the decedent's home (72.1% vs. 68.8%,  $p = 0.19$ ).


 There was an **individual present who could intervene** in only **17.5%** of deaths among construction workers

Among deaths where an individual was present to intervene,
 
**naloxone** was administered only
 
 of the time

**Figure 10: Naloxone administration where an individual was present to intervene** in opioid toxicity deaths in Ontario, by year and history of employment in the construction industry (2018-2020)

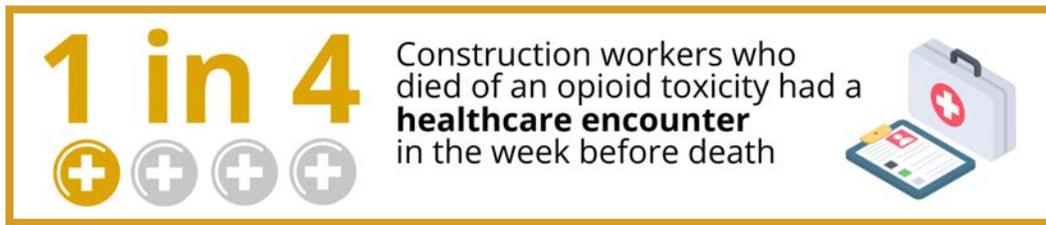


In only 17.5% (N=64) of deaths among construction workers, there was an individual present at the time of overdose who could intervene, although this was similar to those with no employment history in construction (20.2%; p=0.21).

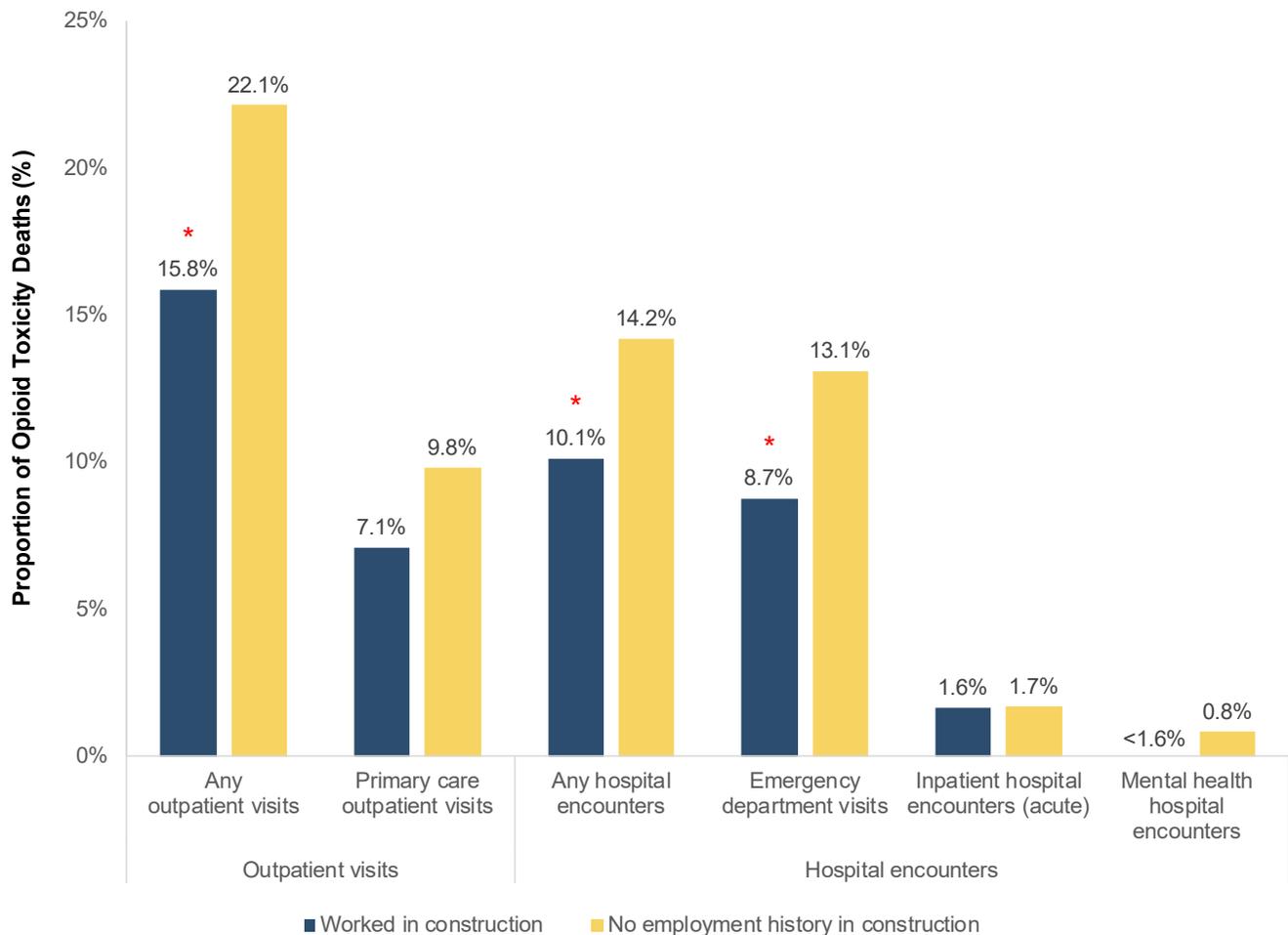
Naloxone administration where an individual was present to intervene (N=33 of 64; 51.6%) decreased over time among people who worked in the construction industry and increased slightly among those without a history of employment in construction. Compared to the year prior, naloxone administration decreased in the year when the COVID-19 State of Emergency was declared among those who worked in construction (from 58.8% [N=10 of 17] to 32.0% [N=8 of 25]), but remained stable among those with no employment history in construction (48.2% vs. 49.7%).

Note: Only individuals who died of an opioid toxicity were included; therefore, we cannot infer the extent to which broader naloxone provision in this population is reversing overdoses.

## Recent Interactions with the Healthcare System



**Figure 11: Recent healthcare encounters** in the seven days prior to opioid toxicity death in Ontario, by history of employment in the construction industry (2018-2020)



