

A cross-sectional study of opioid involvement in non-poisoning suicide – risks and prevention opportunities

Maryann Mason (✉ maryann-mason@northwestern.edu)

Northwestern University Feinberg School of Medicine <https://orcid.org/0000-0001-6524-1532>

Suzanne McLone

Ann and Robert H Lurie Children's Hospital of Chicago

Tami Bartell

Ann and Robert H Lurie Children's Hospital of Chicago

Sarah Welch

Northwestern University Feinberg School of Medicine

Karen Sheehan

Ann and Robert H Lurie Children's Hospital of Chicago

Lori Post

Northwestern University Feinberg School of Medicine

Short Report

Keywords: suicide, opioids, chronic health conditions, substance misuse

Posted Date: July 28th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-46823/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Background

The current opioid epidemic has drawn attention to drug overdose deaths including unintentional and suicide poisoning deaths which peaked in the United States in 2017. Concurrent with the opioid epidemic, the number and rate of suicides in the United States has increased. At the same time, the proportion of suicide deaths across cause of death has shifted and the proportion of suicides by poisoning (including overdose) has decreased. On the face of it, it would appear that the opioid epidemic has not intersected with suicide as signaled by the decline in suicide deaths due to poisoning. However, opioid use and misuse is associated with suicidal ideation and attempts and therefore it is plausible that opioids may play a role in suicide deaths by causes other than poisoning.

Objective

This study examines opioid involvement (as measured by the presence of opioids but below the lethality threshold) in suicides by causes other than poisoning,

Methods

A cross-sectional study utilizing Illinois National Violent Death Reporting System data including all suicides toxicology screened for opioids. Chi-square tests were used to compare decedent and incident circumstance characteristics by opioid toxicology screen status.

Results

Of 1007 non-poisoning suicides screened for opioids, 83.6% (842) were opioid negative and 16.4% (165) were opioid positive. Over half (52.7%) of decedents positive for opioids died by firearm. White race, age 75 and over, and widowed or unknown marital status were associated with opioid positivity. Opioid positivity is linked to testing positive for other substances. One quarter of decedents testing positive for opioids had a history of substance abuse. Twenty eight percent of opioid positive decedents suffered from physical health problems.

Conclusion

Suicide decedents who are opioid positive and who die from causes other than poisoning have distinct characteristics which suggest an array of suicide prevention efforts – for example – including information on risk of suicide for opiate users in firearm sales, including suicide prevention counseling in

health care settings in which opiates and/or benzodiazepines are therapeutically prescribed, and close monitoring of pain symptoms among patients experiencing chronic pain.

Introduction

The current opioid epidemic has drawn attention to drug overdose deaths including unintentional and suicide poisoning deaths which peaked in the United States in 2017 with 46,802 opioid-involved overdose deaths (Hedegaard, Minino, & Warner, 2020). Concurrent with the opioid epidemic, the number and rate of suicides in the United States has increased from 29,199 and 10.48 per 100,000 persons in 1999 to 48,344 and 14.21 per 100,000 in 2018 with wide variations among race, age and sex groups (Centers for Disease Control and Prevention, 2020; Hedegaard, Curtin, & Warner, 2018). At the same time, the proportion of suicide deaths across cause of death has shifted. From 1999 to 2018, the proportion of suicides by firearm has decreased from 56.8–50.5%, the proportion of suicides by suffocation increased from 18.5–28.6%, and the proportion of suicides by poisoning decreased from 16.71–12.9% (Centers for Disease Control and Prevention, 2020). On the face of it, it would appear that the opioid epidemic has not intersected with suicide as signaled by the decline in suicide deaths due to poisoning. However, it is well-known that opioid use and misuse is associated with suicidal ideation and attempts (Ashrafioun, Bishop, Conner, & Pigeon, 2017), and therefore it is plausible that opioids may play a role in suicide deaths by causes other than poisoning.

This study goes beyond existing research on suicide and opioids to examine opioid involvement (as measured by the presence of opioids but below the lethality threshold) in suicides by causes other than poisoning, such as firearms and suffocation, which are leading causes of death among suicide decedents.

Methods

This study was exempted from Institutional Review Board review. This cross-sectional study uses Illinois data from the Center for Disease Control and Prevention's National Violent Death Reporting System including suicides with a date of death between January 1, 2015 and December 31, 2017 (Ertl et al., 2019). Data for the analysis includes all suicides for which post mortem toxicology for the presence of opioids was performed. Data were analyzed using SPSS Statistics (v. 26.0, Armonk, NY) descriptives and frequencies procedures to explore range and measures of central tendency. Chi-square statistics tested for associations between opioid positivity and demographic, toxicology, and circumstance variables. Toxicology variables included all non-opioid substances tested for in 70 percent or more of decedents. For variables with significant chi-square results, we ran comparisons of column proportion procedures to describe patterns in the data. We also reviewed narrative accounts of incidents for physical and mental health history and status at time of death and documentation of substances on scene to better understand their involvement in suicide among opioid positive suicide decedents with causes of death other than poisoning.