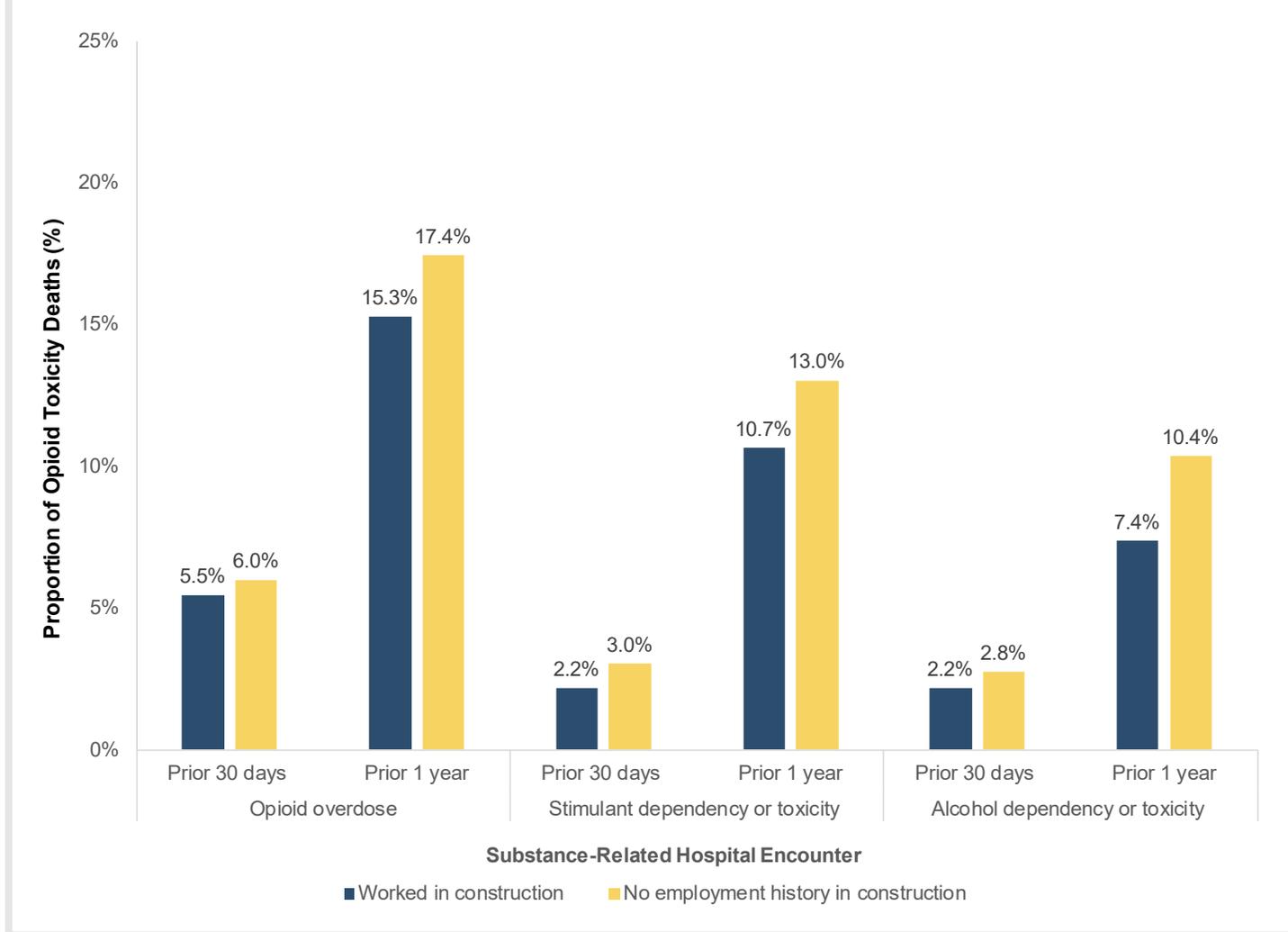
### NOTE

\*Red asterisk indicates statistically significant difference between construction workers vs. those with no employment history in construction ( $p < 0.05$ ).

“Any hospital encounters” specifically includes ED visits, inpatient hospitalizations (acute), mental health hospitalizations and opioid overdoses treated in hospital.

Nearly 1 in 4 construction workers who died of an opioid toxicity had a healthcare encounter in the week before death (24.3%;  $N=89$ ); which was lower than what was observed among those with no history of employment in construction (31.2%;  $p=0.006$ ). These patterns held across most types of healthcare encounters, with a lower percentage of construction workers having outpatient visits (15.8% vs. 22.1%;  $p=0.005$ ) or hospital encounters (10.1% vs. 14.2%;  $p=0.03$ ) in the week before death. Overall, 1 in 10 ( $N=37$ ) construction workers experienced a hospital encounter in the week prior to opioid toxicity death, most of which were emergency department (ED) visits ( $N=32$ ).

**Figure 12: Substance-related hospital encounters** among individuals who died of an opioid toxicity in Ontario, by history of employment in the construction industry (2018-2020)



In general, substance-related hospital encounters were slightly less common among construction workers compared to those with no history of employment in construction, although none of the comparisons were statistically significant ( $p \geq 0.05$ ).

In the year prior to death, 1 in 7 construction workers were hospitalized for an opioid toxicity event (15.3%; N=56), 1 in 9 were hospitalized for stimulant dependency or toxicity (10.7%; N=39), and 1 in 14 were hospitalized for an alcohol dependency or toxicity (7.4%; N=27).

## Clinical Characteristics

**Table 3: Injuries and pain diagnoses** among individuals who died of an opioid toxicity in Ontario, by employment history in the construction industry (2018-2020)

	Worked in construction N=366	No employment history in construction N=4,394	Stat. Sig.
<b>Any pain diagnoses or injury</b>	285 (77.9%)	3,585 (81.6%)	
Major traumatic injury in prior 10 years	20 (5.5%)	156 (3.6%)	
Traumatic brain injury in prior 10 years	36 (9.8%)	363 (8.3%)	
Low back pain in prior 5 years	176 (48.1%)	2,155 (49.0%)	
Fractures, dislocations, strains or sprains in prior 5 years	209 (57.1%)	2,634 (59.9%)	
Arthritis and related conditions† in prior 5 years	147 (40.2%)	1,865 (42.4%)	
Bone and spinal conditions in prior 5 years	112 (30.6%)	1,641 (37.3%)	*
Unspecified musculoskeletal disorders or congenital abnormalities in prior 5 years	147 (40.2%)	2,153 (49.0%)	*
<b>Industrial and construction area as the place of occurrence of the external cause of injury resulting in hospitalization</b>			
5 years prior to death	19 (5.2%)	75 (1.7%)‡	*
10 years prior to death	33 (9.0%)	184 (4.2%)‡	*

### NOTE

\* Stat. Sig. = statistical significance between construction workers vs. those with no employment history in construction, where the presence of a red asterisk indicates  $p < 0.05$ .

† Includes inflammatory arthritis, soft disorders, joint derangement, unspecified arthritis.

‡ Some of the hospitalizations for industrial and construction-related injuries which occurred among those with no employment history in construction may be a result of other industrial or non-work-related accidents, or may reflect misclassification of employment history, particularly among those who worked in the construction industry many years prior to death.

A history of injury or pain diagnosis was similarly prevalent among construction workers who died of an opioid toxicity (77.9%) and those without a history of employment in construction (81.6%;  $p=0.06$ ). The most common pain conditions identified among both construction workers and those with no employment history in construction were fractures, dislocations, strains, or sprains (57.1% and 59.9%, respectively) and low back pain (48.1% and 49.0%, respectively), and these did not differ considerably between groups. However, a slightly higher proportion of construction workers had a major traumatic injury (5.5% vs. 3.6%) or traumatic brain injury (9.8% vs. 8.3%) in the prior 10 years, and a lower proportion had diagnoses of bone and spinal conditions (30.6% vs. 37.3%) or other musculoskeletal or congenital abnormalities (40.2% vs. 49.0%) in the prior 5 years.

In the ten years prior to death, about 1 in 11 (9.0%;  $N=33$ ) construction workers were hospitalized for an injury that took place at an industrial or construction area, compared to only 4.2% of those without a history of employment in construction ( $p < 0.001$ ).

**Table 4: Pain diagnoses and opioid use disorder** among those who died of an opioid toxicity in Ontario, by employment history in the construction industry (2018-2020)

	Worked in construction N=366	No employment history in construction N=4,394	Stat. Sig.
History of chronic pain†	136 (37.2%)	1,667 (37.9%)	
Indication of opioid use disorder‡ in prior 5 years (opioid agonist treatment or other opioid-related diagnosis)	221 (60.4%)	2,858 (65.0%)	
History of chronic pain and indication of opioid use disorder in prior 5 years	94 (25.7%)	1,164 (26.5%)	

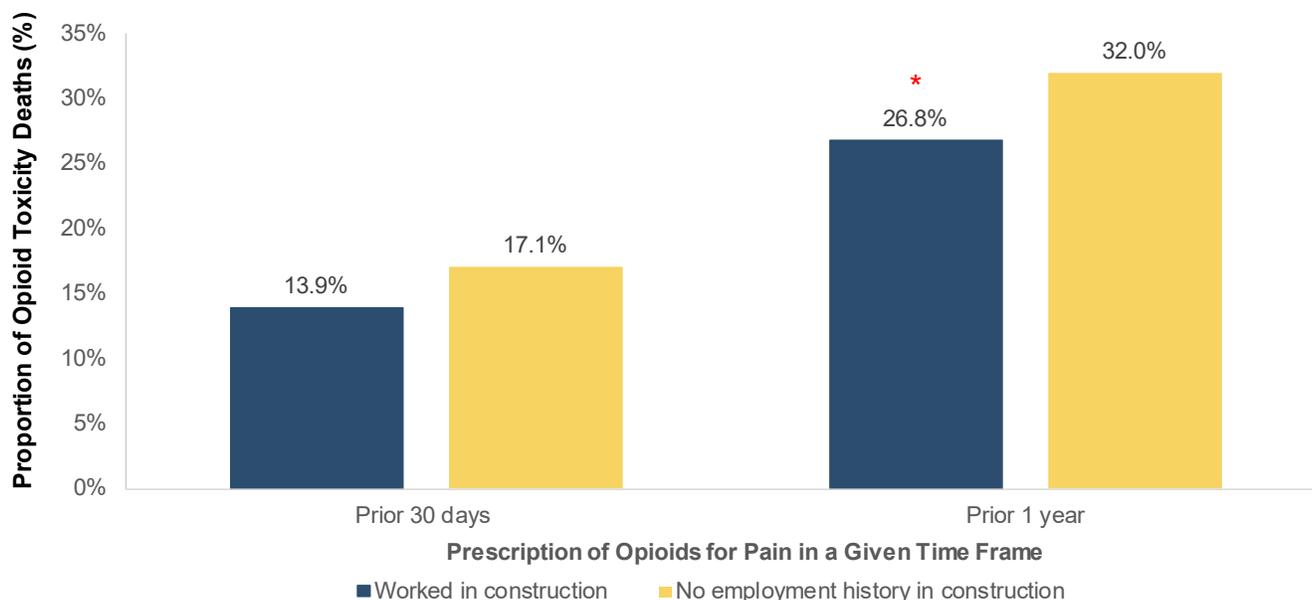
**NOTE**

† Includes any of the following: Prior contact with a pain physician in the past year, major traumatic injury in past 10 years, ≥10 claims for a nerve block injection in the past year, receipt of ≥90 days of opioids for pain in the past 100 days, or identified as having chronic pain through coroner's investigation.

‡ Includes OAT or other opioid-related diagnosis.

Over 1 in 3 (37.2%; N=136) construction workers who died of an opioid toxicity had a history of chronic pain, and nearly two-thirds (60.4%; N=221) had an indication of an opioid use disorder in the five years prior to death. One in four (25.7%; N=94) construction workers had a history of both chronic pain and an opioid use disorder. These findings were generally similar between people who worked in construction and those without a history of employment in construction ( $p \geq 0.05$  for all comparisons).

**Figure 13: Recent receipt of a prescription opioid for pain** among individuals who died of an opioid toxicity in Ontario, by history of employment in the construction industry (2018-2020)

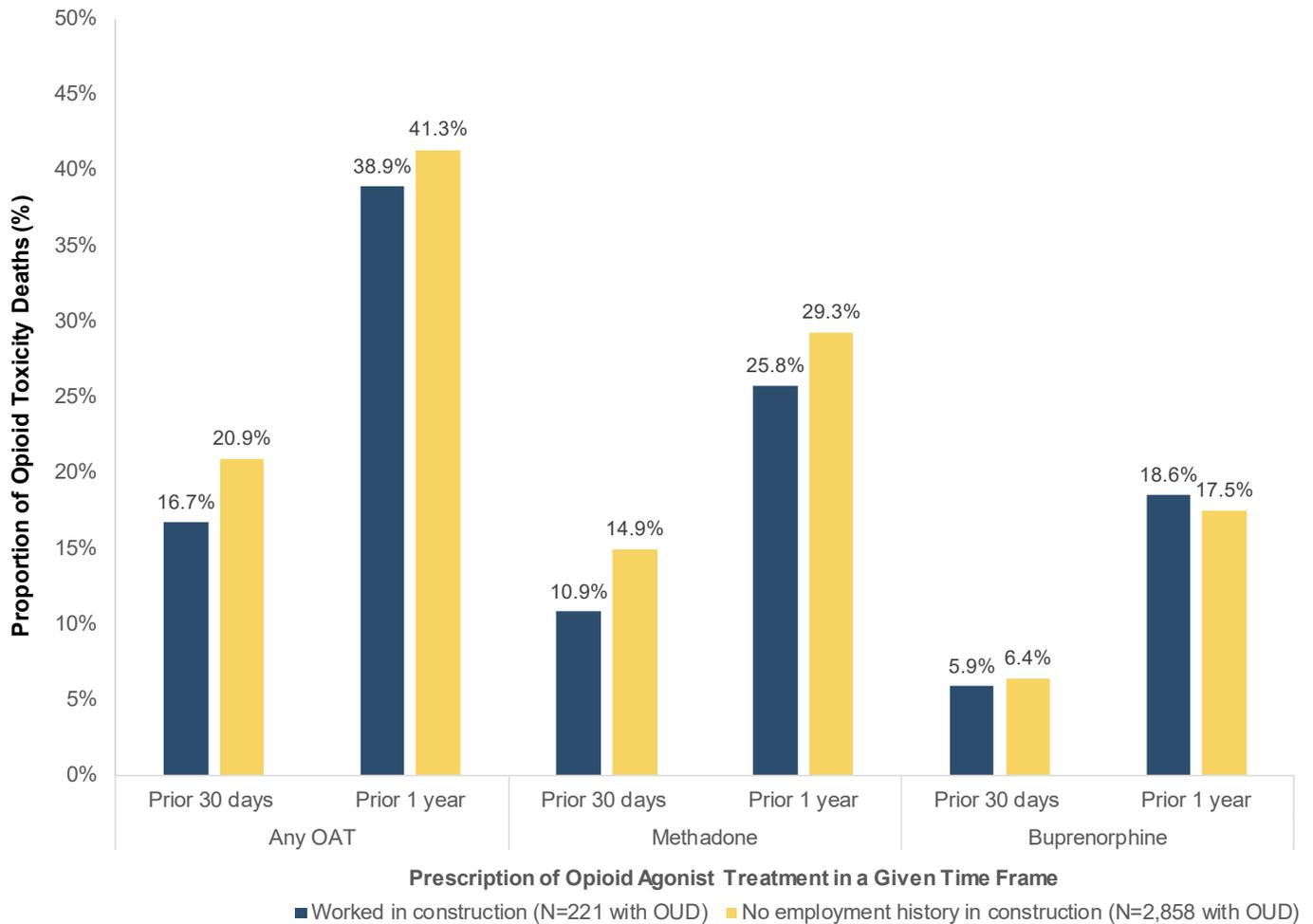


**NOTE**

\*Red asterisk indicates statistically significant difference between construction workers vs. those with no employment history in construction ( $p < 0.05$ ).

The prevalence of having recently received a prescription opioid for pain was generally lower among people employed in the construction industry compared to those without a history of employment in construction. In the 1 year prior to death, approximately 1 in 4 construction workers received an opioid for pain (26.8%) compared to nearly 1 in 3 among those without a history of employment in construction (32.0%;  $p = 0.04$ ).

**Figure 14: Recent receipt of a prescription for opioid agonist treatment (OAT) among those with an opioid use disorder (OUD) who died of an opioid toxicity in Ontario, by employment history in the construction industry**