Results

The original data set included 2,784 suicides in 16 Illinois counties representing approximately 65% of all Illinois suicides from January 2015 to December 2017. We removed 1,449 cases which had no toxicology testing or for which opioid testing was not included in post mortem toxicology, leaving 1,335 cases. An examination of tested vs. not tested/testing results missing cases shows no statistically significant differences in the demographics (sex, age or race/ethnicity) of those for whom toxicology reporting is available vs. those who were not tested or for whom testing data are missing. We also examined variation in opioid testing status and cause of death and found no significant differences by status ($p = .779$). Reasons we are aware of for not performing toxicology testing or not including opioid testing in toxicology vary by coroner/medical examiner office policies and practice, and include toxicology testing budget limitations, and infeasibility (decomposed remains).

While we are primarily interested in opioid-involved non-poisoning suicides, we explored demographic differences between poisoning and non-poisoning decedents. We found statistically significant differences in age and sex, with a larger proportion of poisoning deaths among those aged 45–54 ($p = 0.05$). A larger proportion of males who were opioid positive died from causes other than poisoning ($p = 0.05$). Conversely, a larger proportion of opioid positive females died by poisoning compared to other causes ($p = 0.05$).

Because we are primarily interested in opioid involvement in non-poisoning suicides, we removed 328 suicide cases where cause of death was poisoning (e.g., overdose) leaving 1007 cases for analysis. Of these 1007 suicides, 83.6% (842) were negative and 16.4% (165) were positive for opioids. Over half (52.7%) of decedents positive for opioids died by firearm, 33.3% by hanging/strangulation or suffocation, 6.7% by sharp instrument, 1.2% by fire/burns, 0.8% by other transport, 0.6% by drowning, and 0.6% by other causes.

Table 1 compares decedent demographic characteristics by opioid positivity status. Compared to opioid negative suicides, opioid positive suicides have greater proportions of persons who were non-Hispanic white, 75 years old and older, and persons who were widowed or had unknown marital status at the time of their death. Opioid negative suicides had greater proportions of persons who were non-Hispanic Black, persons who were 15 to 24 years old, and persons who had never married.

Table 1
Decedent Demographics by Opioid Toxicology

	Opioid positive %/(n)	Opioid negative %/(n)
Sex		
Male	15.8(128)	84.2(684)
Female	19.0(37)	81.0(158)
Race/Ethnicity		
Non-Hispanic, White	90.3*(149)	77.0(648)
Non-Hispanic, Black	3.6(6)	10.5*(88)
Am Indian/Native Alaskan	0.0	0.2(2)
Asian/Pacific Islander	1.2(2)	3.0(25)
Other (non-Hispanic)	0.0	0.1(1)
Two or more races	0.0	0.5(4)
Hispanic	4.8(8)	8.8(74)
Age group		
0–14	0.0	1.2(10)
15–24	3.6(6)	17.3*(146)
25–34	17.6(29)	19.0(160)
35–44	18.8(31)	16.9(142)
45–54	17.6(29)	18.5(156)
55–64	21.8(36)	15.7(132)
65–74	9.1(15)	5.7(48)
75+	11.5*(19)	5.7(48)
Marital status		
Married	32.7(54)	28.1(237)
Divorced	24.8(41)	18.8(158)
Separated	1.8(3)	3.1(26)
Never married	27.9(46)	44.3*(373)

* $p \leq 0.016$

	Opioid positive %/(n)	Opioid negative %(n)
Widowed	7.9*(13)	3.8(32)
Unknown	4.8*(8)	1.9(16)
* p ≤ 0.016		

We found that testing positive for an opioid is associated with testing positive for one or more additional substances. A larger proportion of opioid positive decedents tested positive for each of the substances except for alcohol included in the analysis compared to opioid negative decedents. The mean number of substances present for those who were opioid positive was 2.5 vs. 0.68 for those who were opioid negative (p = 0.00). See Table 2 for details.

Table 2
Toxicology by Opioid Presence

Substance present	Opioid positive %(n)	Opioid negative %(n)
Alcohol	32.0(48)	34.3(288)
Amphetamine	12.5*(17)	5.1(40)
Barbiturates	5.0*(7)	0.1(1)
Benzodiazepines	44.6*(68)	12.0(95)
Cocaine	9.5*(13)	6.2(15)
Marijuana	22.5*(34)	13.2(103)
*P ≤ 0.000		

To learn more about substance use at time of death, we reviewed narrative data for 165 opioid positive non-poisoning suicide cases. Only 16.9% of opioid positive decedents had evidence of prescription medications noted in the case narrative. A mere 4.4% of decedents in our data set had indications of consumption of large quantities of substances other than alcohol proximate to their fatal injury. We also found relatively few cases (4.4%) in which evidence of drug use was found at the scene.