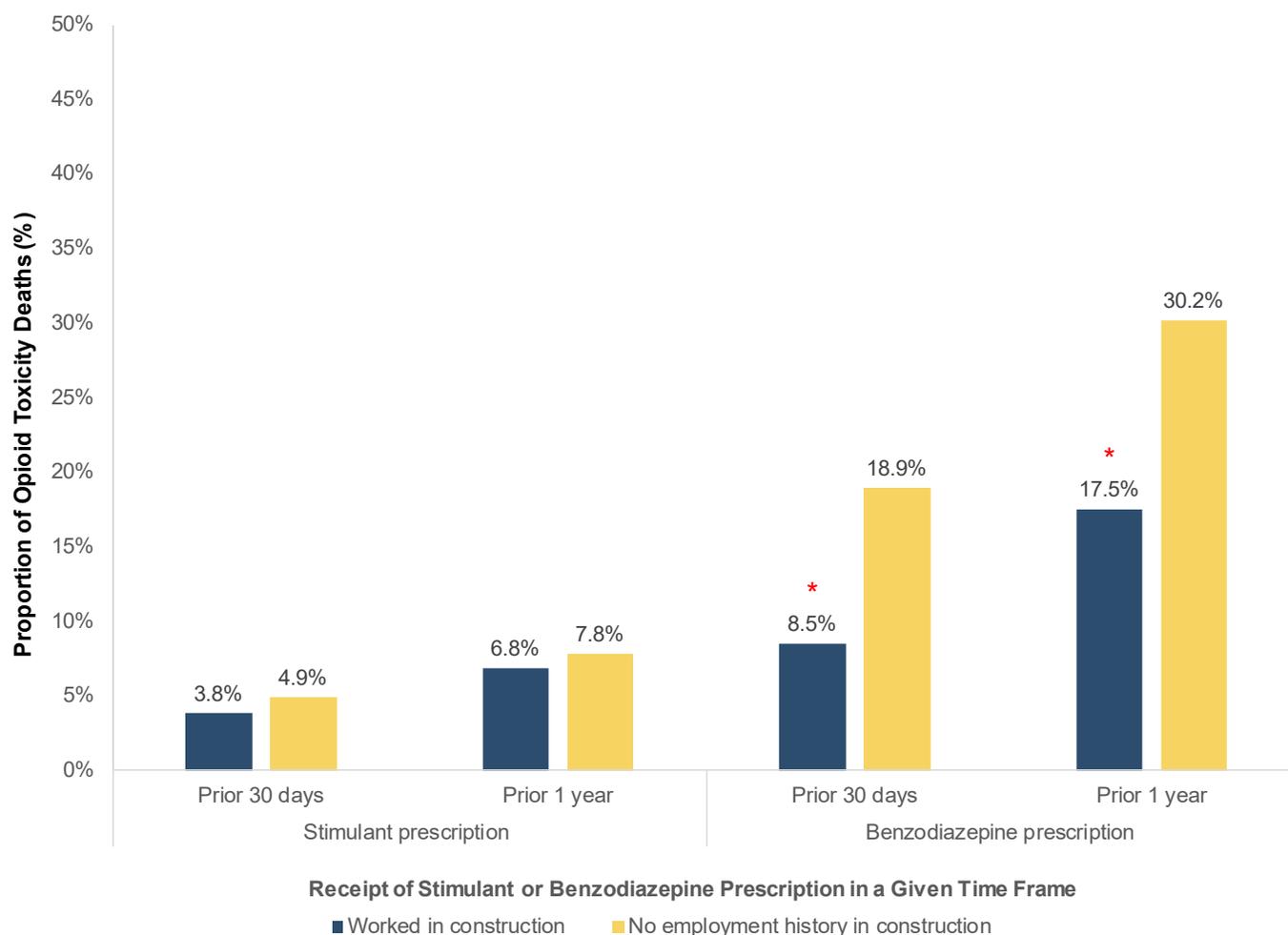


**NOTE**

Buprenorphine includes buprenorphine/naloxone, Sublocade, and Probuphine.

Among the 221 construction workers with an OUD diagnosis in the previous 5 years, only 1 in 6 (16.7%; N=37) were dispensed any form of opioid agonist treatment (OAT) in the month prior to death, and 38.9% (N=86) received OAT in the one year prior to death. Although comparisons were not statistically significant, in general, prior receipt of OAT was lower among construction workers compared to those with no employment history in construction. When stratified by type of treatment, methadone was more common than buprenorphine/naloxone among both construction workers and those never employed in the construction industry. However, in the year prior to death, buprenorphine/naloxone use was more common among construction workers (18.6%) compared to people never employed in the construction industry (17.5%). This may reflect a slight preference for buprenorphine/naloxone among employed individuals due to the more rapid provision of take-home doses for this treatment compared to methadone (which often requires daily pharmacy visits for observed dosing).

**Figure 15: Recent receipt of a stimulant or benzodiazepine prescription among individuals who died of an opioid toxicity in Ontario, by history of employment in the construction industry (2018-2020)**



## NOTE

\*Red asterisk indicates statistically significant difference between construction workers vs. those with no employment history in construction ( $p < 0.05$ ).

Overall, stimulant prescribing in the month and year prior to death was relatively uncommon and did not differ significantly between construction workers and those without a history of employment in construction (prior 30 days: 3.8% [N=14] vs. 4.9%,  $p=0.37$ ). However, benzodiazepine prescribing was much less common among construction workers, with 17.5% (N=64) receiving a benzodiazepine prescription in the one year prior to death, compared to 30.2% among those without a history of employment in construction ( $p < 0.001$ ).

**Table 5: Healthcare encounters for mental health-related diagnosis** among those who died of an opioid toxicity in Ontario, by employment history in the construction industry (2018-2020)

	Worked in construction N=366	No employment history in construction N=4,394	Stat. Sig.
<b>Healthcare encounter for mental health-related diagnosis in prior 5 years</b>	299 (81.7%)	3,830 (87.2%)	*
Emergency department visit or hospitalization	176 (48.1%)	2,447 (55.7%)	*
Community Health Centre visit	21 (5.7%)	436 (9.9%)	*
Other outpatient visit	279 (76.2%)	3,648 (83.0%)	*
Psychotic disorders	26 (7.1%)	605 (13.8%)	*
Mood and anxiety disorders	209 (57.1%)	2,913 (66.3%)	*
Substance use disorders	196 (53.6%)	2,625 (59.7%)	*
Non-psychotic disorders	48 (13.1%)	727 (16.5%)	
Other	32 (8.7%)	433 (9.9%)	

## NOTE

\*Stat. Sig. = statistical significance between construction workers vs. those with no employment history in construction, where the presence of a red asterisk indicates  $p < 0.05$ .

Over 80% (81.7%; N=299) of people who worked in the construction industry had a healthcare encounter for a mental health-related diagnosis in the five years prior to death, and almost half (48.1%; N=176) had a hospital encounter specifically (emergency department or inpatient admission). Although mental health-related encounters were common among construction workers who died of an opioid toxicity, they were significantly less frequent compared to those without a history of employment in construction. We are unable to determine whether these patterns are influenced by a lower prevalence of mental health diagnoses among construction workers, or less help-seeking behaviour.

# Limitations

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1. 76.7% of employment industry data was missing among individuals who died of an opioid toxicity from July 2017 to December 2020. Industry of employment was missing among 14.4% of employed individuals, 56.9% of retired individuals, 83.6% of unemployed individuals, and 97.4% of individuals with unknown employment. Thus, the numbers reported here are likely to be underestimates of the true prevalence of opioid toxicity deaths among construction workers. For example, those in more precarious positions (e.g., temporarily or seasonally employed) may be less likely to be included in this analysis as it may be more difficult to ascertain their employment information. Further, employment information relies on reporting by friends and family of the decedent, which may not always be accurate or complete. Related to this, it is also possible that there could have been some misclassification of people with or without a history of employment in the construction industry. Therefore, this limitation should be considered when interpreting these findings.
2. The Office of the Chief Coroner/Ontario Forensic Pathology Service OCC/OFPS has not concluded all investigations for opioid toxicity deaths that occurred during the pandemic period. Therefore, we restricted our analysis to confirmed opioid toxicity deaths to ensure complete information; however, this means that some deaths later determined to be opioid-related are not included in this analysis. In total, 10 deaths among construction workers were not accidental, and were therefore excluded.
3. Data related to prescribing is based on records of prescriptions dispensed from pharmacies. We are unable to determine whether people who were dispensed medications took the medication as prescribed.
4. Opioid use disorder is not well defined in administrative health data, and therefore we relied on prior receipt of opioid agonist treatment or healthcare encounters related to opioid use disorders in the previous 5 years to define a population with a high likelihood of having a diagnosed opioid use disorder. However, it is likely that we are not capturing all people with opioid use disorder with this definition and therefore may be underestimating its prevalence in this analysis.
5. Some misclassifications of the origin of the opioid may have occurred for some cases. For example, some deaths with morphine as a direct contributor could be caused by heroin, which is metabolized to morphine. 6-Monoacetylmorphine (6-MAM), a metabolite of heroin, is rapidly cleared from the body such that its absence does not allow complete determination of whether morphine was the substance consumed or if the morphine detected was a metabolite of heroin. Heroin-related deaths may therefore be underreported. Morphine can also be a metabolite of codeine, more typically occurring at higher concentrations of codeine. Although we have attempted to address this in our methods (i.e., by removing morphine as a direct contributor if other metabolites of heroin (i.e. 6-MAM) are found in post-mortem toxicology), there remains the possibility of some misclassification. Similarly, we classified all deaths with fentanyl as a direct contributor as non-pharmaceutical opioid toxicity deaths. Although it is possible that prescription fentanyl could be involved in these deaths, this is anticipated to be very rare, with only ~1% of fentanyl-related deaths having evidence of a fentanyl patch or fentanyl prescription at the scene of the incident.<sup>17</sup>

# Discussion

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Between 2018 and 2020, at least 366 Ontarians with employment history in the construction industry died of an opioid toxicity, accounting for nearly 1 in 13 opioid toxicity deaths during that time. Furthermore, trends in opioid-related deaths in this population have mirrored those observed more broadly across Ontario, with a 66% increase in the number of deaths from opioid toxicity between 2019 and 2020 alone. Unregulated opioids (91.0%, mainly fentanyl) and unregulated stimulants (56.0%; cocaine and methamphetamines) directly contributed to the majority of opioid toxicity deaths among individuals with and without employment history in construction. Fentanyl and cocaine involvement were significantly higher among those with employment history in construction compared to those without, while the involvement of methamphetamines and pharmaceutical opioids was significantly lower. Alcohol also directly contributed to 1 in 5 opioid toxicity deaths among construction workers, which was significantly more common compared to those without a history of employment in construction. Pain was also highly prevalent among construction workers who died of opioid toxicity – almost 80% experienced a pain-related condition or injury in the five years prior to opioid toxicity death, which was similar to those with no employment history in construction. Importantly, more opioid toxicity deaths among construction workers occurred in private residences and in the absence of someone who could intervene. Furthermore, among cases where an individual was present to intervene, naloxone administration decreased slightly over time among those who died of an opioid toxicity and had worked in the construction industry, despite increasing among those with no employment history in construction. Diagnosis and treatment for an OUD was slightly lower among construction workers who died of an opioid toxicity compared to those with no employment history in construction, although this difference was not statistically significant.

This report suggests that use of drugs from the unregulated supply and polysubstance use among those who died of an opioid toxicity is more common among construction workers compared to those with no employment history in construction. In particular, fentanyl (90.2%), cocaine (44.8%), and alcohol (17.5%) directly contributed to a larger proportion of opioid toxicity deaths among construction workers. These findings align with previous studies, which found that construction workers had elevated mortality rates related to alcohol and opioid use<sup>18</sup> as well as higher cocaine and non-prescription opioid use<sup>19</sup> compared to other occupations. In addition to known health and social factors that have been associated with substance use and related harm, injury and illness, job insecurity, and non-standard working arrangements may further contribute to substance and alcohol use among construction workers.<sup>19,20</sup> For example, the negative impact of injuries on job security within the construction industry can lead to under-reporting of injuries and pressure to return quickly to work, which can in turn lead to unresolved pain, worsening injuries, and a reliance on non-prescription opioids to manage pain.<sup>21-23</sup> This can be particularly challenging for temporary workers who often do not have access to health benefits, have less jobsite health and safety training, and whose positions are particularly precarious.<sup>21-24</sup> Taken together, these findings reinforce the need to address structural barriers to appropriate pain management and injury prevention throughout the construction industry while promoting access to comprehensive healthcare (including rehabilitation following workplace injury) and treatment, harm reduction services (e.g., naloxone distribution, supervised consumption services, safer drug supplies) and education around the risks of polysubstance use.

Importantly, the majority of opioid toxicity deaths among construction workers occurred in private residences (78.7%), most often the individual's home (72.1%), and rarely at construction sites (<1.6%) or motels/hotels used for work purposes (1.9%). Although in 2018, naloxone administration (where there was an individual present to intervene) among construction workers was higher than among those with no employment history in construction, rates have declined since this time with a more considerable reduction observed in the first year of the COVID-19

pandemic (2020). Despite our inability to infer from these data the degree to which naloxone provision in this population is successfully reversing overdoses, these trends occurring against a backdrop of rising opioid-related deaths among construction workers suggests a need to ensure that naloxone is broadly accessible within this population. Further, it is important to note that less than 20% of opioid toxicity deaths among construction workers occurred where an individual was known to be present to intervene. Stigma and fear of loss of employment may contribute to using drugs alone, although convenience and comfort may also play a role.<sup>25</sup> Therefore, not only is there an ongoing need to improve access to naloxone, but it is imperative that naloxone is available in people's homes, and that people are provided with supports to prevent them from using drugs alone.

Diagnosis and treatment for OUD prior to opioid toxicity death was low among construction workers, and slightly lower relative to those with no employment history in construction. Nearly 40% of construction workers had no OUD diagnosis, and only 1 in 6 of those with an OUD diagnosis were dispensed any form of OAT in the month prior to death. These findings suggest that a high number of deaths among construction workers occur among people using opioids intermittently, many of whom appear to use multiple substances, including cocaine and alcohol, which can increase the risk of toxicity. Alternatively, this finding could reflect lower rates of OUD-related healthcare encounters among construction workers who may be less likely to seek treatment for an OUD due to stigma and fear of potential repercussions by their employer. Among those with a recorded OUD diagnosis, despite low OAT use, our findings show a slightly higher 1-year prevalence of buprenorphine use among construction workers compared to those not working in the construction industry. These findings are consistent with studies from British Columbia, which found a positive association between employment and consistently low OAT engagement patterns and a negative association between methadone and employment initiation.<sup>26,27</sup> Specifically, rigid OAT program requirements can interfere with employment responsibilities and contribute to stigma and fear of job loss among employed individuals with an OUD.<sup>26</sup> Buprenorphine may thus be a more attractive option because, unlike methadone, it does not require frequent pharmacy visits that can be particularly inaccessible for employed individuals.<sup>26</sup> Broadly, these findings support the need for low-barrier access to treatment for OUD and other substance use disorders among construction workers, as well as focused efforts on improving accessibility of harm reduction programs (e.g., naloxone distribution, access to low-barrier safer supply programs) that will support those at risk of toxicity from the unpredictable unregulated drug supply.

Although we are unable to determine the reason for drug use in our data, high rates of injuries and pain-related conditions (77.9%), chronic pain (37.2%), and mental health diagnoses (81.7%) among construction workers suggest the possible use of opioids to cope with pain, injuries, depression and anxiety, potentially resulting in more frequent opioid use and dependence over time.<sup>8-12</sup> In particular, higher prevalence of major traumatic injuries and traumatic brain injuries among construction workers in our study is concerning as the severity of these injuries require longer periods of convalescence and rehabilitation that may be impractical or inaccessible for people working in physically demanding jobs, or who may not have access to benefits due to temporary or occasional work status.<sup>21,24</sup> Further, the low opioid prescribing for pain among construction workers observed in this study may reflect barriers to prescription opioid access in this population and/or an internal or external expectation to work despite pain or injury, all of which can contribute to the seeking of unregulated opioids to help manage undertreated pain.<sup>9</sup> Therefore, our findings warrant interventions that promote long-term medical follow-up among construction workers with painful conditions, injuries, and mental health diagnoses including the removal of work-related and cost-related barriers to seeking healthcare for comprehensive rehabilitation, non-pharmaceutical pain management services, and other supports.

# Conclusion

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Our findings demonstrate that those with a history of employment in the construction industry are disproportionately impacted by opioid toxicity deaths in Ontario, with a lower proportion of these deaths involving pharmaceutical opioids prescribed for pain and a higher proportion involving fentanyl, cocaine and alcohol, compared to those with no employment history in construction. With over half of individuals in the construction industry employed at time of opioid-related death, industry-level responses to the ongoing overdose crisis would likely be beneficial; although these responses would need to extend beyond the workplace given the high rate of toxicity deaths occurring within private residences. Specifically, improved access to substance use treatment and harm reduction (e.g., opioid agonist therapy, safer supply programs, naloxone distribution, and supervised consumption sites) and raising awareness about the risks of polysubstance use and using drugs while alone are urgently needed. Finally, employment-related structural barriers to evidence-based treatment (i.e., OAT), pain management, and mental health supports need to be addressed in the construction industry, given the low prevalence of OAT among those with an OUD and the high prevalence of pain and concurrent mental health diagnoses in this population. In particular, adequate workers' compensation benefits, specific supports for temporary workers, and comprehensive post-injury care that is accessible, patient-centred, and multidisciplinary should be considered as core elements to any response to opioid-related harm in the construction industry.

# Contributors

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## Ontario Drug Policy Research Network

The Ontario Drug Policy Research Network (ODPRN) is a province-wide network of researchers who provide timely, high quality, drug policy relevant research to decision makers. The ODPRN houses the Ontario Opioid Drug Observatory (OODO) which is funded through a grant from the Canadian Institutes of Health Research (CIHR). This observatory aims to measure, assess and evaluate the use of prescription opioids, opioid-related overdoses, and opioid-related drug policy by leveraging large, population-level data sources. For more information, visit [odprn.ca](http://odprn.ca).