Table 3
Evidence of prescriptions/drugs at scene

	(%*n)
Current prescription medications confirmed in incident narrative	16.9/28
No mention of prescription medications or drugs present on scene	72.7/120
Evidence large quantity of drugs consumed (out of count prescriptions, etc.) in close proximity to death	4.4/7
Evidence of drugs at scene (illicit or prescription not confirmed in medical history)	4.4/7

A larger proportion of opioid positive decedents had a physical health problem that contributed to their death, a physical health crisis, and/or were experiencing a non-alcohol substance abuse problem at the time of their death compared to opioid negative suicide decedents. See Table 4 for details.

Table 4
Selected Circumstances by opioid positivity

	Opioid positive %(n)	Opioid negative %/(n)
Physical health problem contributed to death	27.9*(46)	10.3(87)
Physical health problem was a crisis	9.7*(16)	1.8(15)
Had a non-alcohol related substance abuse problem	24.8*(41)	12.6(106)
Prior suicide attempts	20.0(33)	18.2(143)
Left a suicide note	30.3(50)	27.9(235)
Disclosed suicidal thoughts/plans	17.0(28)	15.4(130)
Identified as having a current mental health problem	41.8(69)	36.5(316)
*P ≤ 0.000		

To learn more about the medical issues faced by decedents we reviewed narrative data for 165 opioid positive non-poisoning suicide cases. We found that opioid positive decedents suffered from a variety of serious or chronic health problems including cancer (18%/29), chronic obstructive pulmonary disease or other lung conditions (8%/14), heart disease (10%/17), hypertension (21%/34), diabetes (5%/9), and joint/back pain (15%/25). A substantial subset (23%/38) of these decedents had three or more of these serious health problems. Mental health issues including anxiety (19%/32), depression (61%/101), post-traumatic stress disorder (4%/6), and bi-polar disorder (5%/8) were also present for opioid positive decedents. About 17% of cases had documented prescription medicines at the time of fatal injury.

Conclusions

A total of 16.4% of non-poisoning suicides in our data set were positive for opioids. We suspect that this is an undercount due to toxicology testing practices among coroners and medical examiners who provided data for this study. Even so this figure is higher than that (9.3%) found in a similar, earlier Australian study (Darke, Duflou, & Torok, 2009). Among the non-poisoning suicides, opioid involvement was highest in suicides by firearm and hanging.

We found that opioid-involvement in non-poisoning suicides was associated with particular demographic characteristics (non-Hispanic, White, age 75 and over and widowed or unknown marital status. This demographic profile suggests that this population may be more likely to use opioids to treat health conditions as these increase with age.

While common among suicide deaths, the presence of physical health problems and physical health crises in particular stand out as high among this population (Ahmedani et al., 2017). Serious chronic conditions found in our study population include cancer, chronic obstructive pulmonary disease, joint pain/arthritis, and severe back pain implying that un- or undertreated pain may play a role in these deaths. Recent prescribing guideline revisions focused on reducing opioid prescriptions may play a role in undertreating pain and investigations into unintended outcomes for this population could be helpful in furthering our understanding of opioid use among suicide decedents with chronic conditions (Dowell, Haegerich, & Chou, 2016). Investigation into the treatment of health conditions with opioids in this population, possibly through linkage with state Prescription Drug Monitoring Program data, could be helpful in understanding potential connections as well as provide improved data on prescriptions active at time of injury.

While more than a quarter (27.9%) of decedents had documented health conditions for which one would expect therapeutic prescriptions such as diabetes, hypertension, and cancer only 16.9% of opioid positive decedents had confirmed prescription medications noted in the case narrative. This suggests possible under-reporting of prescription drugs in the investigations, under-treatment of chronic conditions, lack of adequate health care, and/or poor health management practices any of which may play a role in suicide for those with chronic conditions.

We also looked for evidence of consumption of large quantities of substances in close proximity to the fatal injury which we presumed would indicate the intention to use substances as a lethal means and found that only 4.4% of decedents in our data set had indications of this. This suggests that substances are not typically used as a secondary means of suicide in the non-poisoning cases we reviewed. We also found relatively few cases in which evidence of drug use was found at the scene which may indicate substance intake had a more distal relationship to the suicide event.