## Office of the Chief Coroner/Ontario Forensic Pathology Service

Together the Office of the Chief Coroner/Ontario Forensic Pathology Service (OCC/OFPS) provide death investigation services in Ontario serving the living through high quality investigations and inquests to ensure that no death will be overlooked, concealed or ignored. The findings are used to generate recommendations to help improve public safety and prevent further deaths. In Ontario, coroners are medical doctors with specialized training in the principles of death investigation. Coroners investigate approximately 17,000 deaths per year in accordance with section 10 of the Coroners Act. The OFPS provides forensic pathology services in accordance with the Coroners Act. It provides medicolegal autopsy services for public death investigations under the legal authority of a coroner. The OFPS performs approximately 7,500 autopsies per year. For more information, visit [mcscs.jus.gov.on.ca](http://mcscs.jus.gov.on.ca).

## Public Health Ontario

Public Health Ontario is a Crown corporation dedicated to protecting and promoting the health of all Ontarians and reducing inequities in health. Public Health Ontario links public health practitioners, frontline health workers and researchers to the best scientific intelligence and knowledge from around the world. Public Health Ontario provides expert scientific and technical support to government, local public health units and health care providers relating to the following:

- communicable and infectious diseases
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- environmental and occupational health
- emergency preparedness
- health promotion, chronic disease and injury prevention
- public health laboratory services

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# Funding

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The ODPRN acknowledges the financial support of the Canadian Institutes of Health Research (CIHR), which provided funds to support this report. Public Health Ontario acknowledges the financial support of the Government of Ontario.

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# Acknowledgments

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The authors wish to acknowledge all families, friends, colleagues and loved ones of construction industry workers who were lost to an opioid toxicity death in Ontario. We would like to recognize that embedded within the data of this report are stories of loss for countless Ontarians who are grieving these losses. This report cannot adequately reflect the burden borne by loved ones across the province. Further, we would like to commemorate the contribution of these construction workers to building, maintaining and connecting our communities throughout Ontario. The authors also wish to acknowledge all people who use drugs, harm reduction workers, peer support workers, first responders, and health care professionals who are working tirelessly to support affected individuals and families during the extraordinary circumstances of the COVID-19 pandemic, including their enormous role in overdose response and resuscitation efforts. Finally, the authors wish to acknowledge the work of all the entire death investigation service including investigating coroners, toxicologists at the Centre of Forensic Sciences, pathologists at the Ontario Forensic Pathology Service (OFPS), nurse investigators and all support staff; their enduring commitment to a robust death investigation system has directly contributed to all of the data presented in this report.

# Disclaimer

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This document was co-developed by the Ontario Drug Policy Research Network (ODPRN), Office of the Chief Coroner, and Public Health Ontario (PHO).

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This study was supported by ICES, an independent, non-profit research institute funded by an annual grant from the Ontario Ministry of Health (MOH) and the Ministry of Long-Term Care (MLTC). As a prescribed entity under Ontario's privacy legislation, ICES is authorized to collect and use health care data for the purposes of health system analysis, evaluation and decision support. Secure access to these data is governed by policies and procedures that are approved by the Information and Privacy Commissioner of Ontario. This study also received funding from: CIHR. Parts of this material are based on data and information compiled and provided by the MOH and the Canadian Institute for Health Information. This document used data adapted from the Statistics Canada Postal CodeOM Conversion File, which is based on data licensed from Canada Post Corporation, and/or data adapted from the Ontario Ministry of Health Postal Code Conversion File, which contains data copied under license from ©Canada Post Corporation and Statistics Canada. The analyses, conclusions, opinions and statements expressed herein are solely those of the authors and do not reflect those of the data sources; no endorsement is intended or should be inferred. We thank IQVIA Solutions Canada Inc. for use of their Drug Information File.

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## How to Cite this Document

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Gomes T, Iacono A, Kolla G, Nunez E, Leece P, Wang T, Campbell T, Auger C, Boyce N, Doolittle M, Eswaran A, Kitchen S, Murray R, Shearer D, Singh S, Watford J. on behalf of the Ontario Drug Policy Research Network, Office of the Chief Coroner for Ontario and Ontario Agency for Health Protection and Promotion (Public Health Ontario). Lives lost to opioid toxicity among Ontarians who worked in construction. Toronto, ON: Ontario Drug Policy Research Network; 2022.

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# Appendix A: Definitions

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## **Opioids:**

A family of substances that include opioids available through regulated and pharmaceutical sources for the treatment of pain and opioid use disorder (e.g., oxycodone, hydromorphone, morphine, methadone) and opioids available primarily through unregulated or non-pharmaceutical markets or sources (e.g., heroin, fentanyl, carfentanil).

## **Opioid toxicity death:**

An acute intoxication/toxicity death resulting from the direct contribution of consumed substance(s), where one or more of the substances was an opioid, regardless of how the opioid was obtained.

## **Opioid use disorder:**

Opioid use disorder (OUD) is a medical condition associated with cravings for opioids that may lead to chronic use of opioids and behaviours that may interfere with the activities of daily life.<sup>28</sup> Opioid agonist treatment is often used as the first-line treatment of OUD.

## **Opioid agonist treatment:**

Opioid agonist treatment (OAT) is the provision of opioid agonist medications and is the first-line, recommended treatment for people with OUD.<sup>29</sup> These medications are opioids that help prevent opioid withdrawal and cravings. Two of the most common types of OAT are methadone and the combination product buprenorphine/naloxone (commonly known by its brand name Suboxone®). We also included newer longer-acting buprenorphine formulations (Sublocade® and Probuphine®). Slow-release oral morphine (SROM) is also increasingly being used as OAT in Canada.

## **Origin of opioids:**

- Opioids with **primarily unregulated and non-pharmaceutical origins** include:
  - Heroin, heroin metabolites (morphine where monoacetylmorphine (6-MAM) was also detected), U-47700
  - Fentanyl, fentanyl analogues (including carfentanil)
- Opioids with **primarily regulated and pharmaceutical origins** include:
  - Buprenorphine, codeine, hydrocodone, hydromorphone, methadone, morphine where 6-MAM was not detected, oxycodone, oxymorphone or tramadol. This category may include opioids that were prescribed to the deceased person or that were prescribed to someone else (i.e., diverted).

## **Benzodiazepines:**

A class of sedative and anti-anxiety drugs that are widely prescribed for the treatment of anxiety, sleep disorders (e.g., insomnia), certain forms of epilepsy, and alcohol withdrawal. Currently, 14 different benzodiazepines are approved for use in Canada. Benzodiazepines that are not approved for medical use in Canada, such as etizolam, are increasingly being found in the unregulated drug supply.

## **Stimulants:**

A class of drugs used for the treatment of attention-deficit/hyperactivity disorder and sleeping disorders (e.g., narcolepsy). These drugs act on the central nervous system to increase alertness, attention and energy. This category also includes stimulants that are used recreationally and primarily available from the unregulated market, such as cocaine and methamphetamine.

**Substance involvement in opioid toxicity deaths:**

- **Detected:** Substances detected in toxicology testing, which may or may not have directly contributed to the death.
- **Directly contributing to death:** Substances determined by the pathologist and/or coroner to have directly contributed to the death based on the complete investigative findings, i.e., toxicology findings and the information obtained during the death investigation.

**Living arrangement:**

- **Collective dwelling:** May include lodging and rooming houses, hotels, motels, tourist establishments, campgrounds and parks, sober living facilities, school residences and training centre residences, work camps, religious establishments, military bases and commercial vessels.
- **Experiencing homelessness:** Without stable, permanent, appropriate housing or the immediate prospect, means and ability of acquiring it; includes no fixed address. This includes people who are unsheltered, emergency sheltered, provisionally accommodated or at immediate risk of homelessness.
- **Private dwelling:** A separate set of living quarters designed for or converted for human habitation. Must include a source of heat or power and must be an enclosed space that provides shelter/protection from the elements. May include apartments/condominiums, row houses/townhouses, trailers/mobile homes, single-detached houses, semi-detached houses and community housing.
- **Other:** Includes locations not applicable to other categories such as hospital, long-term care home, retirement home (including senior residences), correctional facilities and residential care facilities (including group homes); or unknown location.

**Rural Ontario:**

A community with a population of 10,000 people or less, as assigned by Statistics Canada based on the postal code associated with the individual's health card.

**Northern Ontario:**

North East (13) and North West (14) LHINs. For a map of the various LHINs, click [here](#).

**Southern Ontario:**

LHINs 1 to 12. For a map of the various LHINs, click [here](#).

**Rate:**

The frequency with which an event or circumstance occurs per unit of time, population, or other standard of comparison. Example: Based on a rate of 1.5 deaths per 10,000 people, we can expect approximately 15 deaths in a community of 100,000.

**Unemployed:**

Includes people who may be looking for employment, on income assistance or unable to work due to injury or disability.

**Employed:**

Includes full-time, part-time, seasonal and temporary employment.

# Appendix B: Diagnosis Codes Used to Identify Healthcare Encounters and Health Conditions

**Table B1. Healthcare Encounters**

Type of Encounter/Condition	Criteria	Data Source	Codes
<b>General healthcare encounters</b>			
<b>Acute hospital admission</b>	Any acute-care related hospital admission. Excludes admissions to adult-designated mental health beds. Includes admissions related to mental health care for children and adolescents (i.e., people less than 18 years of age).	DAD	N/A
<b>Emergency department visit</b>	Any visit to an emergency department. Includes visits related to mental health diagnoses.	NACRS	N/A
<b>Mental health-related hospital admission</b>	Any admission to an adult-designated (i.e., people 18 years of age or older) mental health bed in a hospital.	OMHRS	N/A
<b>Outpatient care</b>	Any visit with a physician or nurse practitioner in an office, home care, virtual, long-term care, or community health centre setting.	OHIP Claims Database, CHC	N/A
<b>Primary care visit</b>	Outpatient primary care visits were defined as either of the following: <ul style="list-style-type: none"> <li>Any visit to a community health centre with a physician (i.e. General Practitioner) or nurse practitioner.</li> <li>A visit outside of a community health centre with a physician practicing in family medicine, pediatrics, or community medicine, or to a nurse practitioner, in which billing codes related to primary care were submitted. Visits must have occurred in an office, home care, virtual, or long-term care setting.</li> </ul>	OHIP Claims Database, CHC	<b>OHIP billing codes:</b> A001, A002, A003, A007, A903, E075, G212, G271, G372, G373, G365, G538, G539, G590, G591, K005, K013, K017, P004, K130, K131, K132, K030, K080, K081, K082, A261, A268, K267, K269
<b>Substance-related encounters</b>			
<b>Alcohol-related dependency or toxicity</b>	Emergency department visit or hospital admission for alcohol-related dependency or toxicity.	NACRS, DAD	<b>ICD-10:</b> F10, T51.0
<b>Opioid toxicity- related emergency department visits and hospitalizations</b>	Emergency department visit or hospital admission for an opioid toxicity.	NACRS, DAD	<b>ICD-10:</b> T40.0, T40.1, T40.2, T40.3, T40.4, T40.6
<b>Stimulant-related dependency or toxicity</b>	Emergency department visit or hospital admission for stimulant-related dependency or toxicity.	NACRS, DAD	<b>ICD-10:</b> F14, F15, T43.6, T40.5

CHC: Community Health Centre; DAD: Discharge Abstract Database; DDARD: Drug and Drug/Alcohol Related Death Database; NACRS National Ambulatory Care Reporting System; NMS: Narcotics Monitoring System; OHIP: Ontario Health Insurance Plan; OMHRS: Ontario Mental Health Reporting System

## Table B2. Health Conditions: History of Chronic Pain

History of chronic pain was defined as meeting any one of the criteria below:

Criteria	Data Source	Codes
<ul style="list-style-type: none"> <li>Any outpatient visit with a physician practicing in the area of pain or anesthesiology in the year prior to death</li> <li>Or any outpatient visit with a physician practicing in family medicine who billed 40 or more claims related to pain management in the year prior to death</li> </ul>	OHIP Claims Database	<b>OHIP billing code:</b> A937
Experienced any traumatic injury in the 10 years prior to death	Ontario Trauma Registry	See Appendix B in the following document: <a href="https://www.cihi.ca/sites/default/files/services_otr_cds_dict_en_0.pdf">https://www.cihi.ca/sites/default/files/services_otr_cds_dict_en_0.pdf</a>
Received 10 or more nerve block injections in outpatient settings in the year prior to death	OHIP Claims Database	<b>OHIP billing codes:</b> G228, G123, G238, G246, G370, G371, G214, G226, G230, G231, G223, G240, G227, G235, G250
Received 90 days or more of opioids used for the treatment of pain in the 100 days prior to death	NMS	N/A
Coroner investigation determined that the individual had a medical history of a pain disorder or a traumatic injury	DDARD	N/A

CHC: Community Health Centre; DAD: Discharge Abstract Database; DDARD: Drug and Drug/Alcohol Related Death Database; NACRS National Ambulatory Care Reporting System; NMS: Narcotics Monitoring System; OHIP: Ontario Health Insurance Plan; OMHRS: Ontario Mental Health Reporting System

## Table B3. Health Conditions: Pain-Related Injuries and Conditions

Type of Encounter/Condition	Criteria	Data Source	Codes
<b>Arthritis and related conditions</b>	Any healthcare visits for arthritis and related conditions (including inflammatory arthritis, other arthritis, soft tissue disorders, joint derangement, unspecified arthritis).	DAD, OHIP Claims Database, NACRS	<p><b><u>NACRS and DAD databases:</u></b>  <b>ICD-10:</b> M05-M09, M45, M46, M30-M36, M15-M19, M00-M03, M12, M10, M11, M14, M65-M71, M60-M63, M72-M73, M75-M77, M79, M22-M24, M13, M96, M99 30</p> <p><b><u>OHIP:</u></b>  <b>Dxcodes:</b> 714, 720, 710, 446, 711, 715, 716, 274, 712, 727, 728, 729, 717, 718, 739 30</p>
<b>Bone and spinal conditions</b>	Any healthcare visit for bone and spinal conditions.	DAD, OHIP Claims Database, NACRS	<p><b><u>NACRS and DAD:</u></b>  <b>ICD-10:</b> M40-M43, M47, M49-M54, M48.0-M48.3, M48.8-M48.9, M80-M90, M91-M94, M48.4, M48.5, M20, M21.4, L60.0, L60.2, L84 30</p> <p><b><u>OHIP:</u></b>  <b>Dxcodes:</b> 721, 722, 723, 724, 725, 737, 730, 731, 732, 733, 734, 735 30</p>
<b>Fractures, dislocations, strains or sprains</b>	Any healthcare visits for fractures, dislocations, strains or sprains.	DAD, OHIP Claims Database, NACRS, SDS	<p><b><u>NACRS, SDS, and DAD:</u></b>  <b>ICD-10:</b> T08, S12, S32, S42, S52, S62, S72, S82, S92, S13.0-S13.3, S33.0-S33.3, S43.0-S43.3, S53.0-S53.1, S63.0-S63.2, S73.0, S83.0-S83.1, S93.0-S93.3, S13.4, S13.5, S33.5-S33.7 S43.4-S43.7, S53.2-S53.4, S63.3-S63.7, S73.1, S83.2-S83.7, S93.4-S93.6 30</p> <p><b><u>OHIP:</u></b>  <b>Dxcodes:</b> 802, 803, 805, 806, 807, 808, 810, 812, 813, 814, 815, 816, 821, 823, 824, 827, 829, 831, 832, 834, 839, 840, 841, 842, 843, 844, 845, 847, 848 30</p>

Type of Encounter/Condition	Criteria	Data Source	Codes
<b>Low back pain</b>	Any healthcare visit for low back pain, including outpatient and hospital visits as well as spinal imaging procedures.	DAD, OHIP Claims Database, NACRS, SDS	<p><b><u>NACRS, SDS, and DAD:</u></b>  <b>ICD-10:</b> M47.26, M47.27, M47.28, M47.86, M47.87, M47.88, M47.96, M47.97, M47.98, M48.06, M48.07, M48.08, M48.86, M48.87, M48.88, M48.96, M48.97, M48.98, M51.0, M51.1, M51.2, M51.3, M51.9, M53.3, M53.86, M53.87, M53.88, M54.10, M54.16, M54.17, M54.18, M54.19, M54.3, M54.4, M54.5, M54.8, M54.9, M99.83, M99.93, M99.03, M99.84, M99.94, M99.04, S33.5, S33.6, S33.7, S33.8 31</p> <p><b><u>DAD and SDS:</u></b>  <b>CCI:</b> 3SC10KM, 3SC10VA, 3SC10VN, 3SE10VK, 3SC12AY, 3SC12VA, 3SE12VA, 3SE12VK, 3SF12VA, 3SF12VL, 3SF10VA, 3SF10VL 31</p> <p><b><u>OHIP:</u></b>  <b>Dxcode:</b> 722, 724, 847 31,32 Feecode: X025, X202, X203, X027, X204, X028, X205, X206, X032, X033, X031, X034, X207, X035, X20831</p>
<b>Unspecified musculoskeletal disorders or congenital abnormalities</b>	Any healthcare visit for unspecified musculoskeletal disorders or congenital abnormalities.	DAD, OHIP Claims Database, NACRS	<p><b><u>NACRS and DAD:</u></b>  <b>ICD-10:</b> M95, M21 excl. M21.4, M25 30</p> <p><b><u>OHIP:</u></b>  <b>Dxcodes:</b> 754, 755, 756, 781 30</p>
<b>Traumatic brain injury (TBI)</b>	Emergency department visit or hospital admission for TBI.	NACRS, DAD	<p><b>ICD-10:</b> S02.0, S02.1, S02.3, S02.7, S02.8, S02.9, S06, S07.1, T90.2, T90.5 33</p>