A quarter (24.8%) of decedents testing positive for opioids had a history of substance abuse implying that opioid positivity at time of death may reflect longer term behavioral and mental health issues which could offer opportunities for suicide prevention. This suggests a secondary consequence of the opioid epidemic may be found in a subset of these non-poisoning suicides. Opioid positive decedents in our study also had significantly more varieties of substances in their system than opioid negative decedents,

signaling a complex relationship with substance use among this population and perhaps reflecting prescriptions for those with multiple health conditions. The presence of benzodiazepines, a medication used to treat anxiety, tremors, seizures, muscle spasms, and alcohol and drug withdrawal, in opioid overdose deaths is common (Ahmedani, Peterson et al. 2017) and was also high in this group of decedents. The high prevalence of benzodiazepine positivity is not surprising given the prevalence of anxiety diagnoses in our study population. Our finding of high overlap between opioid and benzodiazepine in non-poisoning suicides signals the need for further investigation into potential overlapping prescriptions and screening for illicit opioid use when prescribing benzodiazepines to avoid potentially dangerous interactions or other unintended consequences.

Overall, these findings suggest an array of suicide prevention efforts, for example, including information on risk of suicide for opioids users in firearm sales, including suicide prevention counseling in health care settings in which opioids and/or benzodiazepines are therapeutically prescribed, and close monitoring of pain symptoms among patients experiencing chronic pain.

Limitations

This study uses Illinois data from the National Violent Death Reporting System. This system is standardized and provides data for multiple states across the United States. Our data are limited to Illinois and may not reflect the conditions present in other locations. Furthermore, while there is significant testing for opioids in this subsample, toxicology reports are not comprehensive and a portion of cases were not included due to lack of toxicology testing. Lastly, due to the nature of suicide, third party decedent accounts may not accurately reflect the complete details of the incident.

Declarations

Declarations

- **Ethics approval and consent to participate**
 - This study was exempted from Institutional Review Board review.
- **Consent for publication**
 - Not applicable
- **Availability of data and materials**
- The data that support the findings of this study are available from the Illinois Department of Public Health, but restrictions apply to the availability of these data, which were used under a data share agreement for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of the Illinois Department of Public Health.
- **Competing interests**

- The authors declare that they have no competing interests
- **Funding**
 - This study received no dedicated external funding.
- **Authors and Authors' contributions**
- Corresponding author

Maryann Mason, PhD

Associate Professor of Emergency Medicine

- Director, Illinois Violent Death Reporting System
- Director, Illinois Statewide Drug Overdose Reporting System

Buehler Center for Health Policy and Economics

Feinberg School of Medicine

Northwestern University

312-503-5142

maryann-mason@northwestern.edu

ORCID ID: 0000-0001-6524-1532

- MM analyzed the data. MM also was the primary author drafting the manuscript. LP and KS were involved in the creation and concepts behind the manuscript, as well as some of the writing. TB, SM and SW reviewed data analyses and helped shape the manuscript conceptually and with edits for clarity. All authors read and approved the final manuscript.
- **Acknowledgements**
 - We would like to acknowledge the IL OD2A and SUDORS teams without whose work this study would not be possible.

References

1. Ahmedani BK, Peterson EL, Hu Y, Rossom RC, Lynch F, Lu CY, ... Simon GE. Major Physical Health Conditions and Risk of Suicide. *Am J Prev Med.* 2017;53(3):308–15.
doi:10.1016/j.amepre.2017.04.001.

2. Ashrafioun L, Bishop TM, Conner KR, Pigeon WR. Frequency of prescription opioid misuse and suicidal ideation, planning, and attempts. *J Psychiatr Res.* 2017;92:1–7. doi:10.1016/j.jpsychires.2017.03.011.
3. Centers for Disease Control and Prevention, N. C. f. I. P. a. C. (2020). WIQARS.
4. Darke S, Duflou J, Torok M. Toxicology and circumstances of completed suicide by means other than overdose. *J Forensic Sci.* 2009;54(2):490–4. doi:10.1111/j.1556-4029.2008.00967.x.
5. Dowell D, Haegerich TM, Chou R. CDC Guideline for Prescribing Opioids for Chronic Pain - United States, 2016. *MMWR Recomm Rep.* 2016;65(1):1–49. doi:10.15585/mmwr.rr6501e1.
6. Ertl A, Sheats KJ, Petrosky E, Betz CJ, Yuan K, Fowler KA. Surveillance for Violent Deaths - National Violent Death Reporting System, 32 States, 2016. *MMWR Surveill Summ.* 2019;68(9):1–36. doi:10.15585/mmwr.ss.6809a1.
7. Hedegaard H, Curtin SC, Warner M. (2018). Suicide Rates in the United States Continue to Increase. *NCHS Data Brief*(309), 1–8. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/30312151>.
8. Hedegaard H, Minino AM, Warner M. (2020). Drug Overdose Deaths in the United States, 1999–2018. *NCHS Data Brief*(356), 1–8. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/32487285>.