CHC: Community Health Centre; DAD: Discharge Abstract Database; DDARD: Drug and Drug/Alcohol Related Death Database; NACRS National Ambulatory Care Reporting System; NMS: Narcotics Monitoring System; OHIP: Ontario Health Insurance Plan; OMHRS: Ontario Mental Health Reporting System

## Table B4. Health Conditions: History of Opioid Use Disorder

History of opioid use disorder was defined as meeting any one of the criteria below:

Criteria	Data Source	Codes
Any outpatient visit with a diagnosis code for drug use in the 5 years prior to death	OHIP Claims Database	<b>OHIP diagnosis code:</b> 304
Any emergency department visit or acute hospital admission with a diagnosis code for opioid-related dependence in the 5 years prior to death	NACRS, DAD	<b>ICD-10 diagnosis code:</b> F11
Any mental health-related hospital admission with a diagnosis code for opioid use disorder in the 5 years prior to death	OMHRS	<b>DSM diagnosis codes:</b> 304.0, 305.5 <b>ICD-10 diagnosis code:</b> F11
Received a prescription for opioid agonist treatment (methadone, the combination product buprenorphine/naloxone, Probuphine, or Sublocade) in the 5 years prior to and including death	NMS	N/A

CHC: Community Health Centre; DAD: Discharge Abstract Database; DDARD: Drug and Drug/Alcohol Related Death Database; NACRS National Ambulatory Care Reporting System; NMS: Narcotics Monitoring System; OHIP: Ontario Health Insurance Plan; OMHRS: Ontario Mental Health Reporting System

## Table B5. Health Conditions: History of a Mental Health-Related Healthcare Encounter

History of a mental health-related healthcare encounter was defined as meeting any one of the criteria below:

Criteria	Data Source	Codes	
<b>Outpatient visits (in settings other than community health centres) for mental health-related reasons</b>			
Any visit with a diagnosis code for <b>psychotic disorders</b> in the 5 years prior to death	OHIP Claims Database	<b>OHIP diagnosis codes:</b> 295, 297, 298	
Any visit with a diagnosis code for <b>mood and anxiety disorders</b> in the 5 years prior to death	OHIP Claims Database	<b>OHIP diagnosis codes:</b> 296, 300, 311	
Any visit with a diagnosis code for <b>substance use disorders</b> in the 5 years prior to death	OHIP Claims Database	<b>OHIP diagnosis codes:</b> 303, 304	
Any visit with a diagnosis code for other <b>non-psychotic disorders</b> in the 5 years prior to death	OHIP Claims Database	<b>OHIP diagnosis codes:</b> 301, 302, 306, 309	
Any visit with a diagnosis code for <b>other mental health-related disorders</b> in the 5 years prior to death	OHIP Claims Database	<b>OHIP diagnosis codes:</b> 291, 292, 299, 307, 313, 314, 315, or other OHIP diagnosis codes accompanied by billing codes indicating mental health-related services	
<b>Outpatient visits in community health centres for mental health-related reasons</b>			
Any visit with a diagnosis code for any mental health condition or disorder in the 5 years prior to death	Community Health Centre Database	Any ICD-10 diagnosis code between F06 and F99 in the primary diagnostic position, excluding dementia and delirium-related diagnoses	
<b>Emergency department visit or acute hospital admission for mental health-related reasons, or admission in adult-designated mental health bed</b>			
Any emergency department visit, acute hospital admission, or admission to an adult-designated mental health bed with a diagnosis code for the following:			
<b>Any mental health and addictions</b>	NACRS, DAD, OMHRS	<b>ICD-9-CM codes (OMHRS DSM-IV):</b> AXIS1_DSM4CODE_DISCH1 = Any OMHRS diagnosis (includes missing; excludes 290.x, 294.x).  Exclude if AXIS1_DSM4CODE_DISCH1 missing and PROVDX_DSM4CODE_ADM1 =2	<b>ICD-10-CA codes (DAD/NACRS):</b> DX10CODE1= F06-F99 or DX10CODE2-DX10CODE10 = X60-X84, Y10-Y19, Y28 when DX10CODE1 ne F06-F99
<b>Anxiety disorders</b>	NACRS, DAD, OMHRS	<b>ICD-9-CM codes (OMHRS DSM-IV):</b> AXIS1_DSM4CODE_DISCH1 = 300, 300.0x, 300.2x, 300.3x, 308.3x, 309.0x, 309.24, 309.28, 309.3x, 309.4x, 309.8x, 309.9x.  PROVDX_DSM4CODE_ADM1 =7, 15	<b>ICD-10-CA codes (DAD/NACRS):</b> DX10CODE1 = F40, F41, F42, F43, F48.8, F48.9; F93.1, F93.2
<b>Substance-related disorders</b>	NACRS, DAD, OMHRS	<b>ICD-9-CM codes (OMHRS DSM-IV):</b> AXIS1_DSM4CODE_DISCH1 = 291.x (all 291 codes, excluding 291.82), 292.x (all 292 codes, excluding 292.85), 303.x (all 303 codes), 304.x (all 304 codes), 305.x (all 305 codes).  PROVDX_DSM4CODE_ADM1 =4	<b>ICD-10-CA codes (DAD/NACRS):</b> DX10CODE1 = F55, F10 to F19

Criteria	Data Source	Codes	
Schizophrenia	NACRS, DAD, OMHRS	<b>ICD-9-CM codes (OMHRS DSM-IV):</b> AXIS1_DSM4CODE_DISCH1 = 295.x (all 295 codes), 297.x (all 297 codes), 298.x (all 298 codes). PROVDX_DSM4CODE_ADM1 =5	<b>ICD-10-CA codes (DAD/NACRS):</b> DX10CODE1 = F20 (excluding F20.4), F22, F23, F24, F25, F28, F29, F53.1
Mood disorders	NACRS, DAD, OMHRS	<b>ICD-9-CM codes (OMHRS DSM-IV):</b> AXIS1_DSM4CODE_DISCH1 = 296.x (all 296 codes), 300.4x, 301.13. PROVDX_DSM4CODE_ADM1 =6	<b>ICD-10-CA codes (DAD/NACRS):</b> DX10CODE1 = F30, F31, F32, F33, F34, F38, F39, F53.0
Neurodevelopmental and other selected disorders	NACRS, DAD, OMHRS	<b>ICD-9-CM codes (OMHRS DSM-IV):</b> AXIS1_DSM4CODE_DISCH1 = 299.x, 300.16, 300.19, 301.x (excluding 301.13), 302.6, 307.1x, 307.2x, 307.3x, 307.5x, 309.21, 312.x, 313.23, 313.81, 313.89, 313.9x, 314.x, 315.x, 787.6x, PROVDX_DSM4CODE_ADM1 = 1, 12, 16	<b>ICD-10-CA codes (DAD/NACRS):</b> DX10CODE1 = F50.0, F50.1, F50.2, F50.3, F50.8, F50.9, F60, F61, F62, F68, F69, F21, F80, F81, F82, F83, F84, F88, F89, F90, F91, F92, F93 (excluding F93.1, F93.2), F94, F95, F98
Deliberate self-harm	NACRS, DAD	<b>ICD-9-CM codes (OMHRS DSM-IV):</b> N/A (DAD/NACRS)	<b>ICD-10-CA codes (DAD/NACRS):</b> DX10CODE2-10 = X60-X84, Y10-Y19, Y28 when DX10CODE1 ne F06-F99

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